Sustainable Development and Informatics: Emerging Issues

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Dr. Sandeep Poddar is the Senior Research Director and Executive Editor (Publications), Member of Board of Studies, Lincoln University College, Malaysia. He has completed Ph.D in Zoology from Vivekananda Institute of Medical Sciences on Cytotoxicity. After completing Ph.D he pursued Post-Doctoral Research in different projects on Hemoglobinopathies and Oral Cancer mutation. He has been working as Chief Executive Editor, Lincoln University College Publications, Malaysia and working as Reviewer of several International Journals. He has published several research papers, organized international conferences, and edited books in Malaysia. Dr. Sandeep is founder Assistant Secretary of Dr. Tarak Nath Podder Memorial Foundation, Kolkata.

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Dr. Melody Anderson
Former Associate Dean
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FOREWORD

It is a great privilege for me to write the foreword for this edited book, "Sustainable Development and Informatics: Emerging Issues", a collection of papers contributed by eminent professors and researchers across the globe, covering a wide range of contemporary themes on sustainable development and informatics.

The United Nation's Sustainable Development Goals (SDGs) define the world we aspire to, articulating 17 interlinked and interconnected goals that address global challenges such as poverty, inequality, climate change, environmental degradation, peace and justice. The SDGs collectively that aim to ensure that a better, fairer, more sustainable world where no-one is left behind. Informatics plays a major role in the achievement of these goals.

Sustainable Development and Informatics firstly focuses on theoretical and political perspectives and empirical evidence in vast areas of economics such as agriculture, specifically, the impact of Geographic Information Systems (GIS) in agriculture and mechanisation in agriculture.

This edition also presents a thought-provoking and critical analysis of climate change. It's broad impact and associated risks are discussed across a range of G-20 contexts with special reference to India. These cover implications for tribal livelihood, the tea industry in India, the feasibility of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) in rural India and the use of cosmetics in India.

The relationship between sustainable development and informatics is examined in a number of papers that extensively describe and contextualise the SDGs in Indian information and communication technologies and the use of information technology in agriculture, Moreover, the focus on informatics is extended across themes such as energy efficient methods to reduce CO_2 emissions, prospects and challenges of digitisation for emerging national BRICS economies, information technologies in economics, E-Wallet in rural India, artificial intelligence and E-Commerce, GIS and remote sensing in global methane emissions, and other topics that will promote academic critique and debate.

Goals related to poverty, inequality and justice are addressed in a critical analysis of child labor in rural Odisha. Other challenges to sustainable development such as vehicle emissions in Kolkata and Non-Performing Assets (NPA) in public and private sector banks in India are also examined.

This edited volume covers a wide range of studies in sustainable development and informatics. It aims to make a note-worthy contribution to the emerging body of knowledge in this important area of global challenge and to influence government and policy makers as a mechanism for changes in practice for a sustainable future. Further, this volume aims to drive future research in this field, to inform teachers and students, and to inspire entrepreneurs.

In my view the members of the editorial board, along with the authors, have taken a unique approach to the exploration of a range of perspectives to support outreach activities related to the UN Sustainable Development Goals.

Dr. Melody Anderson
Melbourne Graduate School of Education
University of Melbourne
Vic 3010, Australia

PREFACE

The edited book **"Sustainable Development and Informatics: Emerging Issues"** is a collection of papers contributed by eminent professors and researchers across the globe, covering a wide range of contemporary themes on sustainable development and informatics.

The United Nation's Sustainable Development Goals (SDGs) define the world we aspire to. The United nations articulates 17 interlinked and interconnected goals addressing global challenges such as poverty, inequality, climate change, environmental degradation, peace and justice that collectively that aim to ensure that a better, fairer, more sustainable world where no-one is left behind. Informatics plays a major role in the achievement of these goals.

Firstly, Sustainable Development and Informatics focuses on theoretical and political perspectives and empirical evidence in vast areas of economics such as on agriculture, impact of Geographic Information Systems (GIS) in agriculture, mechanisation in agriculture, climate change in the tea industry in India.

Secondly, this edition presents a thought-provoking and critical analysis of climate change in a range of contexts such as implications on tribal livelihood, the broad impact of climate change and associated risks, the Group of Twenty (G-20) with special reference to India, the feasibility of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) in rural India and the use of cosmetics in India respectively.

Thirdly, the relationship between sustainable development and informatics is examined in a number of papers that extensively describe and contextualise sustainable development goals in Indian information and communication technology, information technology in agriculture, sustainable development in information technology etc. Moreover, the focus on informatics is extended across themes such as energy efficient methods to reduce CO_2 emissions, prospects and challenges of digitisation for emerging national BRICS economies, information technologies in economics, E-Wallet in rural India, artificial intelligence and E-Commerce, GIS and remote sensing in global methane emissions, and other topics that will promote academic critique and debate.

Finally, goals relating to poverty, inequality and justice are addressed in a critical analysis of child labor in rural Odisha and other challenges to sustainable development such as vehicle emissions in Kolkata and Non-Performing Assets (NPA) in public and private sector banks in India are also examined.

This edited volume covers a wide range of studies in sustainable development and informatics. It aims to make a note-worthy contribution to the emerging body of knowledge in this important area of global challenge and to influence government and policy makers as a mechanism for changes in practice for a sustainable future. Further, this volume aims to inform teachers and students, inspire entreprenuers and drive future research in this field.

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The Editors of Sustainable Development and Informatics: Emerging Issues

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The editors are greatly indebted to all contributors of papers for the book **"Sustainable Development and Informatics: Emerging Issues"** who have devoted their valuable time and effort on studies relevant to this area of national and global economic importance for every sector.

There is no source of sponsorship or finance for this edited volume. The editors are thankful to the management of Lincoln Research and Publications Limited, Australia for publishing this edited book and also to the management of Lincoln University College, Malaysia and Lincoln Education Australia for their collaboration.

Sandeep Poddar
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Editors of Sustainable Development and Informatics: Emerging Issues
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Agricultural Mechanisation: Necessity for Sustainable Development

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ABSTRACT

India's agricultural production has stagnated at a time when the broader elements of its economy have grown. To sustain an overall growth rate, it is imperative for agriculture sector to grow proportionately. Though, India has achieved self-sufficiency in food grain production, but we witnessed that the growth rate of food grain production lagged that of the population of the country. While efforts such as introduction of high yield varieties and expansion of irrigated area have played a crucial role in achieving the goal of food self-sufficiency in the past, rapidly growing demand for food brings the need for building efficiencies in the agriculture to the forefront. Towards this objective and also to meet the goal of "No poverty and Zero Hunger" of the Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly on 25 September 2015, it is imperative to focus on improving the intensity of agricultural mechanization. Mechanization covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortage, improves productivity and timeliness of agricultural operation, improves the efficient use of resources, enhances market access and contribution to mitigate climate related hazards. Sustainable mechanization considers technological, economic, social, environmental, and cultural aspects when contributing to the sustainable development of food and agriculture sector. Mechanization plays a key role in enabling the growth of commercial agriculture food systems and the efficiency of post-harvest handling, processing and marketing operation, and as such can be a major determinant in the availability and accessibility of food, the food prices paid by urban and rural poor, as well as contributing to increased household food security. This Paper is specifically about Agricultural Mechanization and opportunities provided by mechanization for intensifying production in a sustainable manner, in value addition and agro- food value chain development, as well as the inherent opportunities implied for improved economies and livelihoods. The establishment of viable business enterprises, agro processors, transport services, and so forth as a result of increased agricultural mechanization in rural areas, is crucial to create employment and income opportunities and thereby, enhancing the demand for farm produce, Thus, achieving sustainable development in Farm Sector to achieve the goal of food security.

Keywords:* *Agricultural Mechanization, Sustainable Development, Food Security

INTRODUCTION

Agricultural production of our country has stagnated at a time when the broader elements of its economy have grown. In order to sustain an overall growth rate, it is imperative for agriculture sector to grow proportionately. Though, India has achieved self-sufficiency in food grain production, but we witnessed that the growth rate of food grain production lagged that of the population of the country.

While efforts such as introduction of high yield varieties and expansion of irrigated area have played a crucial role in achieving the goal of food self-sufficiency in the past, rapidly growing demand for food brings the need for building efficiencies in the agriculture to the forefront. Towards this objective and also to meet the goal of **"No poverty and Zero Hunger"** of the Sustainable Development Goals (**SDGs**) adopted by the United Nations General Assembly on 25 September 2015, it is imperative to focus on improving the intensity of agricultural mechanization.

Agricultural mechanization has a key role in economic development process as depicted in the Table below:

Table 1: The potential contribution of mechanization to green food value chain development

Production	Post Harvest/Storage	Processing	Marketing
Crop Establishment	Drying	Chopping	Packaging
Weeding	Grading	Milling	Transport
Fertilisation	Winnowing	Grinding	
Irrigation	Cleaning	Pressing	
Crop Protection	Storage		
Harvesting			

Source: Breuer et al., 2015 (adapted)

There is no doubt that agricultural mechanization for the multitude of smallholder farmers in our country has been an issue for discussion for too long. The application of farm power to appropriate tools, implements and machines - **"farm mechanization"** - is an essential agricultural input with the potential to transform rural families' livelihoods by facilitating increased output of higher value products while eliminating the drudgery associated with human muscle-powered agricultural production. Such an improved situation for smallholder farmers can enable access to input supply chains and integration in modern food systems and thus provide for more income, renewed business opportunities and further value addition. Moreover agricultural mechanization in its broadest sense can contribute significantly to the development of food systems, as it has the potential to render post-harvest, processing and marketing activities and functions more efficient, effective and environmentally Integrated Crop Management income, renewed business opportunities and further value addition. Moreover, agricultural mechanization in its broadest sense can contribute significantly to the development of food systems, as it has the potential to render post-harvest, processing and marketing activities and functions more efficient, effective, and environmentally friendly.

Mrema, Soni & Rolle, (2014) summarizes the main reasons for changing the power source for crop production from muscles (human or animal) to tractors:

i. Potential to expand the area under cultivation.

ii. Ability to perform operations at the right time to maximize production potential.

iii. Multi functionality – tractors can be used, not only for crop production, but also for transportation, stationary power applications and infrastructure improvement (drainage and irrigation canals and road works).

iv. Compensation for seasonal labour shortages (or, indeed, release of labour for more productive work.

v. Reduction of the drudgery associated with the use of human muscle power for tasks, such as hand hoeing for primary tillage - especially important in tropical areas where high temperatures and humidity (sometimes associated with inadequate nutrition) make manual work extremely arduous.

Despite these perceived benefits and the fact that animals had been largely replaced by tractors in our country, arguments were still put forward urging caution. The main preoccupation is the effect of mechanization on rural employment opportunities. But it is not understood that mechanization affects mainly on-farm family employment, not hired labour. Mechanization, in fact, enables farm family members not only to increase farm productivity via production intensification and/or expansion, but also to seek off-farm employment opportunities as a result of the increased time made available to look for and be engaged in such employment. Moreover, it is not appreciated that mechanization applied only to specific farm production tasks (land preparation), and consequently has little effect on hired labour unemployment as presumed. However, mechanization is more likely to increase labour demand when it enables more land to be cultivated and when it is profitably applied along the value chain. Mechanization is just one component in the agricultural intensification process. Moreover, mechanization increases value addition (post-harvest operations and primary and secondary processing), as well as services to support agricultural mechanization development. Given the widening array of mechanization options available, employment in **primary agricultural production** is expected to decline, and this is a credit to the increasing productivity of farming. However, jobs are not actually “lost”, because increasing agricultural productivity means that more jobs are created in **secondary employment** related to agriculture, for example, in the agro food value chain and machinery-related services.

Other concerns those are expressed with regard to agricultural mechanization are Fuel costs which is high and continually rising, and fields are small and fragmented and therefore, perceived as an obstacle to tractorization - without land consolidation mechanization would not be viable. All these considerations lead to a reduced focus on mechanization as an essential input throughout the country. But, we can develop and use mechanized technologies like, 2-wheel tractors, fostering and development of the private sector (an enabling business environment with public support, research systems connected to stakeholders, and good equipment distribution networks especially in rural areas), infrastructure development (development of feeder roads into main road networks), elaboration of the financial system (appropriate financial products developed to enable investment in agricultural equipment), organization of the fiscal system (reduction of import tariffs on machinery), enhancement of extension service networks (mainly rural and connected to research and development centres) and, importantly, policy implementation.

Further, small-scale engine technologies (single cylinder diesel engines) are used for multipurpose functions: 2-wheel tractors, shallow tube well pumps, river boats, road and track transport vehicles, harvesters, threshers, grain mills, timber mills and processing equipment It is envisaged that less area of farm is to foster the need of most of the food production in the near future and it is primarily the farm holders who will have to respond to the need to increase food production At present, many smallholder farms have limited access to production inputs, especially mechanization; they therefore reach low levels of productivity, and often contribute to the increase in negative environmental impacts on already dwindling natural resources. They also have fewer opportunities to access markets and take advantage of the numerous value-adding activities that more developed food systems can provide. At the same time, the rural population is expected to decline as people, especially the young and fit, migrate to urban centres in search of a life characterized by less drudgery than that offered by agriculture. There is also a growing feminization of smallholder agriculture, as women are increasingly left in charge of the family farm while the men migrate in search of higher incomes. Agricultural mechanization can offer women in rural areas opportunities appropriately adapted to cultural, social, and traditional work norms, and to the overall development of local economies; however, these opportunities are often underestimated. However, there is rapid urbanization, rural population will continue to grow at higher rate. This population growth, though, will still see the migration of youth and others to urban centres in search of higher paying jobs that are less labour intensive than farming. Given the current important role of human muscles in smallholder agriculture, there are serious power limitation implications (Sims & Kienzle, 2015). The power sources for developing country agriculture are human muscles, draught animals, and tractor engines. The use of the different sources varies across regions.

The green revolution is credited, with having kick-started the shift to profitable commercial farming, alleviating rural poverty, saving large areas of fragile land from conversion to extensive farming, and helping to avoid potential hunger threats in the face of a growing population. Overall, the proportion of undernourished in the world population declined over the period. However, there have been serious negative consequences. The enormous gains in agricultural production and productivity have been often accompanied by deleterious impacts on the rural natural resource base and ecosystem functions, jeopardizing the productive potential of agriculture and impacting agro food value chains. At production level, many of the effects are easily observable: land degradation (through erosion and compaction), salinization of irrigated areas, over-extraction of groundwater, build-up of pest resistance and decline of biodiversity. The uncertainty and variability of yields and reduction in product quality, combined with degraded lands and depleted water resources, have made smallholder- level processing and value addition a far riskier business.

Mechanization and intensification, fertilizer use and adoption of other modern technologies have all remained at low levels across the country. Nevertheless, degraded lands are widespread throughout the India for a wide range of reasons, including the continuous use of the plough (or hand hoe) resulting in soil degradation, plough- or hoe-pans in the soil profile and loss of fertile top soil (Kienzle & Sims, 2015). Soil erosion is extensive in many regions of India, especially considering the current low level of mechanization. In the long term, if India intensifies and mechanizes its agriculture on a large scale, it must do so with care and in line with the principles of sustainable production intensification summarized by FAO in its **"Save and Grow"** guidelines. Save and Grow is based on environmentally friendly **Conservation Agriculture Mechanization (CAM)** with the aim of achieving resilience in the face of a changing climate (FAO, 2011a, 2016). Farming systems for sustainable production intensification offer a range of productivity, socio-economic and environmental benefits to producers, to other food value chain actors and to society in general. Implementation of Save and Grow enables:

- Improved and stable environmentally friendly production, food distribution and profitability.
- Efficient use and conservation of natural resources.
- Adaptation and reduced vulnerability to climate change; • enhanced ecosystem functioning and services; and
- Reductions in agricultural greenhouse gas (GHG) emissions and agriculture's "carbon footprint".

In summary, agricultural mechanization in the twenty-first century should be simultaneously: environmentally compatible, economically viable, affordable, adapted to local conditions and, in view of current developments in weather patterns, climate smart. These proposed farming and food systems are based on four technical principles:

- Achievement of increased agricultural productivity while enhancing natural capital and ecosystem services.
- Higher rates of efficiency in the use of key inputs, including water, nutrients, pesticides, energy (including farm power), land and labour.
- Use of managed and natural biodiversity to build system resilience to abiotic, biotic, and economic stresses.
- A more effective, efficient, and environmentally friendly food system resulting from increased agricultural mechanization.

The farming practices required to implement the first three principles differ according to local conditions and needs, but in all cases are based on the following concepts:

- Limited soil disturbance by minimizing mechanical tillage to maintain soil organic matter, soil structure and overall soil health.

- Enhancement and maintenance of a protective organic cover on the soil surface, using crops, cover crops or crop residues, to protect the soil surface, conserve water and nutrients, promote soil biological activity and contribute to integrated weed and pest management.
- Cultivation of a wider range of species - annuals and perennials - in associations, sequences and rotations including trees, shrubs, pastures, and crops, to enhance crop nutrition and improve system resilience.

In practice, this involves the wide-scale application of conservation agriculture practices (FAO, 2015). This paper is specifically about agricultural mechanization and the opportunities it provides for sustainable intensified production, value addition and agro food value chain development, in addition to the inherent opportunities Integrated Crop Management for improved local economies and livelihoods. The establishment of viable business enterprises, such as agro processors and transport services, because of increased agricultural mechanization in rural areas, is crucial for creating employment and income opportunities and enhancing the demand for farm produce. Mechanization plays a key role in enabling the growth of commercial agro food systems and increasing the efficiency of post-harvest handling, processing, and marketing operations. Consequently, it determines food availability and accessibility, as well as food prices paid by urban and rural poor, thus contributing to increased household food security with increased accessibility of agricultural mechanization contributing to India's agricultural and economic transformation.

CHALLENGES FACED BY AGRICULTURAL MECHANISATION IN INDIA

Agricultural mechanization - in fact, mechanization throughout the food system - is affected by a series of constraints in our country. These constraints needs be identified, and strategies conceived to alleviate them and allow for the development of mechanization services to benefit all farmers, especially smallholder producers and other actors in agro food value chains. The World Bank's project on **"Enabling the Business of Agriculture"** focuses on identifying and monitoring regulations that negatively affect agriculture and agribusiness markets. Machinery is identified as a key input and market enabler (World Bank, 2016). Some of the potential challenges are discussed below.

1. AFFORDABILITY: Smallholder farmers are, almost by definition, resource poor and often have difficulty investing in physical assets in general and in agricultural machinery in particular. In our country, agricultural machinery suppliers are largely found in the larger towns and cities, as the perceived low demand in rural areas for equipment does not always justify the establishment of distribution networks. Smallholders are often isolated by distance and poor infrastructure (especially feeder roads). There is limited access to sources of financial credit due to the:

- Lack of availability of financial products specifically focused on farm equipment investment.

- Misconception of many financial institutions regarding the need for targeted financial products for investment in equipment.
- Basic nature of agricultural production – i.e. a high-risk business.
- Reluctance of commercial financial institutions (mainly banks) to extend credit to poor farmers with little collateral; and
- The lack of financial products to serve the purposes of small-scale farm mechanization.

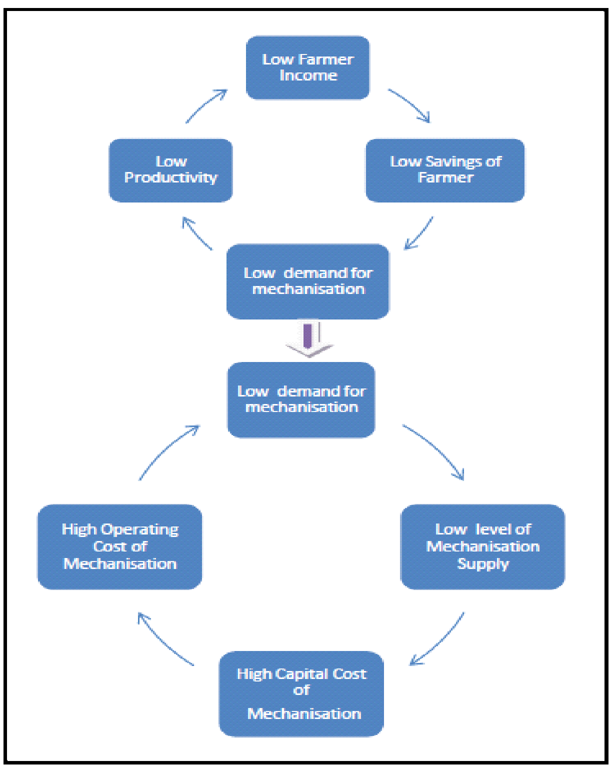
Experience shows that extending credit products to farmers to invest in agricultural machinery not only allows them Integrated Crop Management to raise their productivity and participate more fully in the market economy, but can also incentivize the local machinery manufacturing industry to supply their needs (Casão, Araújo & Llanillo, 2012). The restricted purchasing power of smallholder farmers depends on a series of factors impinging on the farm family's economy:

- Low yields (basic grain crops of < 1 tonne/ha) - caused by many factors, including lack of adequate inputs (especially seed and fertilizer) at the right price and the right time, climate change (with longer drought periods and more frequent storms) and the degraded condition of many agricultural soils.
- Poor marketing facilities and inadequate rural, farm- to- market, infrastructure - resulting in poor returns to smallholder crop production.
- Low market prices.
- High transport costs.

Price issues are a potentially major disincentive for smallholder farmers. Private sector-led input and output markets have not developed as quickly as expected and farmers are constrained by a lack of free competition in these markets, resulting in high prices for agricultural inputs as well as lower prices for produce. The consequent reduction in farm incomes and the lack of incentives to market produce have led to an overall decline in the level of investment in agriculture. This is reflected in low investments in fixed assets, such as agricultural machinery, that commonly have high start-up investment costs and returns spanning a long period, and which may be economically unsustainable for smallholders (even if profitable). At the same time, farmer organizations have had limited success in improving smallholders' access to markets and public services with mixed results in terms of providing machinery services to members. Although farmer organizations do recognize the economic and social benefits to farmers of mechanized services, they are not always able to coordinate such services at managerial level. However, some grassroots farmer organizations (e.g. cooperatives) successfully deliver mechanization services to their members. The cooperatives also have useful contacts with banks and other key stakeholders at local level. In India cooperatives providing mechanization services can deliver both economic and social benefits to their members with a system organized at local level, based on the active participation of small-scale farmers and the concept of self-help. For a successful transition from semi-subsistence farming to profitable, productive agriculture, land tenure must be secure and guaranteed by the state as well as by local laws and traditions. This gives farmers the security and confidence to invest in mechanization and other production enhancing inputs. In our country, there are laws to regulate land tenure, but they are not always effective. Smallholders operating just above subsistence level tend to be extremely risk averse. For the rural family, a reliable source of food throughout the year – even if well below the level of potential yields for the region – is preferable to a situation where yields may be very high in favourable seasons, but very bad in adverse years. A steady yield (albeit low), resistant to the vagaries of the weather is preferable, but does not necessarily result in a marketable surplus. For these reasons, without financial assistance, it is unlikely that smallholders can invest in the kind of mechanization technologies that could lift them out of their precarious condition.

2. AVAILABILITY: Tractors and agricultural machinery can be either imported or locally made, with potential associated problems in both cases. Locally produced machinery is usually low in quality and high in price. This is due to the underdeveloped nature of the machinery manufacturing industry, which in turn is largely the result of poor demand. Moreover, supply chains providing support to owners of tractors and agricultural machinery with spare parts, advice and other services (especially clean fuel) are often underdeveloped and do not easily reach remote rural areas (FAO, 2009).

Analysis of the limited adoption of mechanization and of the relationships between the different determinants clearly indicates that certain conditions have led to the creation of a restrictive environment, which has held back the development of rapid mechanization.



Source: FAO, 2013b.

Figure 1: Factors weakening the demand and supply of agricultural mechanization

These interrelated factors illustrate the structural constraints faced by our country regarding the increased adoption of mechanized farming methods. They highlight how demand and supply of agricultural mechanization inputs are interdependent. On the other hand, they also indicate how debilitating factors can be converted to enabling ones.

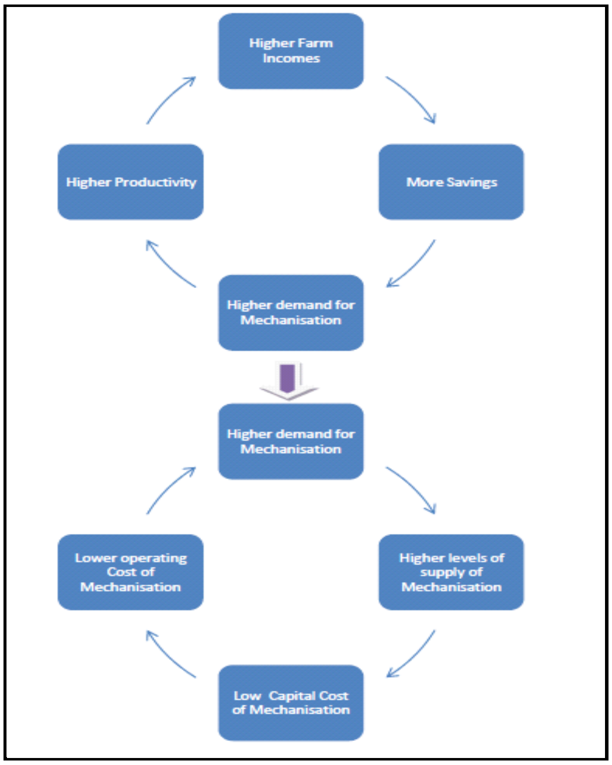
3. LACK OF FARMERS SKILL: Although, Indian farmers have a great deal of traditional knowledge and experience accumulated over generations, they have relatively limited access to new knowledge. The level of farmer training is relatively low and opportunities for further training are limited. Public and private extension and training services do not easily reach rural and remote areas, as distances are great, and transport can be scarce. If demand for extension and training is low, it may be difficult to justify such activities in economic terms. There is a high rate of illiteracy among rural farming populations; this hinders the improvement of agricultural production and productivity and of the general level of farm management. For example, in many parts of our country, only land preparation and transportation are done using tractors, while other operations, such as seeding and harvesting, are mostly carried out manually. Farmers lack the knowledge and skills to operate mechanized equipment (Ashburner & Kienzle, 2011), and when machines are used, this lack of proficiency leads to misuse and mismanagement of machinery – especially of more sophisticated machines.

4. GENDER ISSUES: In our country, women usually contribute large percent of the labour for food production and have extensive traditional knowledge of dealing with natural resources and the natural environment. In a study it has been found that the labour burden for women is mainly concentrated in weeding, tillage, and land preparation; postharvest management and transport of agricultural produce; and chopping and collecting fodder, fetching water and childcare. We find few signs of mechanization to lessen the burden, because the assumption is that women are expected to work hard. Advocating for a reduced work burden for women does not fall within social norms, and women themselves do not have time available to access resources and information that might lead to the reduction of the work burden via investment in mechanization. In fact, it is often men who conduct commercial transactions at farm level and consequently men who make decisions and control the resources required to invest in mechanization (especially capital). Moreover, with the ongoing trend of male migration to urban areas, coupled with the advancement of climate change, women have an increasingly central role in agricultural production and commercialization; nevertheless, they still have little access to mechanization.

OPPORTUNITIES PROVIDED BY AGRICULTURAL MECHANISATION

Raising farmer's incomes through sustainable crop production, intensification, and sustainable commercialization

Given the current state of agricultural mechanization in India, the most promising prospect is to convert the vicious cycles (Figure 1) into virtuous cycles (Figure 2). Figure 2 show that a sustainable increase in farm family income can have a positive knock-on effect on the supply of essential farm power and mechanization. First, raised incomes allow greater savings and the demand for agricultural mechanization services or the acquisitions of farm machinery (and other inputs) become feasible prospects for the farmer. This in turn raises productivity, leading to further improvements in farm incomes. At the same time, in the lower circle, it can be seen how increased demand for agricultural mechanization leads to a concomitant improvement in supply as a market response. An expanding market means that operating costs per unit are reduced and prices can fall without jeopardizing profitability. Lower costs are a catalyst for increased demand and, hence, the virtuous cycle is complete.



Source: FAO, 2013b.

Figure 2: Virtuous cycles resulting from sustainable crop production intensification

Ending poverty is the primary goal of our government also it a global priority. It is evident that large percent of the India's extreme poor live in rural areas and are mostly dependent on agriculture. In addition, agricultural growth in low-income and agrarian economies is at least twice as effective as growth in other sectors in terms of reducing hunger and poverty. Farm family incomes can be improved through investment in rural development, establishing social protection systems, building on **rural–urban linkages** and focusing on boosting the incomes of the critical agents of change, including smallholder farmers. Raising the productivity of smallholder farmers must be a sustainable process, considering the lessons learned from the green revolution (GR).

Beginning in the Green revolution and continuing till date, the GR produced changes in crop varieties and agricultural practices across the country. The production model, which focused initially on the introduction of genetically improved, higher-yielding varieties of wheat, rice and maize in high potential areas (Hazell, 2008; Gollin, Morris & Byerlee, 2005), was based on homogeneity, promoting genetically uniform varieties grown with high levels of complementary inputs (e.g. irrigation, fertilizers and pesticides), often replacing more environmentally friendly practices. Fertilizers replaced organic soil quality management, while herbicides and pesticides provided an alternative to crop rotation as a means of controlling weeds, pests, and diseases (Tilman, 1998). However, as described earlier, the GR had serious negative consequences. It is now imperative to introduce sustainability into the future productivity increases required. The **Save and Grow** paradigm (FAO, 2011a; 2016) advocates stewardship of fragile natural resources, combined with intensification of crop production through greatly enhanced land husbandry methods, including conservation agriculture. The sustainable increase in productivity is just one important aspect of raising smallholder incomes and developing new opportunities for mechanization; there is also a need for sustainable commercialization of farm products. Smallholders can increase commercialization opportunities by adopting equipment for on- farm value addition or improved transport to market. Increased access to more sustainable and lucrative forms of commercialization will raise incomes and provide further opportunities for mechanization.

New opportunities for Agricultural Mechanization development

In many parts of our country, despite the challenges discussed above earlier, there are numerous opportunities for mechanization development soon. Following decades of decline in per capita food production, there is now a new climate of optimism combined with a modified international investment landscape. The agriculture sector is projected to become economically sustainable because of the rapid expansion of urban centres and the associated demand for agricultural products, in addition to the increases in international food commodity prices. The new situation will provide opportunities for the adoption and expansion of agricultural mechanization for many reasons and those are:

- Increasing Agricultural Wages.
- New sources of farm machinery more suitable to Indian Conditions.
- Need for more innovative and energy-efficient sustainable mechanization concepts in line with the FAO **“Save and Grow”** paradigm.
- Climate-smart and conservation agriculture - the need for environmentally sustainable mechanization.
- New need for sustainable business models for mechanization in India.

Investing in Agricultural Mechanization

The recommendations that emerged focused on facilitating support for both private and public sector investment flows into the development of agricultural mechanization in India. The main objectives included the reduction of primary land preparation using hand tools substantially and their replacement with a combination of draught animal power and tractors. The principal recommendations may be as follows:

- Establish national committees on agricultural mechanization.
- Create an enabling environment.

- Increase investment in agricultural mechanization through separate Budget allocation.
- Capacity building.

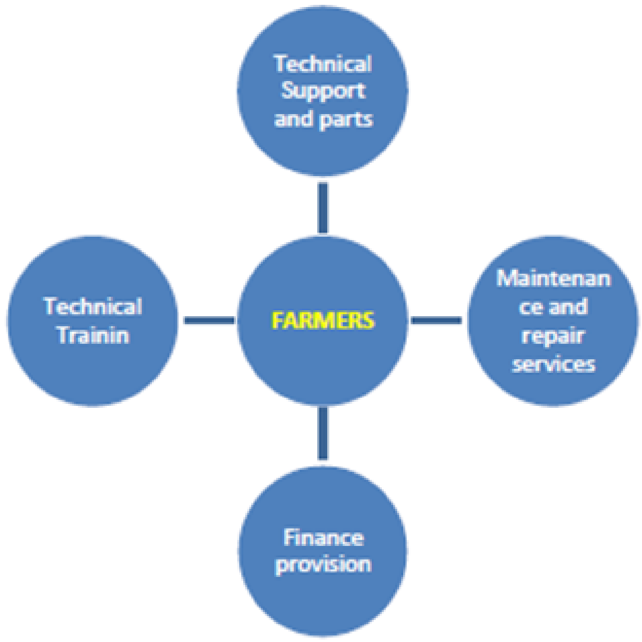


Figure 3: Stakeholders in the farm machinery support network for smallholder farmers

- Establish a code of practice for agricultural machinery suppliers.
- Create regional networks of agricultural mechanization.

While some recommendations will be more relevant than others, depending on the situation, the deliberations of this high-level international group of experts highlight the importance of extending mechanization services to smallholder farms.

THE WAY FORWARD: SUGGESTED ACTION

There are numerous examples of in-depth analysis of the agricultural mechanization scenario in our country. There are some recurring themes:

1. Farm power and mechanization are essential inputs if agricultural productivity and production are to increase and manage to feed the world's burgeoning population.
2. The intensification of crop production must be sustainable: its environmental footprint must be as low as possible, and in any case lower than the rate of natural renewal.
3. Top-down solutions are rarely successful; all stakeholders need to be considered from the outset and the private sector must lead the development

process on the ground.

4. The role of the public sector is to provide an enabling environment for the private sector to perform without unnecessary obstacles.
5. A holistic, value-chain approach is necessary for agricultural mechanization, going beyond green production and into post-harvest, processing, and marketing activities.

We can summarize as: “If agricultural mechanization efforts are to succeed in India, there is an urgent need for all concerned, be they farmers, supporters, planners or policy makers, to understand and contribute to agricultural mechanization efforts across the entire farming system and with a value chain perspective”.

Following are suggested for the rapid and sustainable Agricultural Mechanization:

Integration of Agricultural Mechanization in Pan-India Policy Frameworks: There is a need to sensitize and raise awareness at pan-India level of the potential of agricultural mechanization for development. It is essential to develop appropriate policies, supranational in nature and refocused at regional level.

Sustainable Agricultural Mechanization strategies: Mechanization should not be limited to on-farm practices; economies of use can be enhanced by incorporating off-farm applications. Moreover, agricultural mechanization is successful when there is an effective demand for farming outputs (including on- and off-farm value addition). In order to achieve sustainability, it is essential to consider the entire agro food chain, including financing of the necessary capital investments (Mrema, Soni & Rolle, 2014). It should be noted that mechanization technologies for agro food chains contribute to waste avoidance, help maintain rural infrastructure and provide employment opportunities. Sustainable mechanization involves an increase in production combined with conservation of the natural resources (in particular soil and water). It is vital that future mechanization models conform to FAO’s Save and Grow paradigm. According to Save and Grow, agriculture must be productive and profitable for the farmer, while contributing to the conservation of resources and the delivery of ecosystem services. As the negative effects of climate change are increasingly apparent, the large-scale application of conservation agriculture is essential to maintain food production. The practices involve soil protection, water conservation, and precise and efficient energy use and input application. It is vital to reduce the emission of GHGs during agricultural production, while sequestering carbon in untilled soil and preserved forest areas. For a consistent and coherent change in the use of agricultural mechanization, it is necessary to formulate and implement a plan, especially since major changes are required for sustainable agricultural mechanization. During the formulation process, reference should be made to the FAO guidelines (Gifford, 1988) and it is important that the approach adopted is both participatory, to hear the views of the multiple stakeholders, and systematic, given the complexity of agricultural mechanization. During the process, participatory workshops should be organized to involve the spectrum of interested actors from all along the agro-food value chain, beginning with an inaugural workshop. Formulation comprises four major steps:

Source: FAO, 2013a.

Figure 4: Progressive steps in the formulation of an agricultural mechanization strategy

- **Step 1** involves a thorough analysis of the situation, with experts focused on their specialization.
- **Step 2** entails a second participatory workshop to gather views on the existing situation.
- **Step 3** is the strategy and action plan formulation, aligned with national development goals and policies refined during a third workshop.
- **Step 4** involves further definition of the plan with preparation of a portfolio of project profiles. The results are presented at a final participatory workshop.

Throughout this process, the concept of sustainability is the absolute priority.

Sustainable Agricultural Practices for Smallholders: Agricultural mechanization can make an important contribution to the improved use of natural resources and the overall "greening" of agriculture, in particular at smallholder level. Mechanization technologies enable smallholders to enhance yields through the adoption of intensification, conservation agriculture, and other climate-resilient, labour- and energy-efficient, and gender-friendly practices. Importantly, mechanization also enables a rational and efficient approach to farming in the long term, increasing the prospect of sustained profitability over time and leading to increased ecosystem resilience and long-term sustainability of smallholder systems.

Specific Business Models for Smallholder up scaling: Smallholders are commonly relegated to the margins of agro food value chains and they do not easily find their niche in modern food systems. The identification and specification of appropriate business models for smallholder mechanization can provide numerous opportunities for improved access to and integration in agro food value chains with more reliable supplies, increased volumes of produce, timely deliveries, and value addition.

Economic Advantages of Mechanization for Smallholders: It is important to identify models that not only provide economic benefits to famers, but which can be self-generating in the development of the smallholder sector. There is ample evidence that farmers who – thanks to mechanization – achieve quality and good yields, and consequently higher revenues, tend to spend their new wealth rather than re-invest it in the farm business. Small scale farmers must receive guidance on how investments in equipment repair and maintenance and in other productive revenue-generating assets can reinforce their economic standing. For example, investment in equipment that serves a range of functions is a wise move: not only can services be sold to other farmers, but the different operations offer good potential to provide for positive economic outcomes.

Social advantages derived from Mechanization: Agricultural mechanization has the potential to produce social opportunities (and outcomes) for small-scale farmers. It can reduce the risk of low yields thanks to increased cropping intensity and timely planting, weed control and harvesting, and can facilitate storage, resulting in better food security and improved nutrition for the farm family. Mechanization enables small-scale farmers to diversify their income sources, as they cease to rely on only crops for income and gain access to revenues from services offered to other local farmers. This in turn can reinforce social relations in local communities and provide for greater social harmony and well-being. Poor infrastructures and lack of transport are important constraints in remote rural areas. Agricultural mechanization can provide transport for rural people and rural produce, improving mobility and creating opportunities for commercialization. There are also potential opportunities for a change in gender relationships, as smallholder farm families become more enabled and have more time to search for off-farm employment opportunities.

Mechanization and Gender: The feminization of agriculture offers a series of opportunities for increased agricultural mechanization at farm level and in the agro food value chain that are economically, environmentally, and socially sustainable. Women tend to be proficient in natural resource management. Given the prevailing conditions of climate change and natural resource degradation, it is important to combine women's knowledge with the employment of appropriate machines designed for use by women farmers to make food production more environmentally sustainable. Reducing drudgery for women and speeding up farm and household operations are just two of the potential advantages of appropriately adapted and culturally and socially sensitive mechanization. However, there are numerous constraints limiting women's adoption of technologies, not least their lack of access to and control of resources, combined with cultural norms, values and assumptions (van Eerdewijk & Danielsen, 2015). Interventions to support the adoption of mechanization need to address local norms and values; this may in turn facilitate access to resources. Studies show that if women's access to productive resources were on par with that of men, farm yields would rise by 20–30 percent (FAO, 2011b). It thus makes sense to consider how women can access or have control of resources invested in mechanization

Enabling women's access to mechanization - the "feminization" of mechanization - requires a theory of change that is not only based on technological aspects, but which addresses a wider spectrum of constraints faced by women. Once these constraints have been addressed, the focus should be on technology. First and foremost, young girls must have access to education. Once this is achieved, active engagement in the discussion of local norms and assumptions is vital, encouraging group formation and collective action, and facilitating access to and control over resources. The focus can then turn to women's needs in terms of technologies and their related design parameters, with the objective of providing women-centred labour-saving mechanization technologies at production and other stages in the agro food value chain.

Institutional and Organizational arrangements for increased Smallholder Mechanization: Smallholders who group together - for example, in producer organizations - have improved access to agricultural mechanization opportunities. Increased access to various sources and types of financing, more sharing of knowledge, improved bargaining power, increased value addition and greater opportunities to optimize agricultural mechanization and realize its full potential will all contribute to improving commercial farming, enabling further integration into modern agro food systems.

Increased integration into Agro food Value Chains: Agricultural mechanization is a cornerstone for smallholder integration into modern food systems. Mechanization not only applies at farm level, but it has an important role in value addition, for example in improved post-harvest operations, and processing and marketing activities. Furthermore, it saves time between harvesting and consumption, allowing more time for marketing.

Increased Agricultural Mechanization with Private Sector development: By fostering private sector development within the context of agricultural mechanization, it is possible not only to increase the manufacturing base for agricultural mechanization in India, but also to provide opportunities for more Cooperation among manufacturers, dealers and institutions. Private sector development can support smallholder enterprises at field level, with farmers providing mechanization hire services to other farmers. This leads not only to higher farm yields, but to greater demand for vehicles, equipment and tools at national level, creating a mutually reinforcing virtuous circle.

Development of Knowledge Sharing Platform at National and International level: Common lessons learned during development and the sharing of experiences can create a knowledge sharing platform for improved agricultural mechanization in India. This can lead to technology and know-how transfer in terms of machinery, tools and equipment, in addition to sharing of experiences about the application of models that do or do not work at national and local level. The sharing of policies and strategies for agricultural mechanization - both successful and not - can further enhance the collaboration, fostering more specific and targeted policies and strategies.

Field-based Capacity Building and Capacity Development for Agricultural Mechanization: Field-based methods of capacity building and capacity development for agricultural mechanization need to be integrated with experienced and well tested training methodologies. Agricultural mechanization can be integrated at field level into Farmer Field Schools (**FFS**) and Farmer Business Schools (**FBS**). This not only provides a sound basis for smallholder competency development in agricultural mechanization, but acts as a source of data and information to feed into development projects, R&D organizations (national and international, public and private) and educational institutions, such as vocational secondary schools and universities across the country.

Regional Centres of Agricultural Mechanization with due emphasis on Dizitisation: Regional Centres of excellence be across the nation be established regional centres of excellence that can guide national policy towards sustainable agricultural mechanization. In close collaboration with farmers, other value chain actors, manufacturers, relevant private sector stakeholders and national government organisations, these centres of excellence can engage in R&D, machinery testing and training, wherever deemed appropriate and useful for the private sector. It is vital that the centers focus on the stakeholders' interests to ensure that they do not research concepts (farming methods and machinery) that then remain at the prototype stage. At the testing stage, it is important to keep in mind the machinery's potential users. An interesting model to study is the Asian United Nations Centre for Sustainable Agricultural Mechanization (UN-CSAM) (UN-CSAM, 2016).

CONCLUSION

Mechanization covers all levels of farming and processing technologies, from simple and basic hand tools to more sophisticated and motorized equipment. It eases and reduces hard labour, relieves labour shortage, improves productivity and timeliness of agricultural operation, improves the efficient use of resources, enhances market access and contribution to mitigate climate related hazards. Sustainable mechanization considers technological, economic, social, environmental, and cultural aspects when contributing to the sustainable development of food and agriculture sector.

Mechanization plays a key role in enabling the growth of commercial agriculture food systems and the efficiency of post-harvest handling, processing and marketing operation, and as such can be a major determinant in the availability and accessibility of food, the food prices paid by urban and rural poor, as well as contributing to increased household food security.

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Air Pollution Level Trend and Fluctuation: A Study Based on Vehicular Emissions of Kolkata

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ABSTRACT

Air pollution problem in Kolkata, capital city of West Bengal is serious. According to WHO guidelines for residential areas air pollution level in Kolkata is considerably higher to the standard enumerated. Automobiles are identified to be the single largest source of air pollution and commercial vehicles such as diesel and petrol vehicles are believed to be the most important polluters. The concentration of vehicular emission is extremely high along the traffic corridors. There are several types of vehicle pollutants which are continuously exposing the air of Kolkata. WBPCB has been monitoring ambient air quality for the parameters SPM, RPM, SO_2, NO_2 and Pb in Kolkata throughout the year. In this paper we have focused the seasonal fluctuations of the parameters in the particular years and seen the vehicular pollution is the highest in the winter due to dry air and then summer. But this is the lowest in the rainy season due to wetted air. There is a rising trend in Air pollution as the time series trend in average values suggest.

Keywords: Air pollution, Automobiles, Vehicular Emission, Vehicle Pollutants

INTRODUCTION

Air pollution comes from many different sources being in direct correlation with natural factors, but especially with the human ones (Mitran *et al.*, 2012; Statheropoulos *et al.,* 1998). Compared to the time factor, emissions from atmospheric pollution sources have a dynamic character that follows the dynamic pattern of society development in the affected territory, following the intensity and the specificity of human activities.

The area of study is mainly in Kolkata, the eastern Gateway of India, the capital city of West Bengal, and one of the most populous cities in the country, is a center of commerce, trade and industry in east and north east region. The extent of the city is longitudinal, running from north to south. The geographical area of the city of Kolkata had undergone wide changes in the last three centuries.

The government has taken several vehicular emission control measures, pollution prevention technologies; action plan for problem areas, development of environmental awareness. Yet despite all these measures, vehicular pollution remains one of the major environmental problems. At the same time there have been success stories as well such the reduction of ambient lead levels (due to introduction of unleaded petrol) and comparatively lower SO_2 level (due to progressive reduction of Sulphur content in fuel). The government has initiated to drive electric and battery driven car including two-wheeler and four-wheeler in our country. This leads to environment to be clean, pollution free and green. Green transport brings the sustainable development. So, CPCB has emphasized on green transportation as well as green energy. However, our study is based on the nature and trend of major Vehicular emissions of Kolkata.

The terrific increase in number of vehicles has also resulted in a significant increase in the emission load of various pollutants. The quantum of vehicular pollutants emitted is highest in Delhi followed by Mumbai, Bangalore, Calcutta, and Ahmedabad. Here we have wanted to focus the vehicular pollution in Kolkata.

Apart from the concentration of vehicles in urban areas, other reasons for increasing vehicular pollution are the types of engines used, age of vehicles, congested traffic, poor road conditions, and outdated automotive technologies and traffic management systems. Vehicles are a major source of pollutants in metropolitan cities.

Trend of major Vehicular emissions:

Under the National Ambient Air Quality Monitoring (NAAQM) network, three criteria air pollutants, namely, SPM, SO_2, and NO_2 have been identified for regular monitoring at all the 290 stations spread across the country. By the WBPCB report we have shown the trends of four air pollutants mainly SPM, RPM, SO_2 and NO_2. These data are collected by West Bengal pollution control board from the various traffic sections which are busy with various vehicles in most of the time. These ambient air qualities have rapidly increased over the recent years due to increasing of huge vehicles in Kolkata. This leads to negative effect in air pollution. We have observed the recent trends of Vehicular emissions in our study area. We have tried to understand the Seasonal trend over the years also. First, we come to terms trend of emission level.

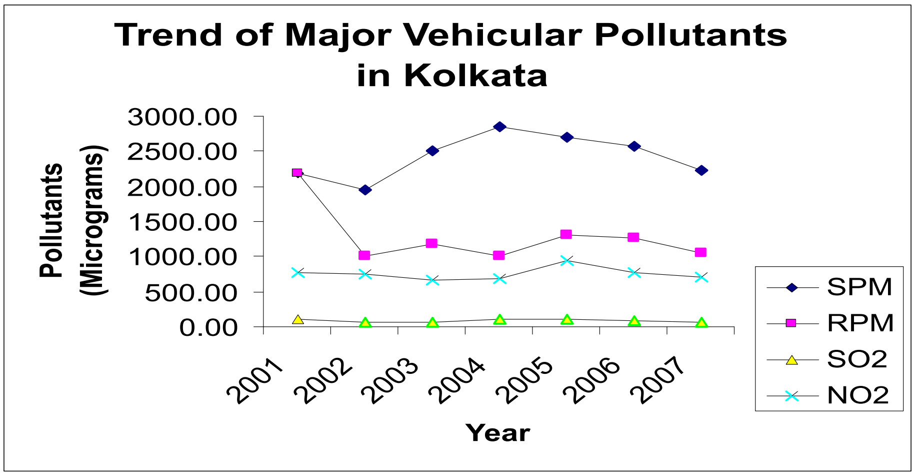
The emission level has shown downward trend in recent years that is shown in the following table.

Table 1: Trend of major Vehicular emissions

Year	SPM	RPM	SO_2	NO_2
2011	2178.07	2178.07	105.29	764.57
2012	1954.79	1006.14	64.97	749.50
2013	2502.36	1186.79	65.07	673.00
2014	2855.73	1005.76	105.68	678.01
2015	2706.11	1297.81	102.65	936.54
2016	2569.85	1253.76	92.36	764.02
2017	2221.64	1044.36	66.57	716.17

Source: WBPCB Report

Next, we have shown the trend of major vehicular pollution in Kolkata by the following diagram.



Source: WBPCB Report

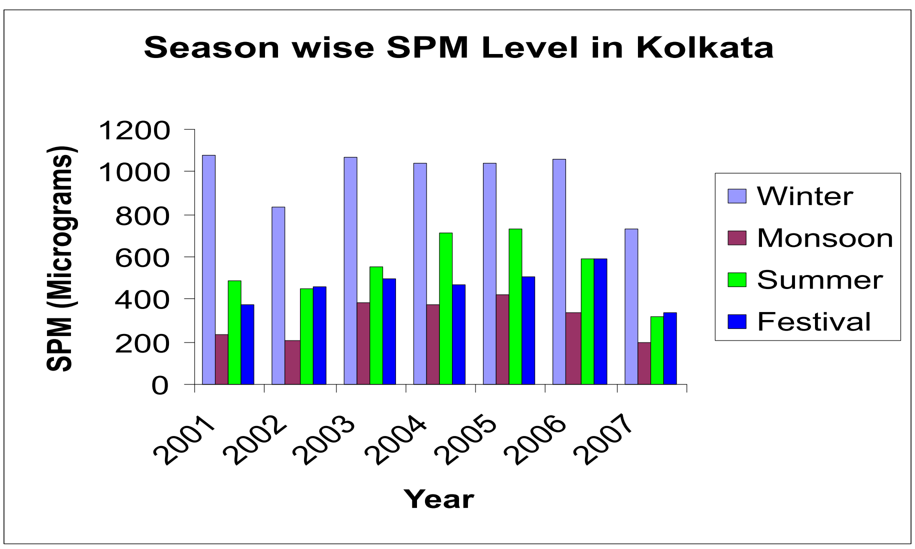
Figure: 1: Trend of Major Vehicular Pollutants in Kolkata

From the figure 1, we can clearly understand level of SPM & RPM are very high. In recent years, level of various kinds of pollutants are downward because the major intervention came in the form of substituting fuel in vehicles, building of flyovers to check road congestion, etc. However, the level is still high.

Nature and Seasonal trend of emissions:

Variation in SPM:

Suspended particulate matter is one of the most critical air pollutants in most of the urban areas in the country and permissible standards are frequently violated several monitored locations.



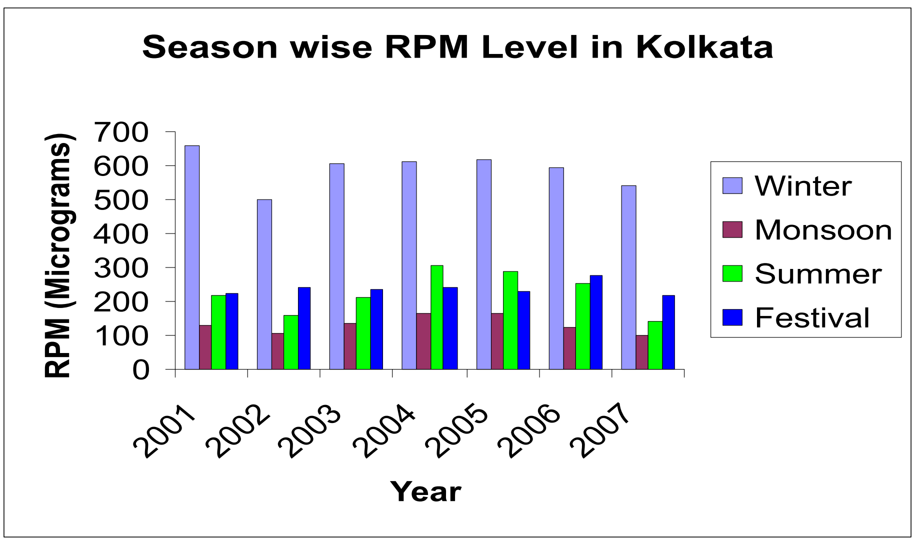
Source: WBPCB Report

Figure: 2 Season-wise SPM Level in Kolkata

Figure 2 is certain pattern in the SPM level in Kolkata. First on average there has been a dramatic draw in the SPM level in the recent year (2017). This is a significant drop, given the near static picture over four years 2013, 2014, 2015 and 2016. These drops may be a result of the introduction of fuel-efficient vehicles with improved technology. Some stringency in the government effort, given the pressure of international norms may be omnipotent. Also, there is a wide season – wise variation in the SPM level. It is high in the winter season and low in the monsoon. The festive season shows a significant disposal of SPM into the city's atmosphere. The social factors play an important role in the environmental degradation along with the natural factors. Thus, environmental problem causes to be mainly a natural phenomenon, at least so far as the air pollution is concerned.

Variation in RPM:

Next, we consider another major pollutant RPM (Figure 3). WBPCB report reveals that Respiratory particulate matter is also much higher than the national standard in residential areas. The situation worsens during winter month that is shown in next figure. Here the picture is not very good in festive season. In monsoon the variation of emission is comparative low. The high bar diagram represents the high variation of RPM. In the following table we have shown the Seasonal year wise nature of variation of RPM.



Source: WBPCB Report

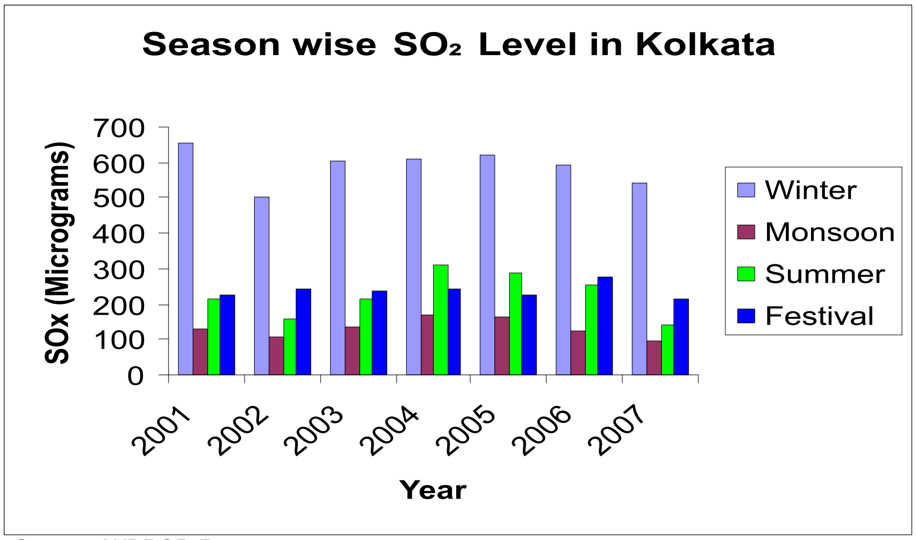
Figure 3: Season-wise RPM Level in Kolkata

A similar season wise is also observed in the emission of RPM. The social factors could not be ignored in any meaningful analysis of urban air pollution. RPM does not fall much as SPM in 2017. But the level of RPM has comparatively fallen in 2017 than the previous years.

Variation in SO_2:

In comparison to SPM, RPM, and NO_2, SO_2 is low. And it is also low enough to have any significant health effect. In case of SO_2 the seasonal variation is also pronounced.

Again, the social phenomenon of festivity plays a dominant role. This fluctuation is shown in figure 4.



Source: WBPCB Report

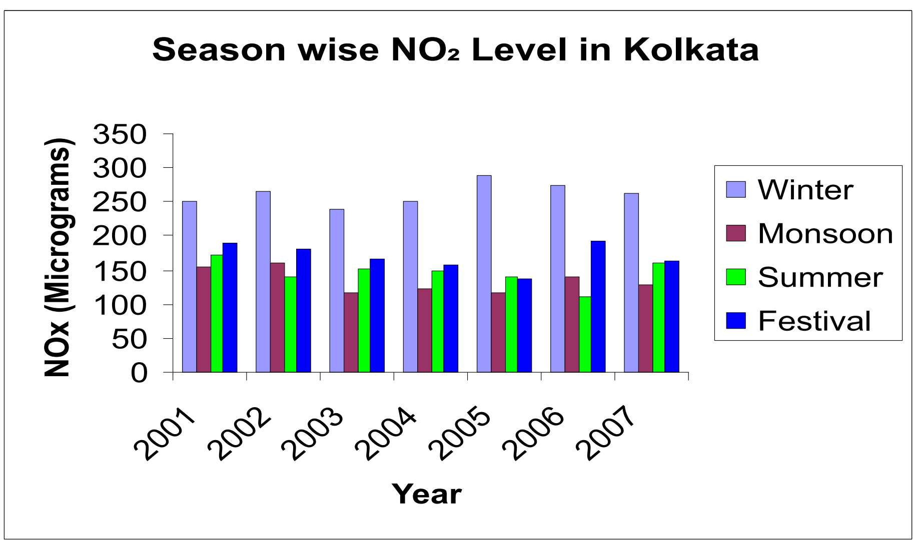
Figure: 4 Season-wise SO_2 Level in Kolkata

From the figure 4, we see it is low in 2017 than the previous years.

Variation in NO_2:

This is also another contributor element of vehicular pollution. This pollutant is appeared in the environment of Kolkata. This is emitted from the old and heavy vehicles. On the road of Kolkata, there is huge traffic jam in the peak time. So, traffic jam leads to traffic congestion. This leads to slow moving and standing for a long time. This causes huge emission. This type of emission plays a role of spread of important pollutant in our study area.

The season wise trend over the years we have shown NO_2 level in Kolkata in the figure 5.



Source: WBPCB Report

Figure 5: Season-wise NO_2 Level in Kolkata

It also reveals a wide seasonal fluctuation and the role of the local festivity. In case of NO_2 we cannot see a lower position of NO_2 level in 2017. This was more or less over the years. We realize that levels of pollutants were high in 2011.Then over the years these have decreased. This is because of the various measures taken by government to mitigate emissions from transport sector.

Status of other Vehicular Pollutants:

There are some other air pollutants viz. lead (Pb) and Carbon monoxide (CO). The salient results of these additional parameters at some stations in the metropolitan city of Kolkata in the respective years. The lead and carbon monoxide levels at most locations were much higher than the prescribed permissible limit. This is because of high traffic density and large number of motor vehicles operating on the roads.

Seasonal Fluctuation of Air Pollution level:

The methodological condition and turbulence in the atmosphere are the primary factors affecting pollutant distribution and dispersion pattern and producing seasonal variations. There are wide fluctuations in seasonal conditions within the country as the seasonal conditions within the country as the seasons are not uniform throughout the country due to diversity in physical and climatic conditions.

During monsoon (June to August), frequent rains wash down the air born particulates and other gaseous pollutants. Therefore, the period between June to mid-September is the cleanest period in the year and frequent rain does not allow pollutants to build up to higher concentration in ambient air though the pollution generating sources remain the same throughout. The winter months of December to February are relatively much calm condition facilitates more stability to atmosphere and consequently slow dispersion of pollutants generated and help in buildup of pollutants generated and help in buildup of pollutants in vicinity of pollution sources. The general pollutant levels in terms of percentage violation of standards increase considerably during winter basically due to lower ambient temperature, calm conditions, lower mixing depth, pollution inversion and high traffic density on the roads. Frequent change in wind direction in the atmosphere during March to May months create turbulent conditions. Local disturbances in environment causes frequent dust storm and hazy condition. Moreover, the winds from 'Thar' desert area brings dusty winds from arid and semi-arid region, building up high particulate matter levels in ambient air in these months, mostly contributing soil borne particles. In the festival season there is huge conglomeration of people in Kolkata. Festive-shopping, Pandal-hopping and increase business activities are some of the factors that increase the flux of urban traffic and increase trips per vehicle. Since there is no concomitant rise in the road space, the huge flow of traffic leads to congestion of road space, low vehicle speed and accident proneness-all adds to the plight of urban people. It is this up search in social activity centering the festivity that adds to the vehicular pollution.

Thus, we find that Kolkata's air quality due to vehicular emission is conditioned both by natural and social factors. The festive season by itself is largely responsible for falling air quality during their time when the natural factors may not be so omnipotent. Thus, the analyzing pollution pattern, Policy makers have to give a due consideration to this point.

At last we have shown the categorization of air quality on the basis of seasonal trend that is represented by the following table 2.

Table 2: Seasonal Trend Based categorization of air Quality

Category	Period	Critical Air Pollutants	Feature
Moderate pollution	March to May	Particulate Matter	Low humidity, high turbulence, frequent change in wind speed
Low pollution	June to August	--------	Cleaner period due to high humidity, rains and monsoon month
High pollution	December to February	Particulate Matter	Low inversion, calm conditions, unfavorable meteorological conditions
High-medium pollution	September to November	Particulate Matter	High conglomeration of people, high emission, low vehicle speed

Source: WBPCB Report

CONCLUSION

From the point of conclusion, we can easily consider that Air pollution in Kolkata is very serious like Delhi, Mumbai, Ahmedabad, Bangalore, and Chennai in our state. The West Bengal pollution control board monitors ambient air quality of major urban centers regularly. Air quality at respirable height is also monitored in some important traffic in the city of Kolkata. In case of vehicular emission suspected particulate matter, respiratory particulate matter, Sulphur dioxide and nitrogen dioxide are measured in some major sections in there. In studied years we see wide fluctuations in across months. It is low in the monsoon season and high in the winter period. The government should take steps and laws to combat the spread of vehicular emissions then we can come back to pollution free air that leads to green transportation. This turns to sustainable development.

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GIS, Remote Sensing and Global Methane Emission

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ABSTRACT

The paper seeks to find out the structure, nature, and patterns of global methane emissions from 1970 to 2018 and discusses about the implications, scope and policy of GIS and remote sensing on the methane emission. The paper endeavours to verify the Environmental Kuznets Curve hypothesis for the global methane emissions during the specified period. Moreover, the paper tries to show the cointegrating relationships and long run causalities from global GDP per capita to the global methane. The paper has applied semi log and double log regression model along with cointegration and Vector Error Correction model. It was found that the global methane emission has been increasing at the rate of 1.06% per year significantly during 1970-2018. Actually, the trend of global methane emission is cubic in nature. The methane emission contains four upward structural breaks. It has significant cyclical trends showing inverse S type shape in H.P. Filter model. In ARIMA (10,0,2) forecast model for 2050, global methane is stable and nonstationary. The global methane has been absolutely decoupled from world GDP per capita square and relatively decoupled from world GDP per capita cube during 1970-2018 significantly which indicate that global methane emission follows Environmental Kuznets Curve hypothesis. Global methane emission is cointegrated with world GDP per capita having one cointegrating equation where cointegrating equation moves to the equilibrium and global methane emission has long run causality from the world GDP per capita from 1970 to 2018.

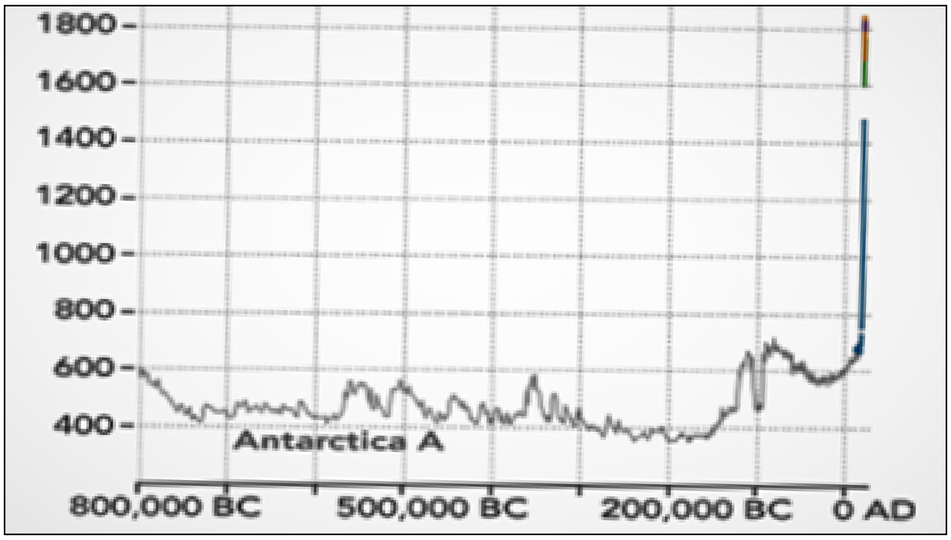
Keywords: Methane Emissions, Environmental Kuznets Curve, Structural Breaks, Long Run Causality, Cointegrating Equation

JEL Classification Codes- C32, 052, Q43, Q54

INTRODUCTION

Alessandro Volta, an Italian Physicist identified methane in 1776 in marshes of Lake Maggiore. It is a tetrahedral molecule with four equivalent C-H bonds. Methane is highly explosive, nontoxic and flammable. Electricity can be generated from methane. Seafloor is the largest reservoir of methane which is called methane clathrates but when it reaches in the surface and atmosphere it is called as atmospheric methane. The importance of methane is second only to carbon dioxide in terms of overall contribution to human induced climate change.

The amount of methane in the atmosphere has more than doubled in the past 250 years. It has been responsible for about a fifth of global warming. During 800000 years ago, methane concentration varied between 300 and 800 parts per billion and it was found that global methane concentration rose from 722 parts per billion in pre-industrial time to 1866ppb by 2019 i.e. an increase by a factor of 2.5. The concentration of methane was relatively stable for hundreds of thousands of years and then started to increase quickly about 1750ppb due to increasing human population along with industrial revolution, more waste and fossil fuel etc which has been depicted in Figure 1 below.

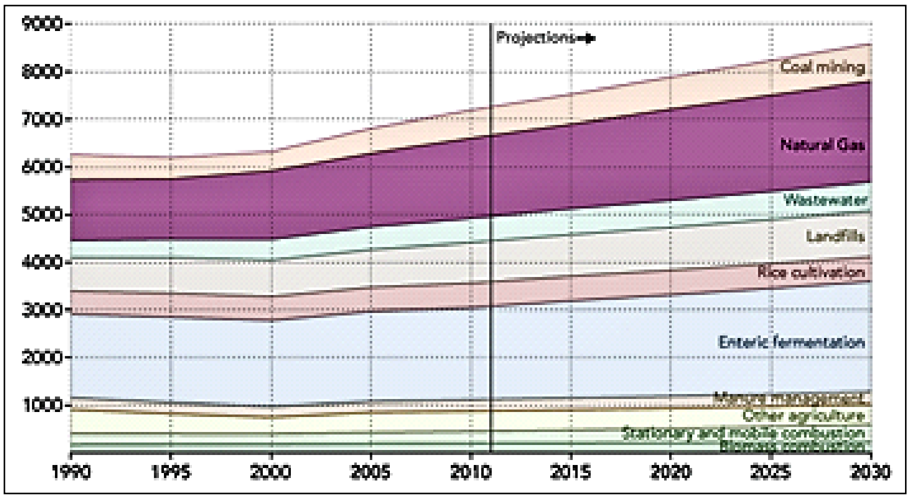


Source: https://earthobservatory.nasa.gov/features/MethaneMatters

Figure 1: Methane Concentration (parts per billion), 800000BC-2014AD

Methane is emitted during the production and transport of coal, natural gas and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills. 60% of methane emissions are caused by humans and livestock animals, while natural sources such as wetlands cause about 40% methane emissions. Human sources include agriculture, especially animal agriculture and rice production waste, and fugitive emissions from industry including energy sector. Grazing animal such as cattle and sheep including livestock animals cause at least 30% of unnatural methane emission. Fugitive emissions contributes about 25 to 34% of methane. Human waste including landfill and waste water cause about 18% of unnatural methane emissions. Rice production causes about 7 to 20% and wetlands make up about 30% while natural sources other than wetland accounts for about 10%. NASA assured that the sources of global methane are as follows: Wetlands constitutes 22% followed by coal and oil mining, natural gas 19%, enteric fermentation contributes 16% followed by rice cultivation 12%. Biomass constitutes 8% and landfills constitutes 6% followed by sewage treatment and animal waste 5% each and terraces contributes only 4%.

A projection of different sources of global methane emission for 2030 has been given in the Figure 2 where from 1990 to 2010 is actual sources and remainder is the forecast values of percentage share by metric tons of CO_2 equivalent where same scenarios of steady progress of shares from sources have been observed.



Source: https://earthobservatory.nasa.gov/features/MethaneMatters

Figure 2: Global methane emission by source (metric tons CO_2 equivalent)

A tonne of methane emitted into atmosphere creates approximately 34 times the atmospheric warming than a tonne of CO_2 over a period of 100 years. On the contrary, methane makes up only 0.00018% of the atmosphere in contrast with 0.039% for CO_2 which is roughly 200 times more abundant. On a 20-year time scale, a mass of methane is about 85 times more powerful than CO_2 at warming the earth. While methane is more potent GHG than CO_2. There is over 200 times more CO_2 in atmosphere. Eq-CO_2 levels are 380ppm while methane levels are 1.75ppm. Hence the amounting of warming methane contributes is calculated at 28% of the warming CO_2 contributes. However, methane is a short-lived climate pollutant and has an atmospheric lifetime of 8.4 years, defined as the atmospheric burden divided by the sink strength. Based on the GWP (100 years span), IPCC's first Assessment Report cited that GWP of methane was 21 which increased to 23 according to second Assessment Report of IPCC for the years 2013-2017. It indicated that one tonne of methane is deemed equivalent to 23 tonnes (23CO_2e). In other words, one litre of CH_4 is 8.4 times as potent as one litre of CO_2. Values of GTP for methane are currently estimated as 13gCO_2eq/gCH_4(GTP 100) and 71 (GTP 20). Whilst the GTP20 is around 20% lower than the equivalent GWP20(87), the 100-year time horizon differs greatly over 60% lower than GWP.

According to World Bank data in 2012, China emits the highest methane emission amounting to 1752290.14kt CO_2 equivalent which is 21.86% of world methane emission followed by India amounting to 636395.82 kt i.e. 7.94% of the global methane emission and USA emits methane emission by 499809.345kt which is 6.23% of global methane emission. In India, CH_4 emission increased approximately 2.5times in a span of 10 years (1999-2009) reaching a total emission value of 1084.03 Gg/year by 2015. An increase of 245% is observed from 1999 to 2011 while a total increase of 109% was found from 2011 to 2015.The maximum CH_4 emission was observed in Maharashtra (70.6Gg) while minimum emission of CH_4 was observed in Tripura (0.2Gg). A positive association was found between CH_4 and GSDP which were 0.88,0.68 and 0.80 for 1999-00, 2009-10 and

2014-15 respectively. The net annual emission of CH_4 from landfill in India increased from 404Gg in 1999-2000 to 990 Gg and 1084 Gg in 2011 and 2015 respectively. The MSW generated from households is considered third major anthropogenic source of CH_4 and it constitutes 11% of total CH_4.The MSW is disposed into landfills. The per capita generation rate of MSW in India ranges from 0.2 to 0.5 kg/day (Singh, Kumar & Roy, 2018).

In this context, the paper seeks to find out the structure, nature and patterns of global methane from 1970 to 2018.The paper endeavours to verify the Environmental Kuznets Curve hypothesis for methane emissions for the specified period. Moreover, the paper tries to show the cointegrating relationships and long run causalities from global GDP per capita to the global methane emissions. It also explains the impact of GIS and remote sensing on methane emission.

LITERATURE REVIEW

Foster and Rahmstorf (2011) analysed global temperature rise using three surface temperature records such as NASA/GISS,NOAA/NCDC and HadCRUT from which it was found that global warming was ranging from 0.014 to 0.018Kyr^{-1}. Schaefer(2019) analysed the revision of anthropogenic fossil fuels trend based on $\delta^{13}CH_4$ and ethane/propane ratio and showed downward revision of geologic source based on the preindustrial methane radiocarbon content to <16Tg/annum which challenged three fold higher inventory and $\delta^{13}CH_4$. He found that the estimates for a combined CH_4 climate feedback of 180Tg/annum from wetlands and permafrost exceeds present day fossil fuel CH_4 emissions(110Tg/annum) and are similar to current agricultural emission.

Jardine *et al.*, (2003) stated that methane can be removed from the atmosphere by a range of chemical and biological processes which includes tropospheric oxidation, stratospheric oxidation, and uptake by soils. Oxidation of methane in the troposphere is the largest methane sink, removing 506Mt of methane per year from the global methane burden. Stratospheric oxidation of methane consumes 40Mt per year. Approximately 30Mt of methane are removed from the atmosphere annually by uptake in soils.

Hausman and Raimi (2019) explained that at current estimates of the monetary cost of climate change impacts would roughly \$75 to \$100 billion in global damage from methane emission where EPA studied that climate related damages have been estimated at \$1300 to \$1600 per ton, i.e. methane leaks can pose a public safety hazard. Market forces will not solve the problem of methane leaks while companies have an incentive to capture the escaping gas that incentive is well below the levels which would be best for society as a whole.

Kumari *et al.*, (2019) studied that CH_4 emission from livestock sector even at a small scale can lead to significant climate change impact and rise in surface temperature. Based on the IPCC Tier 1 methodology, CH_4 emission in India is estimated to be 15.3Tg CH_4 in 2012.CH_4 emission related to enteric fermentation is 92% of the total CH_4 emission(14.20Tg CH_4) and the rest 8% (1.16TgCH_4) of total CH_4 emission from methane management respectively. In India, at 20-year time horizon, the $\Delta T20$ varies from 1.53×10^{-7} to 0.005mK in the Indian livestock sector. However, at 100-year time horizon, the ΔT100 varies from $7.66x10^{-9}$ to 0.0002mK. The states can contribute to the surface temperature response(ΔT20), ranging between $8.5x10^{-5}$ and $1.25x10^{-1}$mK in 20-year time horizon. While 100-year time horizon, ΔT100 varies from $4.23x10^{-5}$ to $6.5x10^{-3}$ mK for different states. The highest global surface temperature response is observed from CH_4 emission in Uttar Pradesh with lowest response resulting from CH_4 emission in Mizoram.

Using SEME Model with Moderate Resolution Imaging Spectroradiometer data of 2010-2012, Bansal *et al.*, (2018) estimated with the help of RS and GIS tools and found that UP emits maximum CH_4 emission amounting to 43.10Gg yr^{-1} and central region is the least contributor amounting to 0.266Gg yr^{-1} in wetland in India.

Garg (2018) taking remote sensing data using SEMEM Model estimated that CH_4 has increased by 150% (722-1803ppb) during 1750-2011 as compared to 40% of CO_2 (278-390ppm) and 20% of N_2O(271-324.2ppb). He found that Indian wetland emit about 3Tg methane annually in which summer season fluxes higher than monsoon and winter in UP which emits maximum of 54.48Gg/year in summer and 32.17Gg/year in monsoon and 17.41Gg/year in winter.

Schneising *et al.*, (2014) used satellite observations and estimated that methane production has increased by 990±650ktCH4 yr^{-1} and 530±330ktCH4 yr^{-1} in Bakken and Eagle Ford in USA between 2006-2008 and 2009-2011 respectively. The estimates of leakages are 10.1%±7.3% and 9.1%±6.2% in terms of energy content.

Zhang *et al.*, (2011) conducted sensitivity test on CH_4 emission in Sanjiang Plan in North eastern China using GIS data base to hold the spatially differential input information to drive denitrification and decomposition for its regional simulation. The data were classified to map the spatial pattern of rice paddies and calculated rice areas. Landsat thematic mapper imagery from the Earth Explorer Interface were processed to extract the spatial distribution of rice paddies in the region. Results from simulation indicated that CH_4 emissions from the region ranged from 0.43 to 0.58 or 0.51±0.07TgCH_4/year.

Katayanagi *et al.*, (2017) estimated CH_4 emission from paddy field in Japan from 1990 to 2010 using DeNitrification Decomposition Rice model and found that CH_4 emission ranged from 323 to 455ktC yr^{-1} which was higher than the IPCC Tier 1 method (305ktC in 2000).

Van Dingenen *et al.*, (2018) concluded that by 2050 for a range of pessimistic scenarios in which CH_4 emission remain unabated, health impact weighted O3 could rise by 2-4.5ppb globally causing 40000(+12%) to 90000(+26%) more O3 premature deaths compared to present. Under low emission scenario of CH_4,the regional shares of global O3 mortalities in 2050 will be in Europe 7.2%,North America 3.5%,Middle East 2.5%,Central Asia 7.5%, East Asia 11%,South Asia 42%, South East Asia 14%,North Africa 1.9%,SSA 5.7% and South Africa 2.4% respectively .Even the percentage change in crop economic loss in 2050 in Europe will be 16% to 37% in comparison to global loss of 8% to 19% respectively.

Wang Shuo *et al.*, (2017) empirically verified that environmental Kuznets curve is U shaped in case of N_2O and CH_4 during 1980-2009 and 1990-2009 in USA but it is inverted U shaped in case of CO_2 in relating with GDP per capita during 1960-2009 using cointegration test which were significant at 5% level.

Cruz *et al.*, (2018) estimated EKC in Argentina using data from 1970 to 2012 relating CH_4 emission and GDP per capita and agriculture through ARDL approach and found that Environmental Kuznets Curve is inverted U shaped having short run and long run causalities.

Benavides *et al.*, (2017) studied empirically in Austria during 1970-2012 using ARDL method among CH_4 and per capita GDP, trade openness, electricity production from renewable sources and found that CH_4 and the variables support inverted U shape Environmental Kuznets Curve and also found short run and long run causalities between CH_4,trade openness and GDP per capita in Austria.

Williamson (2017) studied that both CO_2 and CH_4 emission are related to satisfy EKC hypothesis even if there are GDP per capita, mean years of schooling, government regimes (where there are 5 dummy variables), GDP shares of agriculture, industry and the inputs of electricity production(where there are three dummy variables) are assumed to be control variables in 181 countries in 2012.

GIS and Remote sensing

A Geographic Information System (GIS) is a computer-based system for handing spatial information to acquire, store, analyze and display data which can make maps, charts, spreadsheets, or pictures. The information about objects are collected by a device at a distance without direct contact through active or passive sensing. TIROS-1 is the first remote sensing satellite coincide with the birth of GIS which further strengthened by LANDSAT, NOAA Satellite, Geographic Operation Environmental Satellite, Television Infrared Observation Satellite, Heat Capacity Mapping Mission satellite, the SKYLAB and so on. GIS technology keeps base-level information requirement and contributes emergence management workflow support with the help of data management, situation awareness, planning and field operations.

GIS is the prime element of the forest carbon monitoring system which is used by tropical developing countries to establish and maintain property rights and land tenure. A GIS based programme helps scientific understanding of earth system at a lonely global scale and leads to more thoughtful improved decision making. It represents a vast knowledge expertise and practices in applying technology to the science of climate change and its impacts on nature and human systems. Automated GIS process creates snapshot of biomass and carbon, helps to ensure carbon neutral, zero waste goals, to assess gauge land change effects on nation's endemic biodiversity, can track 33 square mile ice islands in the Arctic and can tap wind power and offer insight on the resource feasibility. GIS contributes to the accuracy of mapping the potential of land cover classes.

GIS and simulation model generally assess the potential sea-level rise on tidal marsh area and delivery ecosystem. Even, the GIS has been widely used in several applications, such as database development and changes in the aquatic environment, model of non- point source pollution, database design for a multiscale spatial information system, assessment of surface and zonal models of population, military housing management and, multiple criteria group decision making etc.

Remote sensing techniques provide near-real-time and high spatial resolution data products related to global environmental variables. Remote sensing is used to get critical information from environment, combined with GIS which can be easily shared with government and farmers for proper investigation and immediate action. The study of remote sensing and GIS in the field of agriculture, environment and climate change are very much helpful to receive maps, crop information, yield estimation, data, and much which are beneficial to farmers, fisherman, people and the government to provide necessary helps and actions. Remotely sensed and ground level data estimate emissions and removals associated with REDD+ where SAR, LIDAR and high resolution optical data have been widely used.

In brief, the fields of application of remote sensing are, [I] agriculture, [ii] forestry, [iii] geology, [iv] hydrology, [v] sea ice, [vi] land cover and land use, [vii] ocean and coastal monitoring, [viii] atmospheric monitoring, [ix] meteorological parameters measured by remote sensing, [x] developing on line mapping services.

Methane emission, GIS and Remote Sensing

In 1996-97, measurement of methane from space started with IMG thermal infrared instrument. Solar backscatter with SCIAMACHY followed by GHG Observing Satellite (GOSAT) were used during 2003-2019 to measure methane column. Atmospheric Infrared Sounder(AIRS),Scanning Imaging Absorption Spectrometer for Atmospheric Chartography, Tropospheric Monitoring Instrument and Green House Gas Observing Satellite (GOSAT) can accurately detect the global and regional distribution of methane with a resolution between 7 and 60 km. TROPOM1 INSTRUMENT has been launched in 2017 with the resolution of 7x7 Km^2 to observe methane from space with daily global average. Now, GOSAT can map methane plum at a resolution of 50x50 Km^2. Methane as measured by satellite can detect emission hotspots and estimate trends and can be used in inverse analysis.GOSAT-2 had been launched in 2018. MERLIN mission, a joint mission of DLR and CNES, a France-German Council of Ministers decided to start a minisatellite mission monitoring the GHG methane in the atmosphere and is expected to launch in 2021. The goal of the MERLIN mission is to measure the spatial and temporal gradients of atmospheric CH_4 columns with high precision and unprecedented accuracy. VSWIR imaging spectrometer will measure typically between 380 and 2500nm with 5-10nm spectral spacing. In 2020, the German Space agency will launch the Environmental Mapping and Analysis Programme and Japan will launch the Hyper Spectral Imager Suite. In 2021, NASA will launch Earth Surface Mineral Dust Source Investigation to the International Space Station. It will also launch Surface Biology and Geology Investigation to include an imaging spectrometer in 2025.

Global Inundation Extent from Multi-Satellite(GIEMS) provides a useful resource for reducing uncertainties in the contribution of natural wetland to the interannual variability of the atmospheric methane .It estimated and adjusted to match the seasonal cycles of CH_4 which is calculated by coupling with ORCHDEE global vegetation model. The following three satellite observations are used in GIEMS, namely [i] Advanced Very High

Resolution Radiometer(AVHRR) visible (0.58-0.68μm) and near infrared(0.73-1.1μm) reflectances and the derives normalized difference vegetation index(NDVI), [ii] Passive microwave special sensor microwave/imager (SSON/I) measurements between 19 and 85 GHz(1.58-0.35cm in wave length), [iii] active microwave backs scattering Coefficients at 5.25GHz(wave length =5.71cm) from the Scatterometer on board the European Remote Sensing (ERS) Satellite.

The advantages of using Satellite System are [i] to detect methane plumes to observe a large diversity of methane emitting factors, [ii] to identify point sources and help to understand the dynamics of oil and natural gas methane emission, [iii] to map future generation of imaging spectrometer in the simulation process, [iv] to integrate larger GHG monitoring schemes and help scientists to understand better for global methane emission.

In USA, use of GIS in mapping spatial distribution of rice production, climate change prediction and surrounding ecology, monitoring CH_4 emission from agriculture, the formulation of policies are regular concerns and track threats from GHG. Moreover, NASA JPL airborne infrared imaging spectrometer usually is observing methane plumes and methane emissions in dairies, landfills, oil and gas wells, natural gas reservoirs and pipelines and refineries in California. Presently, Methane SAT is building a satellite which will capable to reduce methane emission by 45% by 2025 from oil and gas industry. The emission is estimated nearly 17.5%. It is based on remote sensing system having small pixel size covering 500km from above the earth and will sense plumes of methane.

Implications of GIS and Remote Sensing

Bangladesh has developed immensely by adopting remote sensing and GIS technology in climate change disasters. In 2007,November 15,4000 people died from SIDR cyclone but only 100 people died in May 25,2009 from AILA,40 people died in October 11, 2012, and 24 people died by Mahasen cyclone in May16, 2013. Bangladesh has been using satellite technology in flood flow, flood zoning, river erosion, accretion and changes of river direction and the country benefited by sustainable disaster reduction in mass casualties and properties in preparing better prediction in cyclone and flood tracks (Akhand, 2013).

Remote sensing and GIS tools enable to focus glaciers, glaciers lakes, snow, land cover and land use, disasters, and food shortfalls in Hindu Kush Himalayan region. It was found that Imja Tsho Lake in Nepal increased by 0.8km² from 1977 to 2015, glacial lake areas in Bhutan and Myanmar increased by 1.12% and 17.8% from 1990 to 2014, and from 1977 to 2009 respectively. A significant decrease in forest areas due to deforestation was observed in Bhutan, Pakistan, and Greater Chittagong of Bangladesh in 1990, 2000, and 2010. Decrease in grassland, shruland and barren areas have also been noticed and even drought was seen in this region (Shrestha *et al.*, 2016).

In Sudan, LANDSAT TM and TERRA ASTER were used to map and assess the land use and land cover during 1999, 2002 and 2009 on Nuba Mountains to analyse the rate of changes, causal factors and the determinants of changes which helped to plan adaptation strategies (Taisser *et al.*, 2014).

Shilpi and Dahiya (2018) applied GIS platform to map spatial distribution of CH_4 in India in 2012 in 28 States and 7 Union Territories covering 649 districts in the livestock categories of cattle, buffalo, goat and sheep. UP was observed as the highest CH_4 emitted state (2746Ggyr^1) followed by Rajasthan, MP etc. The top three districts are Banas Kantha (Gujarat) emitting 112Ggyr^{-1}, Paschim Medinipur (West Bengal) emitting 103Ggyr^{-1}, and Jaipur (Rajasthan) emitting 102Ggyr^{-1} respectively. GIS based spatial distribution of livestock CH_4 emission revealed that highest emitting districts located in the states of UP, Gujarat, W.B., Rajasthan, Andhra Pradesh and Maharashtra. India's per capita CH_4 emission was 12.71kg where Surajguja of Gujarat was placed highest showing 119 kg per capita and lowest was in Delhi having 2.4x10^{-2}kg per capita. These findings can help to develop district or state level policy for sustainable livestock farming.

Applying Atmospheric Infrared Sounder (AIRS) measurement in Indian region during 2003-2015 to find 3D distribution of CH_4, Kavitha and Nair (2019) observed seasonal variation in vertical distribution of CH_4.Highest mixing ratio was seen in post-monsoon months achieving high altitude peak of 1880ppbv and lowest in the peak monsoon season achieving around 330hpa – 250hpa. In the ocean region, the highest seasonal amplitude CH_4 mixing ratio was found over North-Arabian Sea.

India had already launched geo-stationary satellite INSAT Series and METSAT for meteorological applications which carries VHRR and Data Relay Transponder Payload. The RESOURCESAT-2, CARTOSAT-2/3 series, OCEANSAT-2, RISAT, MADRAS, ISRO-CNES, SAPHIR, I-STAG, SARAL etc. have been working under Indian Earth Observation program for disaster monitoring, ocean-state forecasting, better management of land and water resources, and climate change research and so on. IRS LISS-II data have been using in Glacier Himalayan Area, IRS-LISS-IV is using in topographic map survey of India. Remote sensing data have been utilized to derive the rice area, crop growing calendar and digital elevator in India including methane emission in livestock, wetlands and waste. Spatial and seasonal variation in column CO concentration in India was observed from EOS-TERRA MOPITT and CO_2 from ENVISAT-SCIAMACHY.IRS and MODIS have been working on detection of forest fire and biomass burning events (Ranganath & Raghavendra, 2011).

METHODOLOGY AND SOURCES OF DATA

The linear and nonlinear trends have been calculated from the semi-log regression model. Structural breaks have been obtained from the Bai-Perron model (2003). Decomposition of trends and cycles were found by applying the Hodrick Prescott Filter model (1997). ARIMA(10,0,2) forecast model was applied to show convergence, stationary and stability of Auto Regressive and Moving Average of global emissions during 1970-2018 including prediction during 1970-2030. Double log regression model was fitted to find out Environmental Kuznets Curve hypothesis (1955) in global methane. Johansen model (1988) was fitted to get cointegration and vector error corrections. Wald test (1943) was applied to find short run causalities and the long run causalities which were verified by using the properties of cointegrating equations.

The data of global methane has been collected from the World Bank from 1970-2018 where missing data were calculated through approximation and obtained from internet sources. The global GDP per capita in current US dollar at market prices during 1970-2018 were also collected from the World Bank.

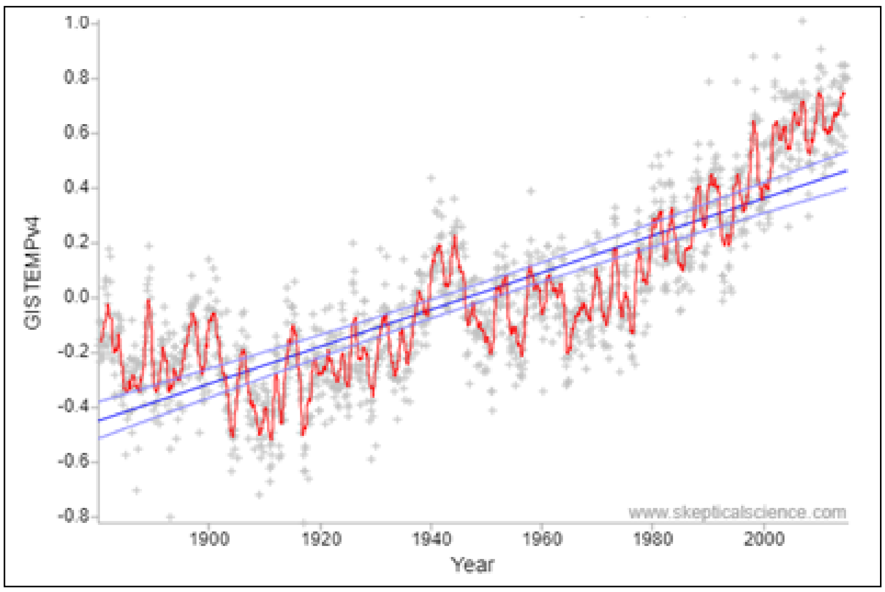
OBSERVATIONS FROM THE ECONOMETRIC MODELS

[1] Temperature rise

GHGs are the main sources of global warming. Various global institutions have calculated and projected global temperature rise using long period data from time to time taking models of global warming.

Using the GISS Surface Temperature Analysis (GISSTEMP4) and applying the methodology of Foster and Rahmstorf(2011), the global surface temperature has increased at the rate of 0.0068±0.0009°C/year(2σ)during 1800-2015 where it was found that β=0.0067522, σ_w=0.00012169, v=12.372,$\sigma_c=\sigma_w\sqrt{v}$=0.00042802.

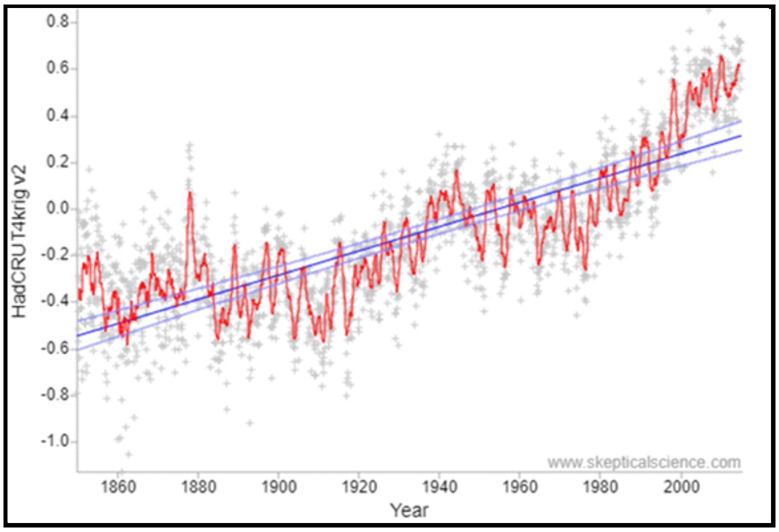
The trend line of temperature rise has been plotted in the Figure 3 given below where fitted and actual lines have been marked.



Source: www.skepticalscience.com

Figure 3: Temperature rise using GISSTEMPT4

On the other hand, using HadCRUT4 analysis and applying the methodology of Foster and Rahmstorf (2011), the global surface temperature had increased at the rate of 0.0052± 0.0006°C/year (2σ) during 1800-2015 where it was found that β=0.0052084, σ_w=0.00094429, v=11.700, and $\sigma_c=\sigma_w\sqrt{v}$=0.00032300. The fitted line and the actual line have been depicted in Figure 4 shown below:



Source-www.skepticalscience.com

Figure 4: Temperature rise using HadCRUT4

[2] Patterns of global CH_4

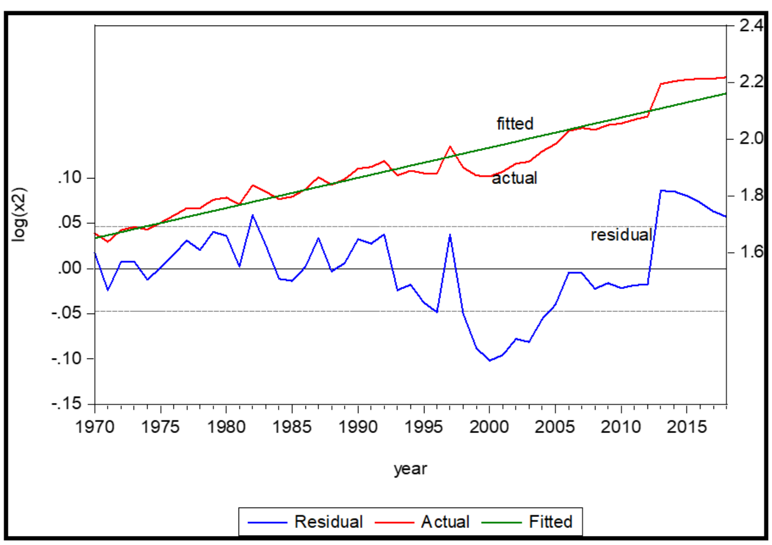
The global methane gas emission has been increasing at the rate of 1.06 per cent per year from 1970 to 2018 which is statistically significant at 5 per cent level.

$$\text{Log}(x_2)=1.6397+0.01066t$$

$$(120.65)^*(22.53)^*$$

R^2=0.915, F=507.88*, DW=0.47, where x_2=methane gas emission in kt,*=significant at 5% level,t= time or year

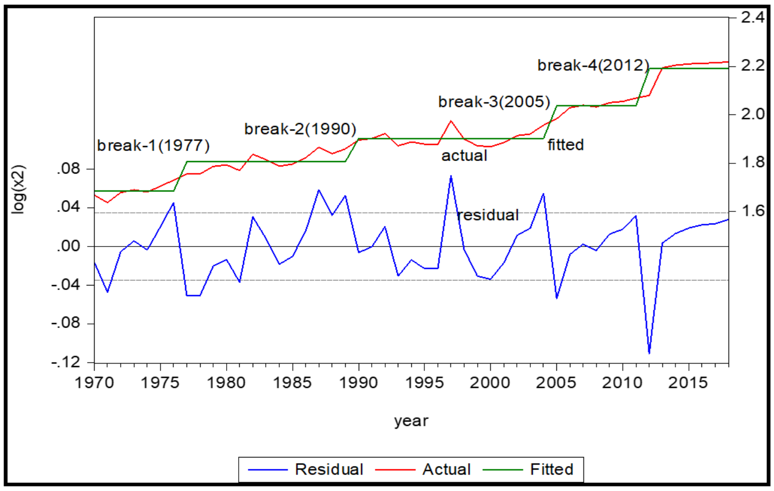
In Figure 5, the global estimated methane gas emission is depicted and is shown upward rising steadily from left to right.



Source- Plotted by author

Figure 5: Estimated methane gas emission

The global methane emission showed four upward structural breaks in 1977,1990,2005 and 2012 all of which are significant at 5% level. In Figure 6, the structural breaks have been marked and plotted.



Source- Plotted by author

Figure 6: Structural breaks of global methane emission

The non-linear trendline of the global methane emission is cubic which was estimated and was found as significant at 5% level.

$Log(x_2)=1.610+0.0231t-0.00079t^2+1.23E-05t^3$

(83.61)*(7.01)* (-5.23)* (6.11)*

$R^2=0.96$, F=403.17*, DW=1.14, *=significant at 5% level.

In Figure 7, it is plotted and the estimated line is an inverse S shaped which is upward.

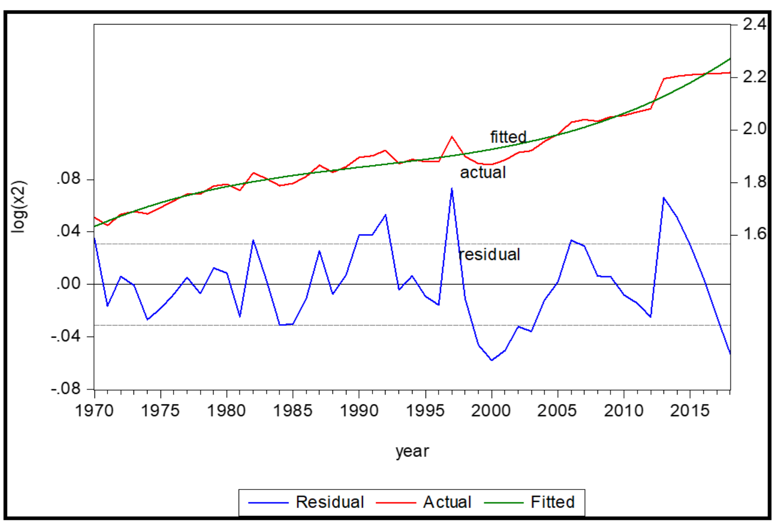


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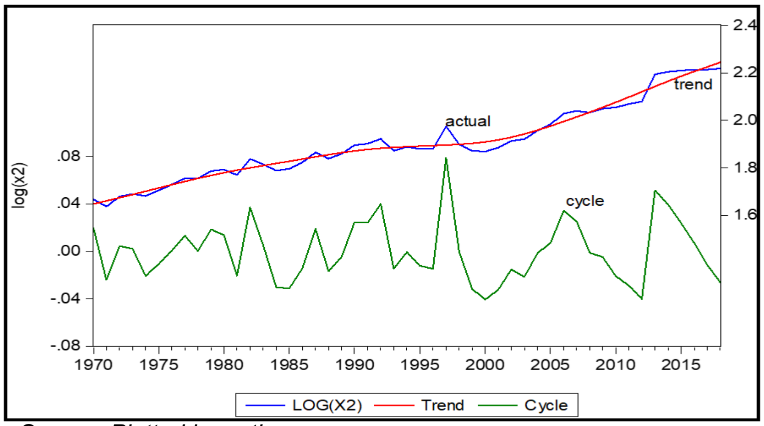
Figure 7: Estimated cubic function

If the cyclical paths of global methane emission from 1970 to 2018 are decomposed into cyclical trend line and cycle through Hodrick Prescott Filter Model (assuming $\lambda=100$) then the cyclical trend line is as good as inverse S shaped which is upward moving and significant at 5% level. It is shown in Figure 8.



Source- Plotted by author

Figure 8: Methane emission in H.P. Filter model

The best fit of ARIMA model of global methane is searched out as ARIMA (10,0,2) where ACF and PACF are significant at 5% level and the estimated model is given below.

$\text{Log}(x_2)=1.919+0.628\log(x_2)_{t-10}+0.734\varepsilon_{t-2}+0.00759\sigma^2_t$

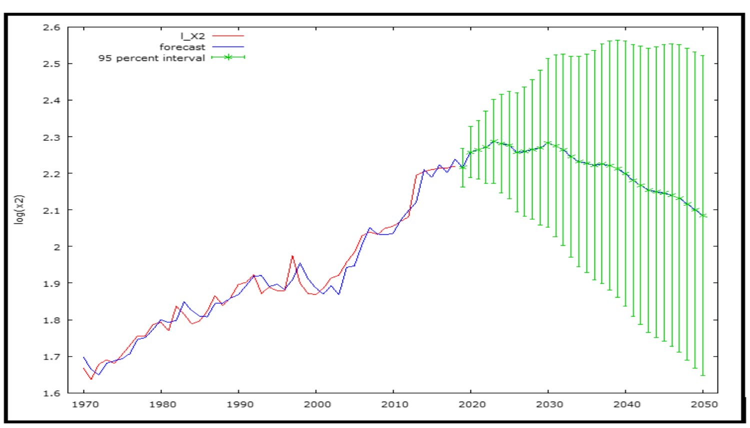
(40.18)* (2.42)* (4.11)* (4.09)*

$R^2=0.694$, F=34.093*, DW=0.372, AR roots:0.95,0.77±0.56i,0.29±0.91i, -0.77±0.56i,

-0.29±0.91i, -0.95; MA roots: -0.00±0.86i

The coefficients of AR (10) and MA (2) are less than one and significant at 5% level and the coefficient of σ^2 i.e. the volatility is negligible and significant which indicated that the model is converging. The AR and MA roots are less than one which implies that it is stable and stationary.

Moreover, the forecasting ARIMA (10,0,2) for 2050 is plotted as converging model and shown below.



Source- Plotted by author

Figure 9: Forecasting ARIMA (10,0,2) for 2050 of Global Methane

[3] Environmental Kuznets Curve Hypothesis

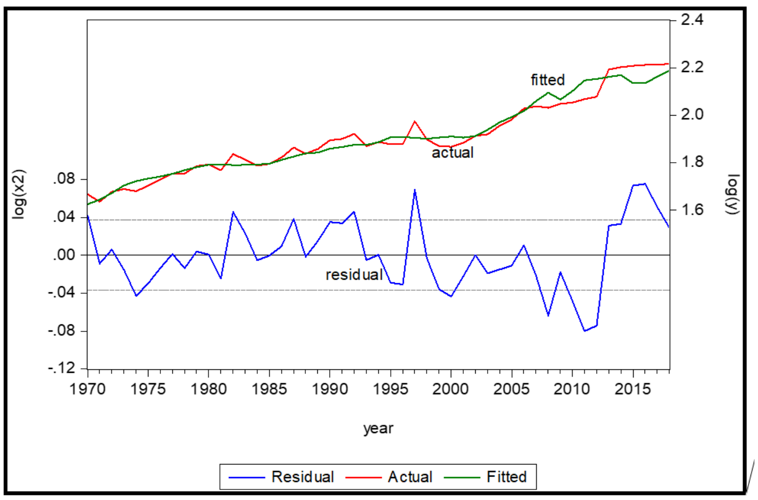
The following estimated equation between global methane emission in Kt CO_2 eq.(x_2) and the global GDP per capita(y) during 1970-2018 have been done through the Kuznets Hypothesis.

$$Log(x_2)=-24.62943+10.1143log(y)-1.3034log(y)^2+0.0565log(y)^3$$

$$(-3.39)^{*} \quad (3.72)^{*} \quad (-3.86)^{*} \quad (4.07)^{*}$$

R^2=0.949, F=281.89*, DW=0.94, SC=-3.52, AIC=-3.67, *=significant at 5% level.

The estimates indicate that global methane emission showed absolute and relative decoupling from the global GDP per capita from 1970 to 2018 because $\delta log(x_2)/\delta log(y)$ =10.114>1 which means there is no decoupling from GDP per capita , $\delta log(x_2)/\delta log(y)^2$=-1.3034 <0 which implies that there is absolute decoupling from GDP per capita square, and $\delta log(x_2)/\delta log(y)^3$=0.0565 >0<1 which showed that there is relative decoupling from GDP per capita cube. Therefore, it follows the Environmental Kuznets Curve hypothesis. In Figure 10, the Environmental Kuznets Curve is inverse U shaped.



Source- Plotted by author

Figure 10: EKC of Methane emission

The above analysis contains autocorrelation problem although the estimation is highly significant. After eliminating the autocorrelation problem, estimated equation is as follows.

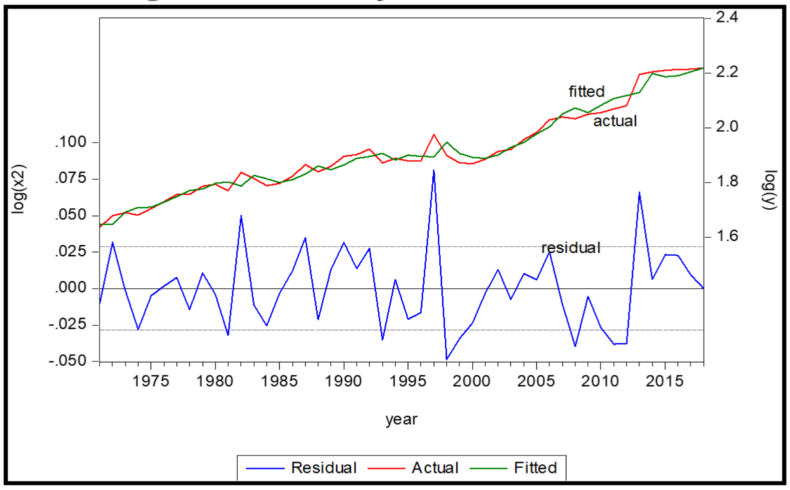
$$Log(x_2)=-16.278+6.459log(y)-0.8203log(y)^2+0.0349log(y)^3+0.573log(x_2(-1))$$

$$(-2.318)^{*} \quad (2.44)^{*} \quad (-2.49)^{*} \quad (2.57)^{*} \quad (5.33)^{*}$$

R^2=0.96, F=343.83*, DW=2.19, SC=-3.97, AIC=-4.17, *=significant at 5% level.

Since, $\delta log(x_2)/\delta log(y)$=6.459>1 which means there is no decoupling from GDP per capita , $\delta log(x_2)/\delta log(y)^2$= -0.8203<0 which implies that there is absolute coupling from GDP per capita square, and $\delta log(x_2)/\delta log(y)^3$=0.0349 >0<1 which showed that there is relative decoupling from GDP per capita cube. Therefore, it follows the Environmental

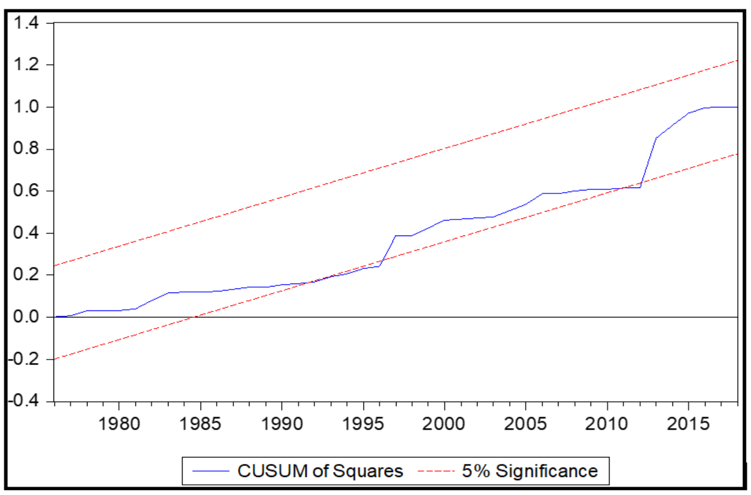
Kuznets Curve hypothesis. In Figure 11, the EKC is inverse U shaped which is more perfect than the previous curve after omitting the autocorrelation problem.



Source- Plotted by author

Figure 11: EKC after autocorrelation

The above estimated equation of Environmental Kuznets Curve hypothesis of global methane during 1970-2018 is satisfied by the CUSUM of Squares stability test which is significant at 5% level that depicted in Figure 12 below.



Source- Plotted by author

Figure 12: Stability test

[4] Cointegration and Vector Error Correction Analysis

Johansen unrestricted cointegration test assures that global methane emission, global GDP per capita, global GDP per capita square and global GDP per capita cube have two cointegrating equations in Trace statistic and Max Eigen statistic which are significant at 5% level.

Table 1: Johansen cointegration test

Hypothesised no of CEs	Eigen value	Trace statistic	0.05 critical value	Probability**
None*	0.699585	87.81698	47.85613	0.0000
At most 1*	0.363478	31.29518	29.79707	0.0334
At most 2	0.183129	10.06356	15.49471	0.2759
At most 3	0.011774	0.556652	3.841466	0.4556
		Max Eigen statistic		
None*	0.699585	56.52181	27.58434	0.0000
At most 1*	0.363478	21.23162	21.13162	0.0484
At most 2	0.183129	9.506908	14.26460	0.2464
At most 3	0.011774	0.556652	3.841466	0.4556

*Source-Calculated by author, * = rejection of the hypothesis at the 0.05 level, **= MacKinnon-Haug-Michelis (1999) p-values.*

The estimated Vector Error Correction Model is given in the Table 2 where dlog(x_2), dlog(y), dlog(y)^2 and dlog(y)^3 are not significantly related with each other during two period lags.

Table 2: Estimated VECM of global methane emission

Error Correction:	d(log(x_2))	d(log(y))	d(log(y)^2)	d(log(y)^3)
CointEq1	-0.317559	-0.027262	-0.927432	-18.03419
	[-2.79189]*	[-0.15023]	[-0.29548]	[-0.43945]
CointEq2	-2.734345	-6.498442	-90.32880	-944.5802
	[-0.91431]	[-1.36200]	[-1.09456]	[-0.87542]
d(log(x_2(-1)	-0.174826	0.104263	2.015508	28.92611
	[-1.22296]	[0.45716]	[0.51093]	[0.56083]
d(log(x_2(-2)	-0.134444	-0.230246	-3.811612	-47.68548
	[-0.97637]	[-1.04808]	[-1.00313]	[-0.95983]
d(log(y(-1))	-18.94648	-18.08600	-318.3899	-4170.136
	[-1.15843]	[-0.69313]	[-0.70547]	[-0.70669]
d(log(y(-2))	-14.55283	-19.08519	-303.0239	-3707.286
	[-1.06546]	[-0.87582]	[-0.80397]	[-0.75228]
d(log(y(-1)^2	2.365786	2.442808	42.40188	548.8366
	[1.19917]	[0.77611]	[0.77887]	[0.77105]
d(log(y(-2))^2	1.793955	2.245960	35.90586	442.7091
	[1.06987]	[0.83956]	[0.77600]	[0.73177]
d(log(y(-1))^3	-0.097904	-0.105610	-1.814730	-23.28548
	[-1.23933]	[-0.83796]	[-0.83247]	[-0.81697]
d(log(y(-2))^3	-0.072381	-0.088770	-1.430437	-17.78701
	[-1.06056]	[-0.81528]	[-0.75955]	[-0.72236]
C	0.010745	0.043587	0.716934	8.948014
	[1.34226]	[3.41295]*	[3.24561]*	[3.09818]*
R-squared	0.367427	0.477205	0.396050	0.325496
F-statistic	2.032954	3.194781	2.295182	1.688998
Akaike AIC	-4.036939	-3.102687	2.598310	7.739691
Schwarz SC	-3.599655	-2.665403	3.035593	8.176975

*Source- Calculated by author, *=significant at 5% level.*

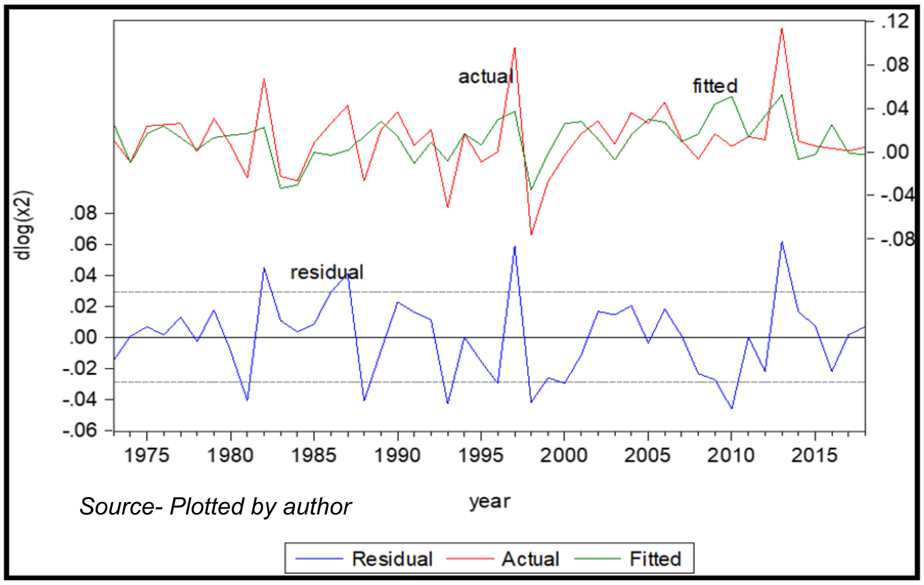


Figure 13: Estimated dlog(x_2)

In Figure 13 the estimated dlog(x_2) is shown where the estimated line has been moving towards equilibrium because cointegrating equation tends to equilibrium.

Both the estimated cointegrating equations which have been found from the system equations are given below where both of them tend to equilibrium, but the first equation is significant and the second equation is insignificant. It indicates that there are long run causalities to global methane emission from square and cube of global GDP per capita in which square of global GDP per capita produces relative decoupling and cube of global GDP per capita produces absolute decoupling.

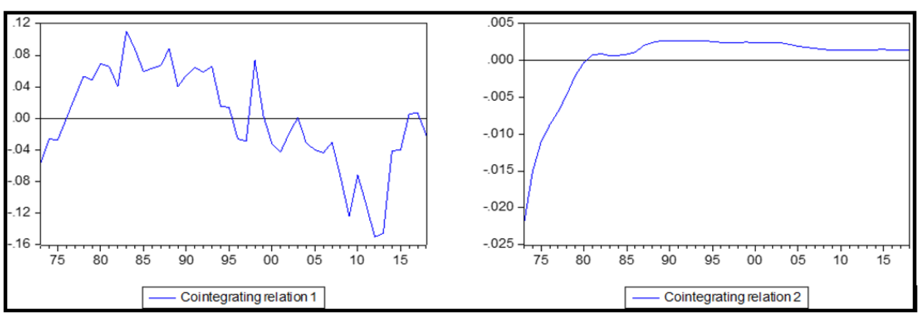
Cointegrating equation 1 $= -0.3175(\log(x_2(-1)) + 0.1289\log(y(-1))^2 - 0.0116\log(y(-1))^3 - 4.058$

$(-2.79)^*$ $(2.91)^*$ $(-3.35)^*$

Cointegrating equation 2 $= -2.734 + \log(y(-1) - 0.1143\log(y(-1))^2 + 0.0043\log(y(-1))^3 - 2.9057$

(-0.914) $(-190.40)^*$ $(92.64)^*$

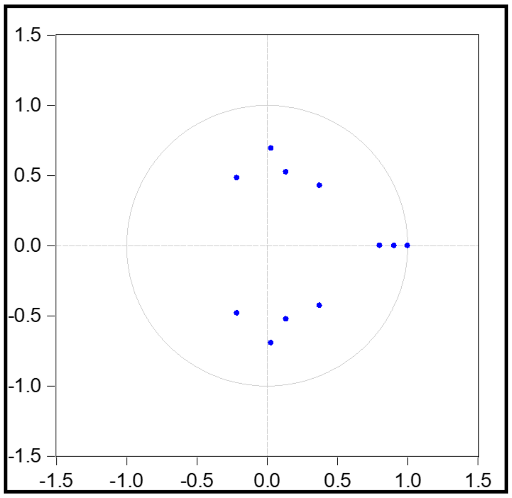
Both the cointegrating equations have been plotted and they are seen as marching towards equilibrium where first one is significant.



Source- Plotted by author

Figure 14: Cointegrating equations

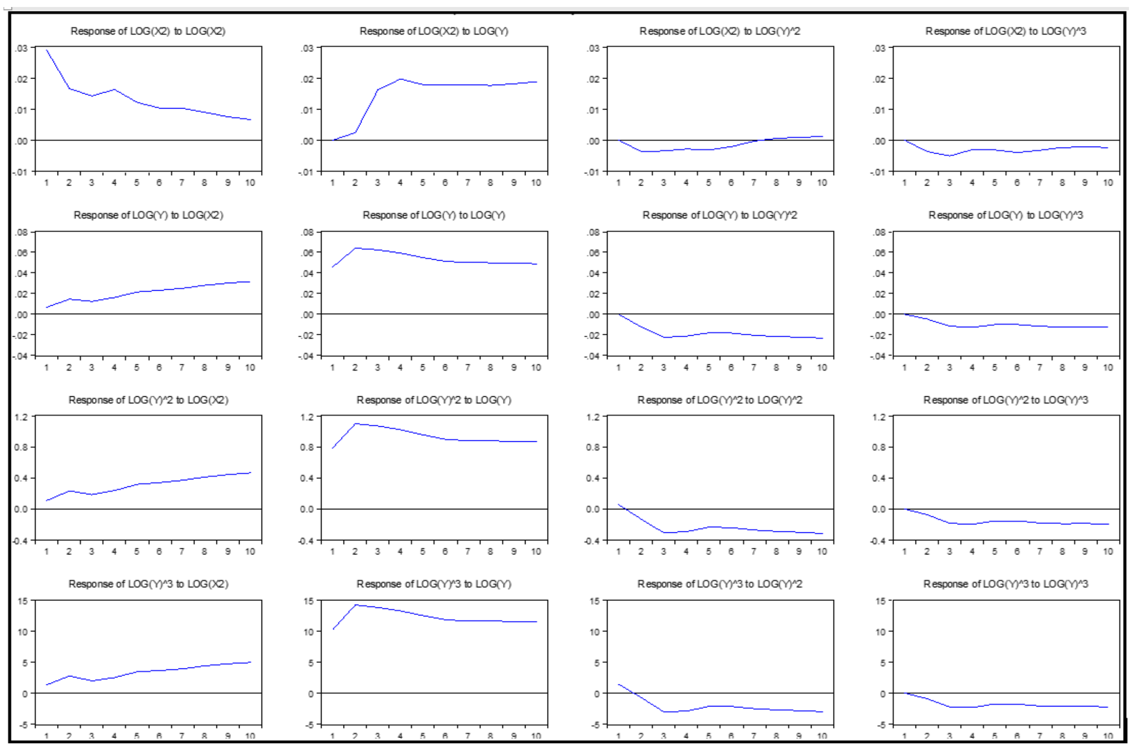
This VECM is a stable and nonstationary model since there is unit root and all roots lie inside or on the unit circle which is shown below.



Source- Plotted by author

Figure 15: Unit circle

In the impulse response functions below, the third and fourth diagram in figure 16 in the first row showed that the response to Cholesky one standard deviation innovation of global methane emission to square and cube of global GDP per capita have been moving to reach equilibrium.



Source- Plotted by author

Figure 16: Impulse response functions

V. Global policy considerations on methane emission

Lowering CH_4 is an alternative to atmospheric CO_2 removal which looks to be necessary for the Paris climate goals. To achieve the target of Paris Climate Change Agreement, U.N. Environment formulated a framework of guiding principles which focussed on cutting methane emissions from natural gas assets. The main objectives of the guiding principles are to [i] reduce methane emissions continually, [ii] advance strong performance across gas value chain, [iii] improve accuracy of methane emissions data, [iv] advocate sound policy and regulations on methane emissions, [v] increase transparency by providing information in external reports.

During the 2019 U. N. Climate Action Sumit, U. N. Environment and the Climate and Clean Air Coalition are looking to set up action on global alliance to cut methane emission for oil and gas sector which target at least 45% reduction of methane by 2025 and to cut 60-75% by 2030 or to a near zero methane intensity target. Even, the European Bank for Reconstruction and Development, the Environmental Defence Fund and the Oil and Gas Climate Initiative target to cut methane emissions by 75%. The Shared Socio-Economic Pathway 1 scenario allows for a low level of SLCPs by 2100 while CCPs must be zero or negative.

The studies of Van Dingenen *et al.*, (2018) estimated that unabated global anthropogenic CH_4 emissions would increase by 35% to 100% within 2050 in the pessimistic scenario or it would rise from 330TgCH_4 yr^{-1} in 2010 to 450-650 Tg CH_4 yr^{-1} by 2050. But the optimistic scenario which targets to reach Paris Agreement goals projected 50% reduction of CH_4 emission amounting to 180-220 TgCH_4 yr^{-1} by 2050. By submitting a project report on behalf of UNECE, Haugland (2019) emphasised that [i] there are uncertainties of methane emission from oil and gas operation where quantification is difficult where Paris Agreement rulebook calls for enhanced national MRV efforts, [ii] enhanced methane emission reductions efforts can emphasise countries' efforts to meet Paris Agreement Targets.

India's CH_4 emission is 20% of all GHG emissions. The University of Bristol has studied that India's methane emission from 2010-2015 has been a little change from the bottom up reporting. The top down atmospheric observations indicated that total annual CH_4 emission from India was 22.0Tg per year which is equivalent to 24 million ton. But bottom up approach may able to find the sources of emissions which are very effective in formulating policies. India can implement three measures at no cost: efficient use of fertiliser, adaption of zero tillage and management of water used in rice irrigation. Even, mitigation measures can be implemented in livestock sources.

Miller and Michalak (2019) estimated that the methane emission from China rose by 1.1±0.4Tg$CH_4$$yr^{-1}$ from 2010 to 2015 culminating in total anthropogenic and natural emissions of 61.5±2.7TgCH_4 in 2015. Coal sector contributes the highest share of 33%.Chinese 12^{th} five year plan specified that coal mine methane utilisation should have been 8.4 billion cubic meter or 5.6TgCH_4 by 2015 which will be 13.2TgCH_4 by 2020. US Environment Protection Agency identified three broad barriers that China would need to overcome to meet its coal mines methane targets which are insufficient infrastructure, inadequate technology and poorly designed policies to reach coal mine methane utilisation targets.

Chinese methane emission rose by 1.1 Tera gram each year from 2010 to 2015 resulting 50% higher level of annual CH_4 emission which is comparable to Russia or Brazil. Ministry of Ecology and Environment organised methane forum where Tsinghua University and Environmental Defence Fund launched methane emission reduction policies to reach the target of climate policy of 2030. Chinese 50% methane emission streaming from energy activity (oil, gas, & coal). China has opportunity to reduce fossil fuel methane emission. China will launch Methane SAT satellite in 2021 to identify, measure and verify fossil fuel methane emission. Liu *et al.*, (2019) studied that China's non-CO_2 GHG emissions from all sources contribute one third of total CO_2 GHG by 2050.It has projected to reduce non-CO_2 GHG by 30% within 2030. The combined mitigation measures can reduce from peak level of 2020 and planned to reduce 870Mt CO_2e by mitigation measures and by implementing current cost -effective non-CO_2 GHG mitigation measures. In coal mining 70% reduction is possible in mitigation of CH_4, waste and waste water contribute 20% reduction of emission by 2050. All are cost effective policies which follow the Paris Agreement Framework where mitigation of methane in agricultural sector may be the greatest challenge.

EPA proposed cost saving measure which would save $97 to $125 million in oil and natural gas industry during 2019-2025. A recent study published in Science found that the US oil and gas industry emits 13 million tonnes of methane from its operations each year which is 60% more than estimated by EPA. Some policies at state level are as follows: In 2014, Colorado found and fixed methane leaks and installed technology to limit or prevent emissions. During 2017, it found that methane leaks fell by 52%. Massachusetts replaced old technologies and fixed methane leaks. California has adopted a novel approach which detected methane leaks from natural pipe lines. Texas and New Mexico considered adopting regulations to cost effective control flaring, venting, and leaks by requiring gas capture at oil well and by preventing them and seeks to promote new technology.

EPA has developed a number of voluntary programmes as part of the Climate Change Action Plan to overcome market barriers and encourage cost effective methane recovery project. In US, total methane emission is projected at 183.7MMTCE by EPA in 2020 in which EPA launched five voluntarily projects to reduce CH4.,i.e. [i] AgSTAR program, [ii] Coalbed Methane Outreach Programme, [iii] Landfill methane outreach programme, [iv] Natural gas STAR programme, [v] Ruminant Livestock Efficiency programme.

According to EPA's 2010 estimate, US methane reduction was possible to 34.8MMTCE (6.1Tg) using the cost market price of $20/TCE for abated methane, then US reduction could reach 50.3MMTCE (8.8Tg) in 2010 which will reach at 47.4 MMTCE in 2020 at the same cost level (USEPA,1999).

Olczak and Piebalgs (2019) explained that methane emission accounted for 11% of total EU-28 GHG emission in 2016. It is declining by 37% since 1990 to 2016, 457 million ton co_2eq was estimated mainly due to reduction in coal mining and anaerobic waste. Contribution of EU to global methane emission declined from 11% in 1990 to 6.4% in 2012 and forecasted to stabilise around 3-5% in 2030-2050. Currently agriculture is the main source of methane emission (237 $MtCO_2eq$) followed by waste management ($124MtCO_2eq$) and energy ($85Mtco_2eq$). European Commission strategy paper in November 1996 for reducing methane emission are as follows.

[1] In agricultural sector, commission suggested measures in two areas: [a] animal manure management and [b] enteric fermentation. Implementation policy consists of two steps, [i] the launch of program at national, regional, and local levels, [ii] introduction of an obligation to install such recovery and use systems at the EU level. [2] In waste sector, proposal include adaption of EU legislation requiring the installation of methane recovery and use system at new and existing landfills. Commission proposed the use of economic incentives to promote recycle products. [3] In energy sector, EU recommended the best available technology for coal mines with 10-years of life span. In Agriculture, gas industry is solving the problem by developing biomethane for injection in its grid. Gas companies have been allowing significant incentives to prevent methane emission. Council attempted gradual reduction of biodegradable municipal waste filled up to 35% by 2016 and by 2020. EU cannot meet its 2030 and 2050 targets nor ensure the success of the Paris agreements without EU methane legislation which will be boon for EU geopolitical outlook as its global market position.

IPCC Special Report on global warming of 1.5°C assured deep reductions in methane emission and black carbon by 35% or more within 2050 relative to 2010. The report also emphasised that 37% methane cut is necessary within 2030 to reach the target of warming below 1.5°C.

CONCLUSION

The paper concludes that the global methane emission has been increasing at the rate of 1.06% per year significantly during 1970-2018. Actually, the trend of global methane emission is cubic in nature. The methane emission contains four upward structural breaks. It has significant cyclical trends of inverse S type in H.P. Filter model. In forecasting ARIMA (10,0,2) model for 2050 it was observed that global methane is stable and nonstationary. Methane emission has been absolutely decoupled from GDP per capita square and relatively decoupled from GDP per capita cube during 1970-2018 significantly which indicate that global methane follows Environmental Kuznets Curve hypothesis. Global methane emission is cointegrated with GDP per capita having two cointegrating equations where cointegrating equation one moves to the equilibrium significantly. Methane emission has long run causality from GDP per capita from 1970 to 2018. GIS and remote sensing technology can determine location, growth and policy implications of methane emission effectively and can project accurately.

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Economic Problem of Child Labour in Rural Odisha: A Case Study in Tangi-choudwar Block of Cuttack District

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ABSTRACT

Migration is an integral part of rural livelihood in Odisha and people move to other aspects. Education, nutrition, primary health care and skill training and Socio-economic are the major issues. Identified child labourers including children migrating from the Gram Issue a show cause notice to every such offending employer directing him to deposit. Child labour is a very common global problem. Magnitude of Child Labour in India, Odisha & Western Odisha. economy and the backward nature of agriculture. Districts belong to Daily wage & agricultural labour. Among 5- 14-year-old the number of children in labour has declined 10% & the number of children in hazardous work by 31%. But there is an alarming increase in child labour in the 15-17 years age group. He emphasised that poverty & poor economic conditions are the main cause of employment of children.

Keywords: Migration, Labourers, Poverty, Poor Economic Condition, Education

INTRODUCTION

Child labour is a global phenomenon. The world recognizes it as a burning problem warranting international attention. Undoubtedly, this increased attention is since child labour has serious social, moral, economic, and demographic implications for children, households, societies, and the world. Therefore, the elimination or reduction of child labour has been the aim of democratic governments in different parts of the world. The problem of child labour has also engaged the minds of jurists, legislators, social thinkers, politicians, economists, and philanthropists from time immemorial. The problem has changed its venues and from public platforms, it has reached the inner circle of legislative, executive, and judicial chambers. It is a universally known that children are the blooming flowers in the garden of society. They are the most valuable assets of the nation and their importance in nation-building process cannot be undermined. Children of today are the potential citizens of tomorrow. The quality of life they enjoy today would ultimately determine the quality of future population of the nation. The children have rights like other human beings, to be respected regarding their integrity, dignity, interest, and opinions. But significantly most of the children in India are deprived of even the basic human rights guaranteed to them, in a civilized society. The Second National Commission on labour in India (2001) also noted that children are the future of the society and economy; and every child should have the opportunity to develop his or her skills and potential to participate both as a citizen and as a worker. The existence of child labour is a slur on a modern welfare state which seeks to promote the all-round development of its citizens. Children are the future hope of the society. They are like buds which need to be properly nursed and well-taken care of so that they bloom fully and grow into able human-beings and contribute their worth to the future development of the society. On the contrary, instead of being sent to schools and properly educated, they are made to work, which amounts to squeezing the bud before it blooms. It not only thwarts the development of children, but of the society as well, since only able citizens can put the society on sound footing.

Meaning of Child Labour

There are basically two arguments on the definition of child labour. The first argument identifies child labour to be work done by children from poor households outside their home/family for a minimal wage. Such a work done by these children and the conditions in which they work are not suited to their young age as it is detrimental to their well-being and safety. Thus, according to this argument child labour is synonymous with exploitation of poor because young children working outside their homes have to work under usurious employers. It is apparent that this definition does not consider work done by children within their home/family as being exploitative. The conventional definition/concept makes a distinction between child-work and child labour. Child labour is perceived to be an economic necessity of poor households and the exploitative aspect in children‘s work is associated with the profit maximizing motive of commercial enterprises, wherein children are made to work long hours, paid low wages and denied opportunities for education. This traditional concept of child labour is also endorsed by International Labour Organization (ILO). As the ILO states, it is not concerned with children helping in family farms or doing household chores'‖ and defines child labour to include children leading permanently adult lives, working long hours for low wages under conditions damaging to their health and physical and mental development, sometimes separated from their families, frequently derived of meaningful educational and training opportunities that could open to them for a better future. The World Bank, on a similar vein, argued that child-work that does not involve an exploitative relationship should be distinguished from child labour. It further argued that in some instances, work done by children within the family may even contribute to the development of the child. Not all child labour is harmful. Many working children who work under the protection of their parents/guardians can derive the benefit in terms of socialization, informal education, and training. The other definition of child labour put forward by groups critical of this conventional definition argued that the issue of child labour is not merely a question of whether work done by a child is exploitative and remunerative or not.

Present Scenario of Child Labour

Every child is a gift of God –a gift must be nurtured with care and affection, with in the family and society. But unfortunately, due to socio-economic and cultural problems, the code of child centeredness was replaced by neglect, abuse, and deprivation, particularly in the poverty afflicted sections of the society.

1. The strategy of progressive elimination of child labour underscores India’s legislative

intent and takes cognizance of the fact that child labour is not an isolated phenomenon that can be tackled without separately taking into account the socio-economic location that is at the root of the problem.

2. While child labour is a complex problem that is basically rooted in poverty.

3. An International Moral Code of Right and Wrong Behaviour said that “human rights and fundamental freedoms are the birth right of all human beings” and as a result such rights may neither be granted nor be taken away legislation.

4. The position of India in terms of child labour is not an appreciable one with a credible estimate ranging from 60 to 115 million, India has the largest number of working children in the world. Whether they are sweating in the heat of stone quarries, working in the fields 16 hours a day, picking rags in the city streets, or hidden away as domestic servants, these children endure miserable and difficult lives.

They earn little and are made to work more. They struggle to make enough to eat and perhaps to help feed their families as well.

Problem of the Child Labour

Child labour and its problems are closely related to the extreme poverty. These children as such contribute to the collection income of the family to fulfil their needs. This is the story of child labour in all the poor developing and underdeveloped countries of Africa and Asia including India. Even after sixty-three years of independence our country has not been able to manage to pay for any reprieve to the poor. The economic policies of India have never been oriented to fulfil the aspirations on people and provide them with the basic needs to survive. That is why child labour and its problems are very much neglected in the country suffer national level. There are many angles to look over these problems including human rights considerations and development of human resources etc. An international pressure has also been growing to disallow child labour in the industry. Child labour is closely associated with poverty. So even though the right to education has a central place in human rights, many poor families are unable to afford school fees or other school costs. The family then sends a child to work to contribute to the household’s income. Children as young as four are forced into factories, and so they miss out on education. But, more than ever today, children need a good quality education and training to acquire the skills necessary to help lift them out of poverty. When children who have had the benefits of education grow up, they are more likely to choose to send their own children to school. So, investing in education is a sound economic decision. Therefore, it is so important for our government to take on more responsibility in aiding poorer countries so they can send their children to school, not a factory. According to a survey of child labour undertaken on orders of the Supreme Court of India, the total number of such labour in India is 5,00,000 as on record. Out of it, Orissa is on top employing 2.15 lakh children in industries.

The Government has recently warned the international organizations and the western countries that in no way the child labour problem be connected with the trade or any other such issues as it is not desirable to compromise over the matter and is considered a challenge to India's autonomy.

1. Child labours are always better than adult workers because they work for longer time and most of the time underpaid, so they are source of cheaper Labour.

2. Education is not very wide spread with all the sections and all the parts of the country so education is one of the biggest problem which helps in neglect the growth of the child labours in India and we have also seen that failure of various educational scheme also added to the increase in the number of child labour.

3. Unemployment and Underemployment of the parents and major members of the family.

4. Use of drugs and alcohols by the parents and the guardian of the child also helps in the increase of the child labour.

5. Homelessness.

6. Widespread poverty in the country.

7. Other problems due to single parenthood, population explosion, traditional occupations and parental attitudes, lack of minimum wages etc.

India, the largest democracy in the world, paradoxically bears the scourge of having tens of millions of child laborers living a life of bondage and slavery. Use of children as laborers is rampant not only in the agriculture sector but also in industries such as match box, leather, carpet, saris, stone quarries, gems cutting and polishing, brick kilns, and many more. These children are denied their fundamental right to childhood, to education, to play and to dream like normal children. According to an authentic report of a UN body, thousands of children have been employed in Italy in a leather industry. While in Portugal, young girls are employed in domestic services and clothing industry. In per cent of the children below 15, are working in miserable bans and more than 30 per cent are employed illegally. In USA, 28 percent of the children are working in inhuman conditions (Joshi, 2005). The child labour has been in employment in all the industries hazardous or non-hazardous.

The existing “Employment of labour (Prohibition and Regulation) Act of 1986” provides for iron of child labour in hazardous industries and hazardous positions and regulates their employment in the non-hazardous The state governments are empowered to determine the hazardous and non-hazardous industries, But the actual position is that all the state governments have not been able to do so as yet.

Causes of Child Labour

Odisha is an economically poor state. Most of the people live in below poverty line and in case of high density all kinds of basic need are not able to meet anybody. The following reason is very much important:

Poverty and family size: In Rourkela, the average family size is six persons. In families where children work, the father often works as either a rickshaw puller or day labourer and the mother as a domestic help. Poverty leads to quarrels, tension and can ultimately result in cruel treatment of children. The mother, being overburdened with work, can lose interest in her children, and neglect them. Without a stable income the children become a burden to parents and must find work for their own survival.

Victims of migration: In general, neglected children migrate to big cities with their families or alone. Often, they must beg or drift on the streets in order to earn a living and will consider any work that helps them survive.

Illiteracy & Ignorance: Many parents of working children are illiterate and unskilled with little prospect of being able to improve their situation. There is a lack of faith in the existing education system as it does not necessarily lead to employment. Many poor parents feel that it is better for their children to learn by working rather than sending them to school presents results on children currently attending school (age 6-17 years) and Children attended before. The percentage of children (6-17 years) currently attending schools varied from 83.1% in Odisha.

The percentage of drop out children (age 6-17 years) is highest in Odisha (14.1%) (Annual Health survey (AHS) 2010-11).

Child labour law and rights: Child labour laws in Rourkela do not protect working children. Employers prefer children as they are cheap, productive, and obedient.

Children working in the industrial sector have no contract of employment and so find it difficult to stand up for themselves and fight for their rights. The demand by factories for child laborers is increasing all the time.

Family breakdown: Migration of families, broken families, parental abuse and abandonment, all lead to child labour.

Natural calamities: Floods, land erosion, cyclones etc, have a devastating effect on many areas of Rourkela every year. This further increases the pressures on poor families and leads to many new children entering the labour force.

Factors Affecting Child Labour

Poverty: Poor families need to keep as many family members working as possible to ensure income security and survival. This makes it very difficult for poor families to invest in their children's education. In fact, educating a child can be a significant financial burden, poverty force parents to send their children to hazardous job.

Over population: limited resource and more mouth to feed, children are employed in various form of work.

Parental illiteracy: illiteracy parents do not realise the need for a proper physical emotional and cognitive development of a child.

Urbanization: MNC’s and expert industries in the developing world employ child workers.

Unemployment of elders: elders often find difficult to get job. The industrialist and factory owners find it profitability to employ children. They will also create union problem.

Orphans: children born out wedlock, children with no parents and relatives, often do not find any one to support them. Thus, they are forced to work for their own living.

LITERATURE REVIEW

The present chapter contains the review of various related studies and the theoretical framework. We have suggested that the incidence of child labour may increase or decrease with income depending on the level of development and the economic relationship between the parents and the child. In this chapter, we begin by discussing the net cost or net economic value of children. Both the money costs as well as the time co-star evaluated and compared at different stages of development. We consider the role of such costs in the household fertility decision. We present a model of household choice. First, we discuss the mathematical model of child demand introduced by Becker which essentially illustrates the case for an advanced stage of development. This is followed by an extension of the model to incorporate child time use to explain the decision faced by households at a lower level of development, where there exists an earnings potential for children. The objective of this chapter is to illustrate the changing valuation of children at different stages of development.

Mishra (2001) examined that Enforcing Ban on Child Labour in India: A Sociologic Perspective between the time periods (2009-2010). The major variable used in income, family size, education, population, attractive towards earn, dislike school etc, the method used in this paper only secondary source form articles and book. He found that a strong positive correlation between parents being ex-child labours and their children being employed. The parent's education level increases the probability of the children being employed decreases.

Gopal Bhargava (2003) has an opinion that children are also engaged in traditional craftworks of the family. The intricate rules governing the existing market for the craft works produced by the children also makes possible exploitation and abuses. In case of family production there will be no wage or other kind of benefits to the children as they are parts of the economic activities of their family. Such kind of labour force is found in almost all kinds of traditional and advanced societies engaged in forming arts and crafts.

Karna (2006) writes psychologically affected child laborers may cultivate negative attitude like ill temper, lying and stealing habits. It may lead to cultivate some bad habits like smoking and drinking etc. Aggression, anti-social behaviour and delinquency etc can be observed among many child laborers. Very few works have been done on the psychological aspect of the child workers and a handful of literature is available on this topic.

Mohapatra & Dash (2011) examined the socio-economic problem of child labour between the time periods (2009-2010). The major variables used in poverty, illiteracy, unemployment, low wages, ignorance, social prejudice, regressive tradition, poor standard of living, backwardness, superstation, low status of women have combined to give birth to the terrible practice of child labour of women have combined to give birth to the terrible practice of child labour. Method used in growth rate sample data through investigation or interview, they found that the migrant's family form various district of Odisha their social economic condition is very poor which make them to go for labour.

Mishra (2001) examined the Child Rights and Situation of Children in Odisha between the time periods 2010-2011. The major variable used income, education, standard of living, lack of education, poverty, and unemployment etc, method used in this paper only secondary data. He found that migrant family and uneducated adults generally send their children to work at an early age.

Objectives of the Study

1. To examine the socio-economic conditions of families of child labours in Cuttack, Odisha.

2. To identify the factors that forces the parents/ family members to send their children to the labour market.

Hypotheses

The study has following hypotheses:

1. Most of the children as domestic servants belong to the socially backward classes.

2. Illiteracy is one of the causes of the child labour. Therefore, most of the children prefer employment than education.

RESEARCH METHODOLOGY

This study uses both primary and secondary data collected from primary and secondary sources. For primary data, working children were directly approached and interviewed industry in Cuttack, Odisha. The present study intends to analyse the socio-economic conditions of child labour as domestic servants in urban areas of Cuttack district. This study is broadly based upon primary data and for this initially a total sample of 40 child domestic workers was taken. But due to non-cooperative attitude of a few children and their parents or due to faulty/incomplete information provided by a few respondents, some of the respondents have been dropped out in final analysis. So, the final sample size comes out to be that of 38 respondents. Random sampling method has been used to collect data and the sample size from each city/town of Cuttack district has been taken proportionately (according to its population). The data has been collected through a comprehensive schedule. Apart from the primary data, secondary data has also been used wherever necessary. To analyse the data, simple averages, percentages, and correlation coefficients have been calculated wherever necessary. Sources of the secondary data used in the study: To study the trend of child labour at global level the data from the global reports of ILO have been used. For analysing the extent and determinants of child labour in India, Odisha and Cuttack district, the sources of the data is Census (1995 to 2011), NSSO (various rounds) and Statistical Abstracts of Odisha (various years). I am going to take 40 respondents of the study area.

Significance of Study

The child labour is still exists today some cause of child exploitation are poverty , lack of education and bottom of feeding, poverty is the main reason for child labour poor family need money to survive and thus need to have as many families members working as possible. This means that their children also have to work as they additional source of income also sometimes in extremely. Child labour was important to factories because the factory could pay them less than an adult for similar work and also the children could fit their hands into small places to fix things or work in which adults could not making them more beneficial.

The Industrial Revolution led to a population increase, but the chances of surviving childhood did not improve throughout the Industrial Revolution (although infant mortality rates were reduced markedly). There was still limited opportunity for education, and children were expected to work. Having children work in this way obviously benefited the family economically, but it also benefited the children by teaching them naturally all the skills they would need as adults.

Child labour only became oppressive when instead of working with their own families, children were sent into factories, mines and mills to work for capitalists who had no care for their safety or wellbeing schooling and literacy became the norm in society, so that any child who was kept away from school was thereby being deprived of vital skills and disadvantaged for their whole lives (UNICEF, 2006).

RESULT AND DISCUSSION

1: Age structure

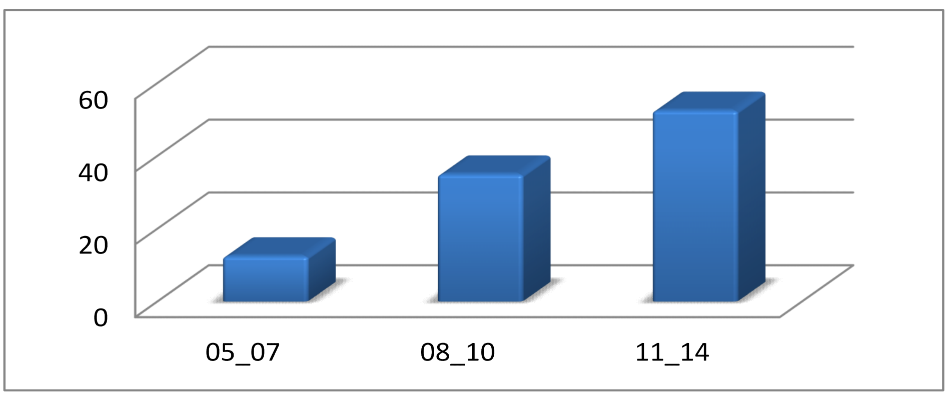
Interpretation

Age not only refers to psychological and physical maturity of man but also an indication of his/her experience. Age plays an important role in shaping personality and values of responsibility to work and to participate in different walks of life. It was against this background that information on age of the respondents was collected.

Table 1: Information on age of the respondents

Age	No. of respondent	Percentage
05-07	5	12.5
08-10	14	35
	21	52.5
Total	40	100

Authors calculation



Authors calculation

Figure 1: Information on age of the respondents

Analysis

As it is clear from the above that 40 respondents 5 are of the age of 5 to 7 years, 14 are of the age of 8 to 10 years, 21 are of the age of 11 to 14 years. That means 12.5% of the age of 5 to 7 years, 35% of the age of 8 to 10 years, and 52.5% of the age of 11 to 14 years.

2. Sex Structure

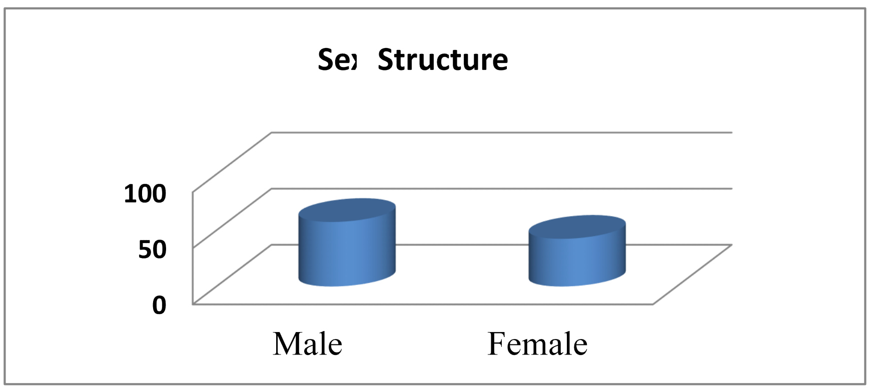
Interpretation

It is clear from the above table that 23 of the respondents are boys and 17 of the respondents are girls.

Table 2: Sex Structure

Sex	No. of children	Percentage
Male	23	57.5
Female	17	42.5
Total	40	100

Authors calculation



Authors calculation

Figure 2: Sex Structure

Analysis

That means 57.5% of the child labourers are boys and 42.5% of the child labourers are girls.

3. Place of work

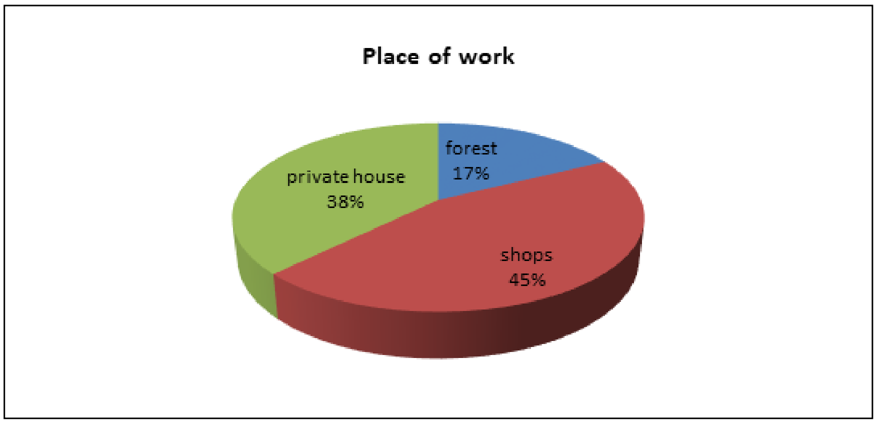
Interpretation

This chart shows that 100 percent of the working children are engaged in different sector. The selected sample is a representation of the total child labour. As far as possible all the different occupation groups are given proportional representation in the sample. The analysis of demonstrates the high presence of child labour among children in the different sector.

Table 3: Place of work

Types of work	No. of children	Percentage
Forest	7	17.5
Shops	18	45
Private house	15	37.5
Total	40	100

Authors calculation



Authors calculation

Figure 3: Place of work

Analysis

The enquiry into the occupational status of the 40 respondents reveals that 15 of the respondents are engaged in the private house, 18 of the respondents are also engaged in the shops and 7 of the respondents are engaged in the forests. That means, 38% are engaged in the private house, 17% in the forests, 45% in the shops.

4. Number of hours

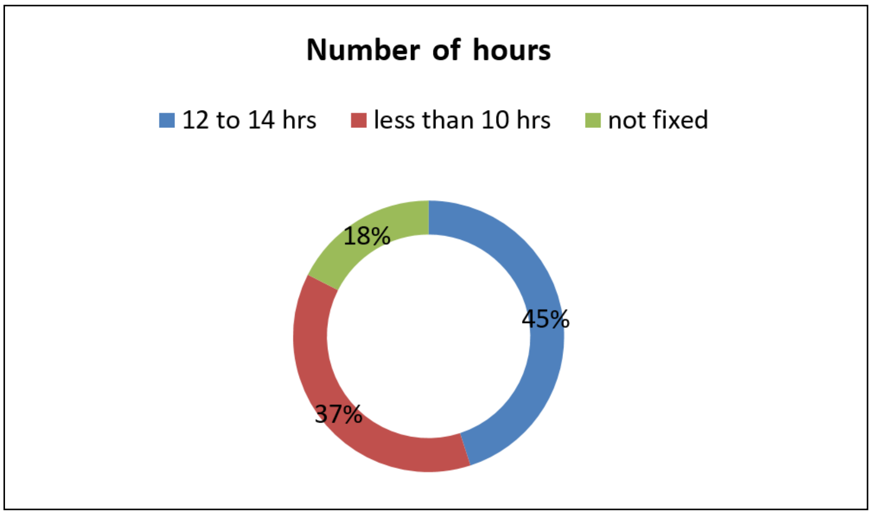
Interpretation

The following table-4 shows the classification of child labours based on their working hours engaged under different occupation. Working hours mean the time duration in which the employees in the establishment are at the disposal of the employer exclusive of any interval allowed for rest and meals.

Table 4: Number of hours

Number of hours	No. of children	Percentage
12 to 14 hours	18	45
Less than 10 hours	15	37.5
Not fixed	7	17.5
Total	40	100

Authors calculation



Authors calculation

Figure 4: Number of Hours

Analysis

The study shows that out of 40 respondents 18 are working 12 to 14 hours, 15 are working less than 10 hours, 7 are working not fixed. That means 45% 12 to 14 hours, 37% less than 10 hours, 18% not fixed the time. This shows that most child labours (45%) are working 12 to 14 hours. As in study a majority of child labour (45%) are shop workers, hence they work 12 to 14 hours. The rest of respondent who work in forest and private houses, they work less than 10 hours. Mostly the children who work in totals do not have a fixed working hour.

5. Income Structure

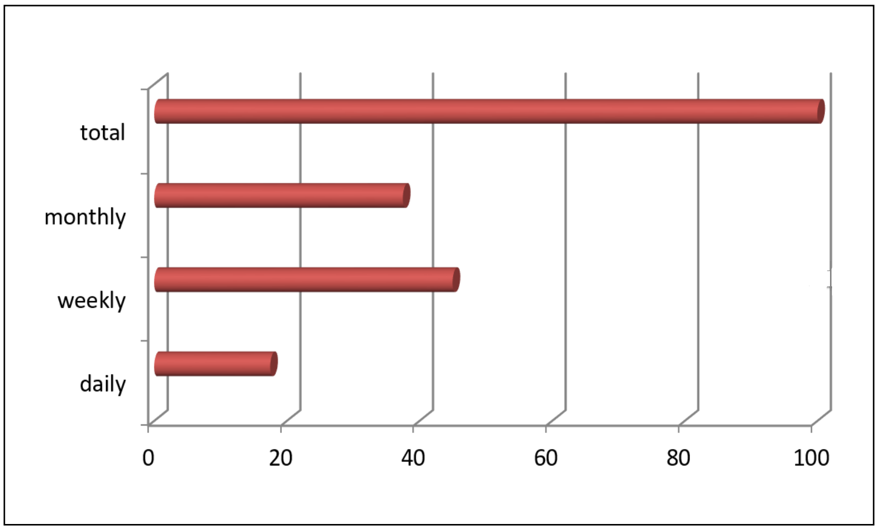
Interpretation

Moreover, number of holidays is not usually fixed. The respondents revealed that sometimes their wages are deducted if they take leave. The children working in some private houses get weekly wages, while some children working in shops get daily wages.

Table 5: Income Structure

Nature of Income	No. of children	Percentage
Daily	7	17.5
Weekly	18	45
Monthly	15	37.5
Total	40	100

Authors calculation



Authors calculation

Figure 5: Income structure

Analysis

Out of 40 child labours, 7 is paid daily, 18 are paid on weekly basis and 15 are paid on monthly basis. That means 17.5% respondents a daily basis, 45 % respondents paid on weekly basis and 37.5% respondents paid on monthly basis. This shows that most of the respondents (45%) get weekly basis.

6. Reason for working

Interpretation

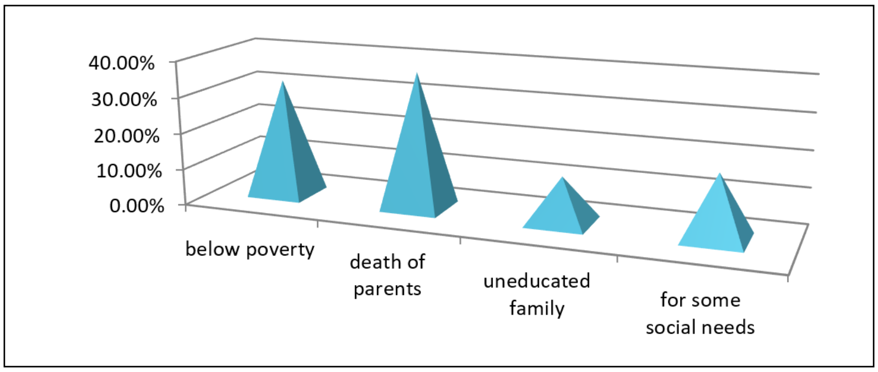
The study tried to find out the various reasons because of wages children below 15 years of age are working as labourers.

Below 10 years out of 40 children 13 are working our poverty, 15 are death of parents, and 5 are parents unable to provide education, 7 are for some social needs.

Table 6: Reason for working

Reason of working	No. of children	Percentage
Below poverty	13	32.5
Death of parents	15	37.5
Uneducated family	5	12.5
For some social needs	7	17.5
Total	40	100

Authors calculation



Authors calculation

Figure 6: Reason for working

Analysis

That means 32.5% are working our poverty, 37.5% are death of parents, 12.5% parents unable to provide education, 17.5% for some social needs. This shows that most of the child labours are complete to work at all early age due to death of parents (37.5%). The second important cause is the below poverty.

7. Attending school

Interpretation

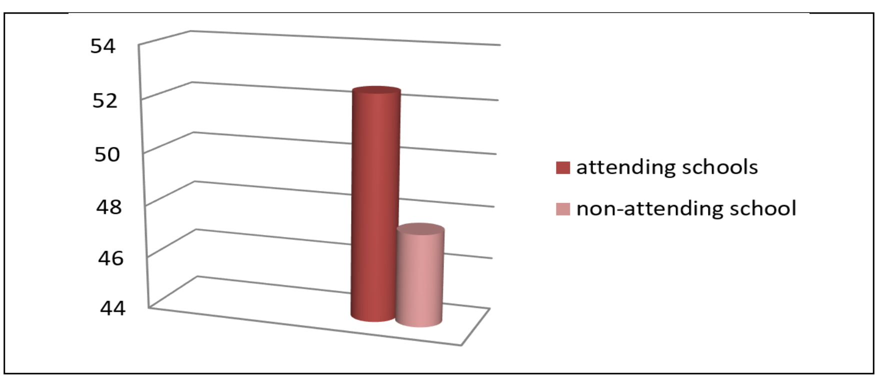
Some of the child labours along with the work have been enrol in the schools.

Before there working hour some of the children attended the primary school in our locality. The study shows, out of the 40 respondents of 21 for attending school and 19 for non-attending as school.

Table 7: Attending school

Category	No. of children	Percentage
Attending schools	21	52.5
Non -attending schools	19	47.5
Total	40	100

Authors calculation



Authors calculation

Figure 7: Attending school

Analysis

That means 52.5% are attending school and 47.5% are non-attending school. Thus, most of the respondent (52.5%) have been enrol and 47.5% have been not non-enrol the school.

8. Reason for not going to school

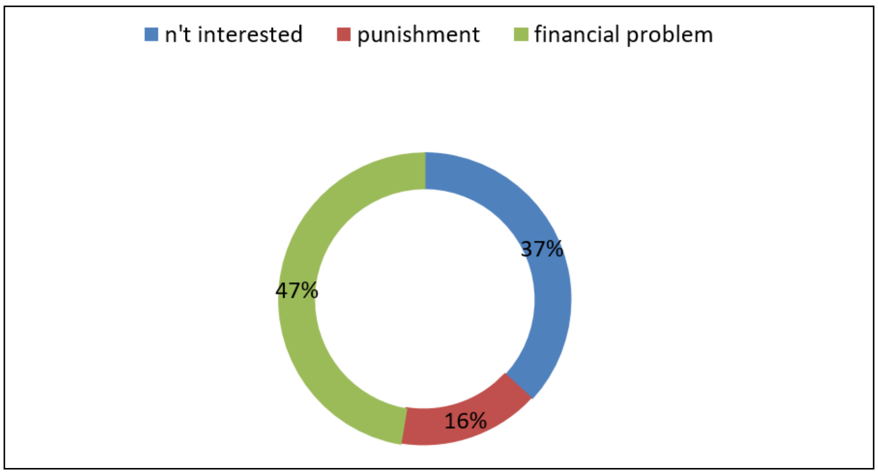
Interpretation

Out of the 19 respondents who have not going to school, it was found that 7 are not going because they are not interested, 3 are not going as their afraid of punishment and 9 are not going due to financial problem.

Table 8: Reasons for not going to school

Reasons	No. of children	Percentage
Not interested	7	36.84
Punishment	3	15.78
Financial problem	9	47.36
Total	19	100

Authors calculation



Authors calculation

Figure 8: Reasons for not going to school

Analysis

This means, that 37% are not interested in study, 16% are not going as of punishment and 47% are not going due to financial problem. Thus, lack of finance is the most important reason (47%) because of which the children working as child labour are unable to attend the school. Moreover 37% of the children are not at all interested to go to school.

9. Heard about child rights

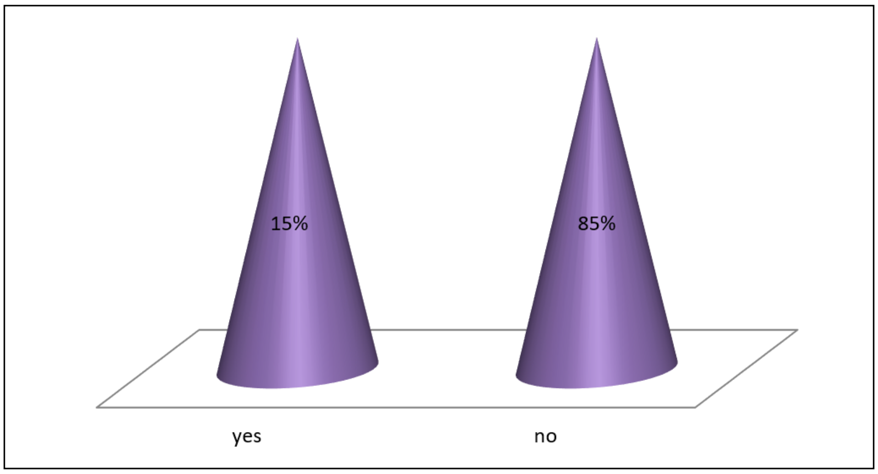
Interpretation

From the table we concluded that 6 respondents are aware of child rights and rest 34 respondents do not aware of child rights.

Table 9: Heard about child rights

Category	No. of children	Percentage
Yes	6	15
No	34	85
Total	40	100

Authors calculation



Authors calculation

Figure 9: Heard about child rights

Analysis

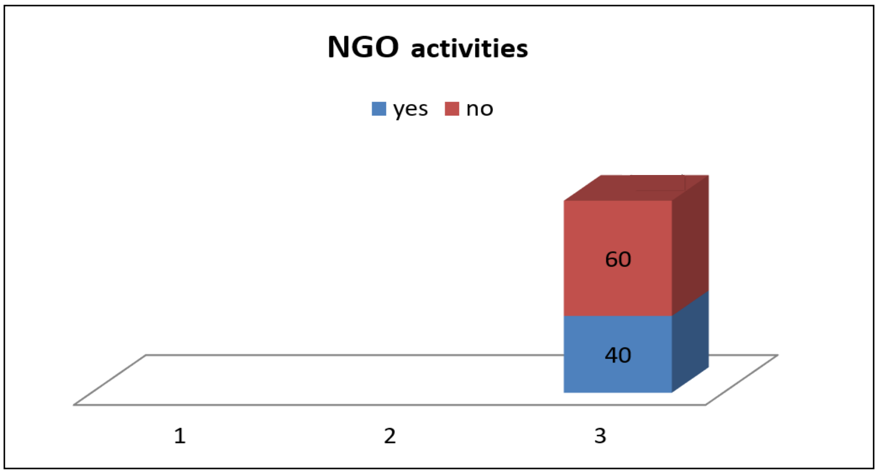
15% respondents are aware of child rights and 85% respondents do not aware of child rights. So, from the table we can depict that maximum number of respondents does not know about child rights.

10. NGO activities

Table 10: NGO activities

Category	No. of children	Percentage
Yes	16	40
No	24	60
Total	40	100

Authors calculation



Authors calculation

Figure 10: NGO activities

Analysis

It was found that some of the children (40%) have been helped by various NGOs who have provide them with study materials, given medicine and taught them from time to time at their locality. But around 60% have not been helped by any NGOs in any way.

11. Access to Hospital

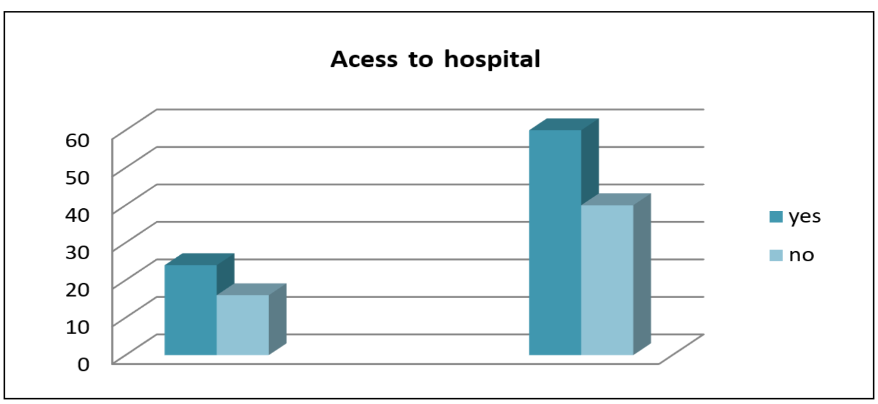
Interpretation

From the table we can conclude that 24 respondents so have access to hospitals and 16 respondents do not have hospital facilities.

Table 11: Access to Hospital

Category	No. of children	Percentage
Yes	24	60
No	16	40
Total	40	100

Authors calculation



Authors calculation

Figure 11: Access to Hospital

Analysis

Most of them (60%) have access to hospital as a government hospital is available in the study area. Still (40%) of the respondents do not go to the hospitals most of the time.

12. Reasons for not going to Hospital

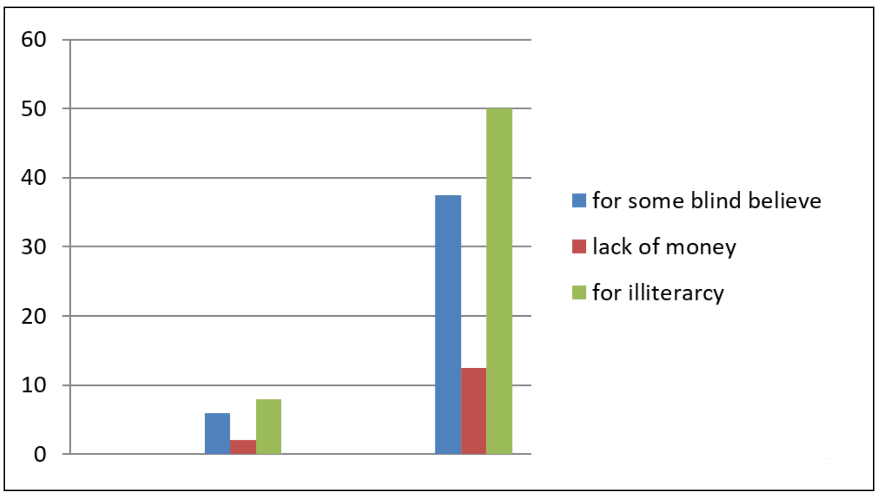
Interpretation

Out of the 16 respondents who have not going to hospital, it was found that 8 respondents for illiteracy, 2 respondents for lack of money and 6 respondents for some blinds believe.

Table 12: Reasons for not going to Hospital

Category	No. of children	Percentage
For some blinds believe	6	37.5
Lack of money	2	12.5
For illiteracy	8	50
Total	16	100

Authors calculation



Authors calculation

Figure 12: Reasons for not going to Hospital

Analysis

50% respondents for illiterate, 12.5% for lack of money, 37.5% for some blinds believe.

CONCLUSION

From the investigation the family members and their parents are send their children from the tender age to earn. But it some case children are from small family, but due to the death of the parents, they earn for the family from the very small age. To earn some children are migrating to this city, but there is a basis fact which may be noted in this study is that children do not get proper care and attention at their home. Financial problems and large size of family are responsible for not getting proper care, love, and attention. Child labour engaged in private house and hotels get food from their employers but children in grocery shops and the auto mobiles worm shops etc do not get food from their employers. The major content of their food is rice. Thus, most of the child labourers (45%) in the study are workers as assistants in shops, (37.5%) are private house workers.

This shows that most child labours (45%) are working 12 to 14 hours. As in study a majority of child labour (45%) are shop workers, hence they work 12 to 14 hours. The rest of respondent who works in private houses work less than 10 hours, who work in forests have no fixed time. Moreover, number of holidays is not usually fixed. The respondents revealed that sometimes their wages are deducted if they take leave. The children working in shops get weekly wages, while some children working in forests get daily wages. Thus, most of the respondents (52.5%) have been enrol the school and (47.5%) have been not enrol the school. Thus, financial problem is the most important reason (47.36%) because of which that children working as child labour are unable to attend the school. Moreover (36.84%) of the children are not at all interested to go to school.

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In Looking Into an Energy Efficient Method to Reduce Carbon Emissions

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ABSTRACT

"There is too much data today and there will be too much in the future by a factor of thousand."

— Benn Hoffman, CEO, Movmento

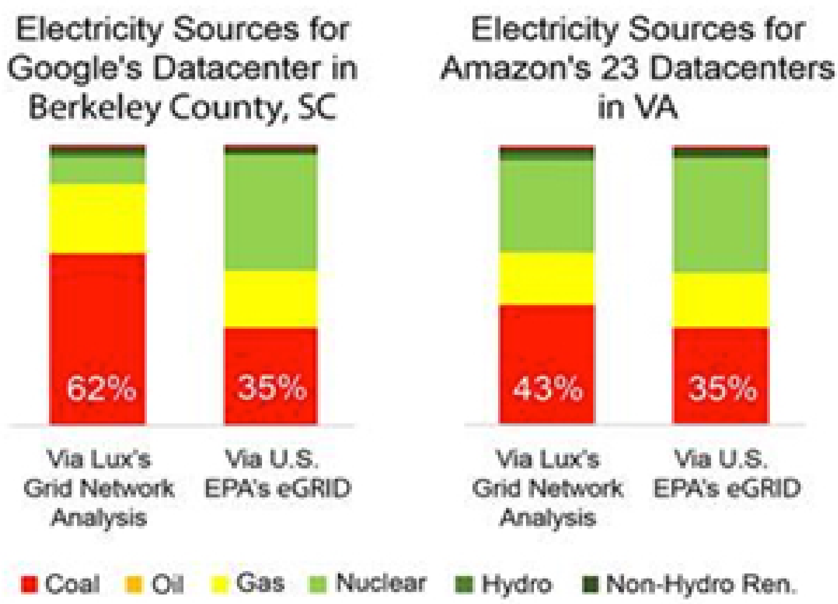
Data is becoming an integral part of our life, and with such growth of data storing them is a new concern, and Cloud Computing is one of the solutions to this problem. With more and more usage of this technology, carbon emissions have grown to be a huge part and reduction is very necessary. With such growth in data we need both technical infrastructures like a data center to store these data and a suitable, abundant, reliable power supply to keep the work operational. The modern concept of Smart City is glooming - it reduces the resource consumption, but it creates a huge amount of data. We know that data center consists of set of servers and various resources that should be available to the consumer on demand. The continuous use of such a data center leads to high carbon emissions and a consequential destruction of our environment without our knowledge. In this paper, we propose an algorithm to reduce carbon emissions at the data center. The proposed algorithm reduces the carbon emissions intensity by load balancing the input jobs and proper scheduling thereby allowing us to improve server efficiency in instruction handling. The algorithm is based on optimal usage of the data center and correctly choosing the server to assign a work for best performance scenario. There are various heterogeneous servers in a particular data center; thus, choosing a high efficiency server for a job which has lower number of instructions (instructions are the files or any task which we upload in the cloud for our need gets converted into instructions as per the size or complexity of the file. Then those instructions are processed by the VM's.) will result in wastage of power and energy and this scenario is commonly called the 'worst case scenario'. Thus, our algorithm will check and work in such a manner that the server with a similar workload is assigned to the job in line with the instructions which is at the place. By introducing this technique, the chance of a worst-case scenario arising will be lowered and subsequently, there will be a rise of both the 'average' and the 'best case scenario'. Thus, power consumption will be capped and there will be lower carbon emissions leading to a relatively cleaner environment.

Keywords: Data Center, Load Balancing, Carbon Emission, Resource Availability

INTRODUCTION

The outburst of data usage has now led to rise of new data centers. Currently, these data centers are facing a problem of carbon footprint generation. Most of the organisation in the industrial market is well known about the advantages of the data center but they are least concerned about the negative impact on the environment through carbon emissions. In the modern time the largest consumer of electrical energy are the data centers. This data centers consume near about 1.5 to 2 percent of the power of the total energy produced in the country which costs some billion dollars. In modern times, governments across the globe are making government data centers to build their own energy efficient infrastructure to put a cap on the level of carbon emissions. The carbon footprint is completely based on energy consumed in data centers.

From figure 1, we can see that carbon emission from various sources by leading cloud service providers such as Google and Amazon in 2018. Among all the power sources, coal is the primary source for both the providers in the US. This clearly shows that carbon footprint is quite high at these data centers (see the coal % in Figure 1). The carbon footprint can be reduced by properly measuring power consumption. There are three major factors that have their impact on data center's power consumption namely, Data Center Location, IT Load, and Electrical efficiency (Boel & van Schuppen, 1989; Hajek, 1990).



Source: Compiled from the database of EPA's Emissions & Generation Resource Integrated Database, eGRID

Figure 1: Carbon Emission from various sources by leading cloud service providers

Carbon Footprint:

In the above context, we have used the word “Carbon Footprint” a many time. “Carbon Footprint” is defined as — total set of greenhouse gas emissions caused by an individual or organization or community. The major constituent gases in the carbon footprint are Carbon dioxide (CO_2) and methane (CH_4) and these gases are mostly responsible for “Global Warming”. As carbon footprint calculation involves a lot of factors, thus we cannot calculate the accurate levels of carbon emissions. In the case of data center, the carbon footprint of a data center is the carbon emission equivalent to the total amount of electricity a data center consumes. Geographical locations also play a key role on the impact because data centers located at regions having access to hydro, nuclear, and wind power have low carbon footprint because carbon emission is low compared to data centers located in areas where fossil fuel based resources like coal, natural gas, and oil are in use.

Peaker Plant:

Peaker plants also called as peakers are those plants that generally run where there is a high demand of electricity. These plants are coal fired where CO_2 emission is high. As they supply power only occasionally, they charge much higher prices than base load power per kilowatt. Peak hours are formed depending on the location, but it is generally morning or late afternoon. A peaker plant may operate many hours a day or few hours per year, depending on the condition of the regions electric grid. The equipment and fuel used in peaker plants are different from the ones in base load power plant.

Avoided Emissions:

When the use of electricity is being optimized in an organization, there is a significant dip in the power usage. Thus, a dip in utility power or power usage leads to lower carbon emissions. When changes made regarding electrical consumption eventually results in demand on the utility power being lower — it leads to avoiding of carbon emissions, thus, reducing carbon footprints.

Carbon dioxide (CO_2):

Carbon dioxide (CO_2) is a greenhouse gas because it traps energy from the sun and keeps the earth at livable conditions. But increase in atmospheric CO_2 associated with human activities can increase problems. The carbon dioxide emission is linked with every part of the data center from the manufacturing of servers to other components until they are disposed of. This aspect of carbon emissions is termed as "embedded carbon".

(A) Comparison between Data Centers and Office Buildings in terms of carbon emission:

The amount of energy that is being consumed by Data Centers and Office Buildings are different. Data center requires huge amounts of power for working and cooling off compared to less power usage in case of commercial buildings. On the other hand, the operational life cycle, of an office building, which is the life cycle of a product from its first stage i.e. conceptualization to its last stage of product delivery, is more than the data center.

Embedded Carbon:

Every server's manufacturing and delivery process would add to the carbon footprint of the data center hosting that server which includes many factors like water consumption for cooling, electrical consumption, smokestack operation, and employee transportation. Government is concerned about global warming and assigned that all corporations be assigned a carbon allocation. Violating the rules leads to fines and penalties. The carbon footprint measurement would account for all processes and purchases within an organization. To know the impact of the data center's electrical consumption on carbon footprint it is important to understand how a utility is tasked with supplying energy (Allan, Farkas & Mansfield, 2012).

The different power supply sources are coal, natural gas, oil, nuclear reactor, hydroelectric, tides, and wind farms. The energy sources that the utility employs to fuel generation of electricity are important in calculating the carbon footprint. The type of fossil fuel burnt by the utility also plays a major role as coal has very high carbon content per unit energy released. For the unit of power from the utility, three times the amount of carbon is produced during the process of converting the fuel into electricity and delivering the electricity to the site.

One of the biggest challenges while reducing the data center's electrical consumption is to link data center's activities to that of electrical use. Data centers consumption is based on IT and infrastructural loads or when cooling system removes heat from the data center to maintain optimum temperature. The fuel or energy used to generate electricity is the most significant factor affecting the year to year change in CO_2 emissions. The emission can be reduced by using nuclear, hydroelectric, and renewable source of energy. As previously mentioned, the three factors influencing carbon footprint in a data center are namely, Location, IT Load, Electrical Efficiency.

(i) Location:

Geographical locations with high temperature and humidity level will tend to consume more energy to cool down the infrastructure and restore it back to working condition. A data center's location has a major impact on "avoided emissions". Data Centers having its major power source as nuclear reactor has low carbon footprint in comparison to data centers having coal as major source of power having high carbon footprint.

(ii) IT Load:

IT load defines the power consumed by the IT equipment in the data centers. IT load consists of all the IT architecture that makes up the business-like servers, routers, storage devices, etc. The carbon footprint depends on the load over IT infrastructure.

(iii) Electrical Efficiency:

The traditional practice of oversizing infrastructure to support the IT load also has a negative impact data center efficiency. Oversizing results in underutilization of equipment and resources are wasted and which in turn increase the carbon footprint. The data centers should plan for the software which allow them to predict more accurate data center capacities and data center power consumption. There are certain tools which help to calculate the carbon footprint of a data center by considering many factors into consideration which is defined in the section 1.2. Using these tools, we can get an estimated carbon footprint in our data center. However, these tools do not consider embedded carbon.

(B) Power Estimating Tools:

The power in data center can be divided broadly into two parts namely, static power and dynamic power. The metrics can be measured by using the following tools as in Table 1.

Data Center Power Sizing Calculator:

It defines basic characteristics of IT load and how much utility power is required to support that load. The tools generate values based on characteristics of IT infrastructure (Xu, Pang & Fu, 2013).

Data Center Efficiency Calculator:

It calculates resulting efficiency and the electrical cost based on key characteristics of data center. The user input is power and cooling infrastructure details and results are calculated based on a tested and validated four parameter efficiency model (Lenhardt, Chen & Schiffmann, 2015).

IT Carbon and Energy Allocation Calculator:

It calculates the allocated carbon emission and energy cost to the data centers' users. The goal is to make users aware of energy cost and encourages them to use energy saving approaches like virtualization and server retirement.

Data Center Carbon Calculator:

It calculates the "green" characteristics of a data center by converting energy usage rates into carbon emissions. The basic parameters of "green computing" are to switch off the computer and other peripherals during a period of inactivity. Basically, follow measures to reduce the electric power consumption (Duan & Yang, 2017; Jiang *et al.*, 2016). These four tools work together with the output from one tool is input to the other tool.

Table 1: Power Estimating Tools

TOOL	**User Input**	**Tool Output**
Power Sizing	1.Number of Servers 2.Server Characteristics 3.Storage Characteristics 4.Design Attributes	IT Load KW
Efficiency Calculator	1.Power Capacity 2.Local electricity rate 3.Physical Infrastructure	Energy Efficiency and Annual electrical Cost.
Carbon Calculator	1.IT Load KW 2.Geographical Location	**Data Center Carbon Footprint** and avoided emissions.
Carbon and Energy Allocation Calculator	1.Energy Efficiency 2.IT load in KW 3.Geographical Location	**Yearly energy cost per server.** Yearly carbon per server.

Authors own

1. Related Works

Energy efficient scheduling of tasks has been into research work for quite long time and many researchers have done their research works in that module. Jacob Leverich proposed a strategy of selecting a part of physical machines in Hadoop Cluster to execute the tasks while powering down other ones to reduce the power consumption. However, Willis Lang proposed the use of all physical machines to run the workload and hence, powering them simultaneously can save more energy. In what is stated, both the methods can't work well if workloads are data intensive, i.e. it's a class of parallel computing which process large volume of data parallel, because powering down some physical machines will result in data unavailability while using all at one will cause data migration, it is a process to transfer data from one cloud to other cloud. A replication scheme named Chained de-clustering was introduced to ensure data available when powering down physical machine in a cluster and it also guaranteed load balance between the active machines. As the replication scheme is based on powering down physical machine and load balance, it is not well suited for deployed clusters. Considering the energy consumption during both execution time and idle periods, powering down fractional machines is an accepted method to make cluster energy efficient (Duan & Yang, 2017; Jiang *et al.*, 2016).

Virtualization is widely used in cloud computing to fully utilize the resources and improve the performance. Various VM scheduling methods have been proposed to dynamically allocate and consolidate the VMs into the cloud computing environment. The allocation algorithm can be divided into two parts namely, Allocating VMs onto PMs and assigning PMs onto VMs. The consolidation is mainly achieved by VM migrations (Boel & van Schuppen, 1989). It needs to be noted that energy consumption was not considered in traditional VM scheduling in cloud computing.

Energy efficient VM scheduling in data centers mainly focuses on fully utilizing each physical machine to reduce energy consumption. They take a physical machine as a whole and formula used is:

$$P = P_{idle} + (P_{max} - P_{idle}) \times u$$

This is used to compute the power of each node, where:

u = Utilisation of a physical node

P_{max} = Peak Power of Node

P_{idle} = Ideal Power of Node

This is an experimental formula and has been tested in many test data centers for a period of long time (Doyle, Shorten, & O'Mahony, 2013). It is the simplest way to estimate the total energy consumption of data center using this formula but may be not optimal solution for the computation intensive VMs as the powers fluctuate constantly. It is reported that we can save energy via proper VM scheduling energy efficient virtual machine; scheduling is often viewed as an allocation or mapping problem, which is an optimization problem.

2. Problem Definition

There are two main challenges for energy efficient VM scheduling in cloud environment — first, heterogeneous PMs and second, practical energy consumption of the PMs. The assumption of homogeneous PMs is often adopted in energy efficient VM scheduling in cloud computing, which is not actual in practice. The energy of processors is often used to replace the energy of PMs for scheduling of computation intensive VMs; the energy can be easily lowered in the processors, but it doesn't imply that subsequently there will a lowering of energy usage in PMs; as the data center consists heterogeneous construction of PMs, it's difficult to optimize the power consumption when compared with the way it's done for a processor (Chen & Li, 2015).

In addition, modern hardware provides some opportunities to save energy. The most popular technology is DVFS, which is used in almost all the processors nowadays. DVFS technology provides the finer grain of controlling the power of processors, which results in another way to reduce the energy consumption of the cloud. However, it is adopted in only few research on energy efficient scheduling of VMs in cloud (Moharir, Sanghavi, & Shakkottai, 2013).

RESEARCH METHODOLOGY

This section provides proposed algorithms that can ensure the following objectives to reduce the power consumption and increase the resource availability.

- Design the power model and physical machine model to develop an energy efficient virtual machine scheduling algorithm.
- Develop the virtual machine scheduler to reduce the amount of energy and developing an algorithm to reduce the cooling power.
- We define an optimal power performance ratio to weight hybrid machines at data center.
- Performance can be analyzed using various power estimating tools to measure the carbon footprint.

In this case, we assume that we know all the instructions beforehand and we can arrange our VM accordingly at a point of time. To reduce the carbon footprint of data center, we need to reduce the power consumption while performing the consumer requests that get uploaded. This provides an immense benefit to data center and environment. As we know that data center is a pool of server, where consumer jobs can be executed on virtual machines. The sever computation time can be measured by number of cores and for each virtual machine there is a set of cores.

Server Computation

=(Frequency of the VM)×(VM's available)×(Number of cores)

where, core is defined as the number of separate processors present in VM;

Power consumption of a server can be divided into two types: Static and dynamic power consumption.

$$P_S = P_{Static} + P_{Dynamic}$$

Here, P_S is total physical server energy consumption. P_{Static} is a leakage power of server and $P_{Dynamic}$ is dynamic power consumption? The $P_{Dynamic}$ can be derived as

$$P_{Dynamic} = sCV^2 f$$

Where, s is switching activity, C capacitance of server, V is voltage and f is operating frequency. Power consumption of virtual machine can be:

$$P_{VM_i} = P_{VM_i}^{CPU} + P_{VM_i}^{Memory} + P_{VM_i}^{I/O} + P_{VM_i}^{Disk}$$

Virtual machine power model can be

$$P_S = P_{Static} + \sum\nolimits_{i=1}^{n} P_{VM_i}$$

The numbers of cores are running at Time t_i can measured as a utilization of the server. If the server is performing at its maximum capacity, then it can consume more power than normal.

Table 2: Meaning of the variables used in proposed algorithm

Algorithm: Weight Calculation or Approximation

Input: $Task\ of\ t_i\ of\ Job\ J$ $S\ receives\ job\ from\ VMM$	Output: $Ws\ for\ VM\ allocation$

1. $Search\ for\ S$
2. $Best\ server$:

$$W_s = \frac{Freq_s * \frac{(AR - AIR)}{Total_r} * No.of\ cores}{\sum_{i=0}^{n} PUE}\ \text{where, AR = weight of previous server, AIR}$$
$$= \text{weight of current server, PUE = total computation time required}$$

3. $Sort\ S_i\ in\ decreasing\ W_s$
4. $if\ (J_s > WS_1)$

4.1 $WC\ (WS_1\ and\ WS_n)$

$else\ if\ (J_s < WS_1)$

4.2 $Comp\ \ until\ Sb$

else

4.3 $WK\ WS_1$

Authors own

Variable	Meaning
S	Server
S_i	Available Server
W_s	Weight of Server
T_i	Task of Job "J"
J_s	Job Size
N	Number of Servers

WS_1	First Server
WS_n	Last/ n^{th} Server
WC	Work Combined
Comp	Compare with other servers
S_b	Appropriate Server
WK	Work With

State Model:

There are three states of the server namely,

a. Sleep State

The sleep state is the state of the server in which the server is not in working absolutely. Its entire capacity is not being in use and the server does not consume any kind of power in the dynamic power. Not a single part of its instruction/second capacity is in use (Hui & Chanson, 1999).

b. Ideal State

The ideal state of the server is defined when the server is working partially, like some of its instruction/second capacity is in use by some job assigned. For example, a server of 15k instruction/second capacity is there and a job of 12k instruction is assigned to it; thus, in this condition 3k instruction/second is excess; this state is called the ideal state (Duan & Yang, 2017).

c. Running State

The running state of the server is defined when the total capacity of the server is being in use. That is its total capacity of instruction/sec is in use. For example, a server is there of 5k instruction/sec capacity and a job of 5k instruction/sec is assigned and thus, its total capacity is in running; thus, it's called running state.

There are also two kinds of power types namely,

(a) Static Power

The fraction of the power consumed that is independent of any activity is called static power. The static power is made of leakage power and standby power. The leakage power comes by the power consumed by the transistors in off state as the transistor in reverse biased mode. Similarly, the leakage power comes from the constant current from Vdd to ground. The static power is consumed in the absence of any kind of design activity. Static Power remains constant all through the three states namely, Sleep State, Ideal State, and Running State.

(b) Dynamic Power

In the total power consumption model there are two parts, one is static, and the other is dynamic power model. The dynamic power consumption is made by the circuit activity in a model. The circuit activity consists of the activities of transistor switches, change of value in register etc. The source point of the dynamic power consumption is short-circuiting current and switched capacitance.

One of the major sources of dynamic power is switched capacitance; thus, it can be defined as

$$P_{Dynamic} = sCV^2f$$

Where *s* is switching activity, *C* capacitance of server, *V* is voltage and *f* is operating frequency.

The values of these power sources are determined by low-level system design. And reduction in this model is called Dynamic Voltage and Frequency Scaling (DVFS). Here, power is consumed for ideal and running states.

Best Case, Average Case, and Worst-Case Scenario:

Let, in a data center we have 10 servers with different instruction per second of working capacity. As the servers have different capacities, they are heterogeneous in nature.

Let we have servers with capacities in Table 3:

Table 3: Servers with Capacities

10k instruction/second
15k instruction/second
5k instruction/second
1 Lac instruction/second
1k instruction/second
80k instruction/second
45k instruction/second
22k instruction/second
14k instruction/second
64k instruction/second

Authors own

As per our proposed algorithm they are arranged in decreased order of capacity in Table 4: New order:

Table 4: Servers with Capacities after applying our algorithm

1 lac instruction/second
80k instruction/second
64k instruction/second
45k instruction/second
22k instruction/second
15k instruction/second
14k instruction/second
10k instruction/second
5k instruction/second
1k instruction/second

Authors own

All the servers are arranged in a circular queue in the decreasing order of their capacities. The decreasing order is taken in clockwise sense.

The first and the last server are connected (i.e. 1k instruction/second and 1 lac instruction/second server) as the special feature of our model. Similarly, all the following servers are connected next to the one in line (2 to 3, 3 to 4, so on) (Chou & Abraham, 1982).

Now,

- A new job of 12k instruction/second comes first, it's compared to the working capacities of 1 lac instruction/second server, but here a lot if instruction/second will be wasted as it will only consume 12k instruction/second and the rest 88k instruction/second will be lost; thus, it's assigned to the 15k instruction/second server.
- Next a 6k instruction/second job comes and its assigned in the queue, it is assigned combining 5k instruction/second and 1k instruction/second server, as combining them gives the required machine capacity to accommodate 6k instruction job.
- Then 16k job comes from here, now the 14k instruction/seconds server is combined with the remaining instruction from the 15k instruction/second server. Earlier, the given 12k instruction/second is assigned and the 3k instruction/second is excess and the 2k instruction/second is combined with the

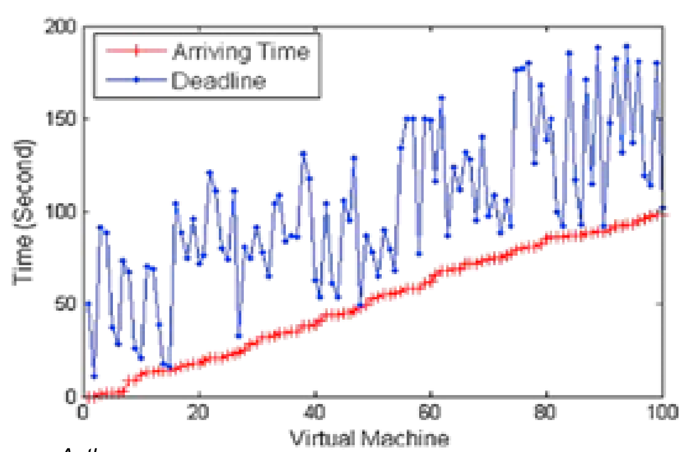
14k instruction/second server to accommodate the job.

- Similarly, 80k, 64k, 45k, 22k, and 10k instruction/second server are accommodated with the respective works.
- Now we get a job of 5k instruction/second but here we have to accommodate the 1 lac instruction/second server to this work; here 95k instruction/second goes into waste. This situation is called the Worst-Case Scenario, where a huge amount of instruction/second goes in for wastage.
- The scenario of 6k instruction/second was performed using 5k instruction/second and 1k instruction/second servers combined; this scenario is called Best Case Scenario as there is absolutely no loss of instructions.
- The Scenario of 12k instruction/second job to which the 15k instruction/second server was assigned but 3k instruction/second goes in waste; this is, however, a small-scale loss and this scenario is called Average Case Scenario.

We have developed an algorithm where carbon footprint is reduced by developing a weight approximation algorithm. This algorithm calculates the weight of each server and is placed in a manner that the outsized job will access the highly weighted server. If the consumer request is more than the capacity of all individual servers, then high weighted server along with low weighted server will be provided to the outsized job. Here, weight of the first server in the list of weighted and weight of the last server can accumulate, and its resulting weight will be compared with the task. If the task is less than or equal to the resulting weight, then those servers will be provisioned to that task.

3. ANALYSIS ON THE BACKDROP OF THE RESULT

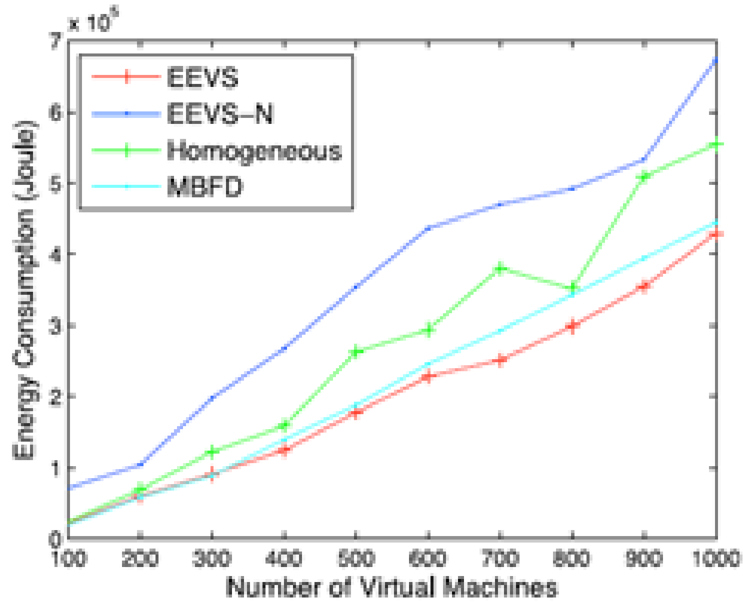
Our aim was to mainly reduce the carbon footprints by optimizing the usage of the servers in the data centers. Figure 2 refers to the usability of our proposed method.



Authors own

Figure 2: Graph showing the deadline and arriving time using CloudSim toolkit

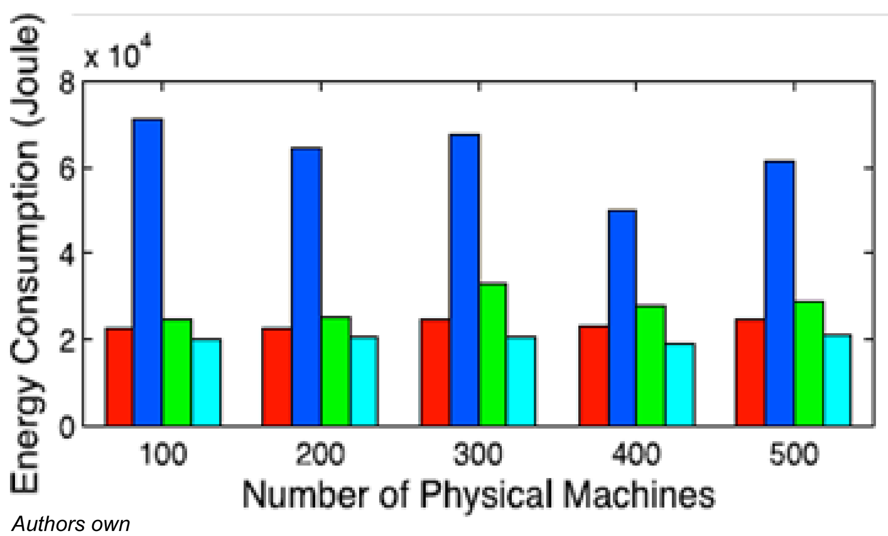
In figure 2, we can clearly see the arriving time of the task in each data center is less than the deadline which is assigned in the data center. As the data centers are working beforehand to the assigned deadline, there is a significant amount of savings in energy levels; hence, leading to lower carbon footprints.



Authors own

Figure 3: Graph showing the energy usage of different technique using CloudSim toolkit

In Figure 3, we can see that the said algorithm (red curve) is consuming the least amount of energy (measured in units of joule) as compared to EEVS-N - Algorithm, where the servers are arranged only in round robin order giving equal time slots to every VM; Homogeneous - where only homogeneous type of servers are being used; and MBFD, where the least capacity servers are arranged first. From this figure we can support our algorithm, as there is a significant lesser consumption of energy; hence, the total carbon emissions will be reduced following a reduction in carbon footprints.



Authors own

Figure 4: Graph showing the consumption of energy wrt. number of machines using CloudSim

From Figure 4 we wanted to show that consumption of energy remains same for the number of physical machines. There is no sudden increase of energy consumption following our algorithm. Therefore, we can conclude our model is robust to increment of number of physical machines when compared with the likes of EEVS-N, Homogeneous and MBFD.

Estimation from Amazon states that, the cost which is related to power consumption in a data center is around 42% including both direct power consumption cost and cooling infrastructure. The large data center consumes more energy as job received is much more. For example, in 2012, the total power consumption in Facebook was 678 m KWh, which is 30% higher than its last year consumption. The consumption can be capped by replacing the old cooling machines by the new ones, but it is a recurring cost. To solve the recurring cost in this field, we can implement our algorithm, which is to arrange the VMs in a reducing order of their weights in clockwise direction and connecting the previous VM to the next to reduce the power consumption which will subsequently lead to a lower carbon footprint generation and thereby leading to a lower monetary cost, benefitting both the organization and mother nature.

CONCLUSION

The biggest challenge faced while attempting to reduce the data center's electrical consumption is to link data center's activities to electrical use. Data center consumption is based on IT and infrastructure loads or when cooling systems remove heat from the data center to keep the temperature optimal. The fuel or energy used to generate electricity is the most significant factor affecting the year to year changes in CO2 emissions. Herein, the proposed algorithm shows the reduced energy consumption of data center.

This paper has some shortcomings which can be modified and be treated as a future scope of research. One of the key assumptions taken in the model is that the information in the workload is well informed but in more practical scenario this is not always maintained; thus, we have to further develop a model which can take the un-informed instructions, i.e. we won't know which kind or how much instruction will arrive in our VM in the respective data centers at a particular point of time.

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Climate Change, Sustainable Development and Tribal Livelihood

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ABSTRACT

Tribes, climate change and environmental vulnerability make tribal jeopardy for their intimate connection with the natural for their culture, health, and livelihoods. Tribes have a government-stipulated right for attachment to specific places and resources, challenging tribes' mobility, and flexibility to go elsewhere in response to future changes. So, the climatic deterioration raises the question of the sustainability of tribal communities. In this context, the paper attempts to measure tribal livelihood index based on their perception of climate change and deforestation index that have impacted on tribal livelihood index. We have documented the linkages between tribal livelihoods and climate changes with their sustainable development in the Bankura district of West Bengal based on a primary field survey of the tribal community at Kamo Village of Ranibandh block of Bankura district of West Bengal in two-point of time, i.e., 2015 and 2020. Deforestation and climate change have a significant impact on changing tribal livelihood. The climate change and deforestation tribal livelihood have been forced to shifting their occupation to labour wage especially as migrated labour and/or labour on government programs. This indicates the adaptability of tribes with climate change and deforestation.

Keywords: Climate Change, Deforestation, Environmental Vulnerability, Livelihoods and Sustainable Development

INTRODUCTION

In recent decades, the world is experiencing a dramatic environmental and socio-economic changes due to environmental degradation and climate changes. With carbon dioxide concentration doubling from pre-Industrial Revolution levels, India's climate could become warmer by 2.33 to 4.78°C during the twenty-first century (Lonergan, 1998). Climate change is one of the major threats to sustainable development because of its effects on health, infrastructure, agriculture, food security, and forest ecosystems (IPCC, 2007a) and (Lonergan, 1998). India's economy is largely dependent on climate sensitive sectors such as agriculture, water resources and coastal zones, biodiversity, and forestry (INCCA, 2010). In India 700 million rural populations directly depend on climate-sensitive sectors like agriculture, forest, and fisheries. Forest ecosystems provide a wide range of economic and social benefits, such as employment, forest products, and protection of cultural values (FAO, 2006). Forest-dependent people comprise a significant proportion of the communities most vulnerable to the impacts of climate change on forests.

The economy's forests are under a huge and growing pressure to sustain the fuel and fodder needs of an increasing human and cattle population. About 100 million people living in and around forests in India derive their livelihood from the collection and marketing of non-timber forest products (NTFPs) (Saxena, 2003). The NTFPs play important roles in the livelihoods of millions of rural and urban people across the globe (Shackleton *et al.*, 2015; Malhotra & Bhattacharya, 2010; Pandey *et al.*, 2011). It is well established that NTFPs fulfil multiple functions in supporting human wellbeing. The role of environmental resources or forest products (NTFP) in the economic development of local communities and sustainable forest management has been documented by many researchers. Available evidence on developing countries (for example, Arnold & Bird, 1999; Cavendish, 1999; Adhikari, 2005; Reddy & Chakravarty, 1999) focuses on quantifying the contribution of natural resources or forest products to income of rural people and analyzing the socio - economic factors that affect forest dependence. Recent studies that carefully tracked household income conclude that non timber forest products (NTFPs) contribute between 10% and 60% of income (Cavendish, 2000; Reddy & Chakravarty, 1999; Fisher, 2004). This contribution varies substantially across households. The contribution of forest resources to the livelihood of rural people varies across studies depending on the nature of forest products included in the study, methods employed in the valuation of products, and the type and management of forests prevailing in the study area.

Tribal Communities are often highly dependent on local natural resources such as forests, hence are far more vulnerable to the impacts of climate change than urbanized parts of the country (Bhattacharya 2009, Thomas, 2005). Most of them are poor and underprivileged. In most of the developing countries, the local poor people are dependent on forest products like food, fuelwood, fodder, timber, medicine etc. from which they generate cash income as well as meeting subsistence needs (Angelsen *et al.*, 2014, Mukul *et al.*, 2016). Empirical evidence from developing countries indicated that forest products play a significant role in rural livelihoods, particularly for the rural poor. Tribes are vulnerable to the impacts of climate change because of their close dependence on and connection with the natural environment for their culture, health, and livelihoods. Tribes have reservations and treaty rights that are connected to specific places and resources, challenging tribes' mobility, and flexibility to go elsewhere in response to future changes. So, tribal communities face difficult social and economic conditions that may be exacerbated by climate change and there is a question of their sustainability also.

Given the backdrop, the paper attempts to measure tribal livelihood index based on their perception of climate change and deforestation have impacted on tribal livelihood index. The objective of this paper is to document the linkages between tribal livelihoods and climate changes with their sustainable development in the Bankura district of West Bengal. The present study is based on primary field survey of tribal community Kamo Village of Ranibandh block of Bankura district of West Bengal. This study is based on primary data that has been collected in two point of time, i.e., 2015 and 2020. Initially this paper, briefly discuss the analytical framework and the methodology regarding Perception of Tribal Livelihood Index and Climate change Index, and then present an overview of the study area and tools employed for data collection. Major findings have been discussed in the subsequent Results section. In the final section discussion have been based on the lessons drawn from these micro-level studies.

RESEARCH METHODOLOGY

Analytical Framework

The quality of forest and the pattern of forest management determine its productivity and flow of natural forest resources for sustainable livelihood opportunity for the rural forest dwellers. National Forest Policy 1988 (MoEF, GoI, 1988) and the subsequent government resolution on Participatory Forest Management (MoEF, GoI, 1990) emphasize the need for community based programme in forest management, which ultimately leads to Sustainable development of the tribes. The links between climate change and sustainable development are strong. Poor and developing countries, particularly least developed countries, will be among those most adversely affected and least able to cope with the anticipated shocks to their social, economic, and natural systems. Climate change is the most significant challenge to achieving sustainable development, and it threatens to drag millions of people particularly for tribal households. However, only this much is not enough, as these households in the rural areas continuously face various economic, political, social, natural, and familial difficulties and threats. These difficulties and threats have adverse effects on their livelihoods, which directly affect fulfilment of their needs and further result into making their livelihoods vulnerable. Threats to the livelihoods include sudden shocks (e.g., floods, draught, earthquake, storm, or sudden change etc.) as well as long-term stresses (for e.g. chronic illness, addiction, debt, seasonal shortages, food deprivation etc.). Shocks are sudden, unpredictable and have dramatic impacts, while stresses are pressures, which are typically continuous and cumulative, predictable, and distressing. While considering livelihood security, taking cognizance of environmental sustainability becomes necessary, as majority of rural households heavily rely on their surrounding natural resources for their livelihoods. Thus, livelihood security of rural households is closely linked with the environmental sustainability. It is seen in most of the literature that 'security' is often subsumed in the concept of sustainability and also expressed as 'social sustainability,' implying sustainability against shocks and stresses. However, this study differentiates between security in the short term and sustainability in the long-term as two separate conceptual categories and emphasizes the fact that for the poor the former is more important than the latter. As a result, the term 'sustainable livelihoods' is often used to indicate environmentally sustainable and 'secured' livelihoods.

Empirical Strategies

From the theoretical framework we understand that the dependent variable can be climate change perception, tribal livelihood and/or sustainability. As the model is non separable, the functional form of the reduced-form equations cannot be derived analytically (Singh et al., 1986). In empirical studies, researchers use descriptive and multiple regression methods that include ordinary least squares (Adhikari, 2005), discrete choice model, Tobit (Fischer, 2004; Dayal, 2006), instrumental variables, and panel data analysis techniques (Cook, 1998). The econometric analysis employed in this paper is explained below based on the questionnaire primary surveyed data of 2020 and 2015.

Constructing Tribal Livelihood Index and Climate Change Index

For Tribal Livelihood Index (TLI) we take the responses from the households on their mean agriculture income, mean business income, mean service income, mean income from labour wage and income from minor forest products.

For Climate Change Index (CCI) we take the responses from the households whether the collection of fuelwood increased, whether the time taken for the collection of non-timber forest products (NTFPs) increased and whether the quantity of non-timber forest products increased.

To formulate index, we take normalize value of each indicator. The normalize value lies between 0 to 1. "0" shows minimum and "1" shows maximum values. This normalization procedure was followed by the methodology of Human Development Index (UNDP, 2006).

After normalization we are to take the averages of all sub-indicators.

TLI = ∑ (AI+BI+SI+LWI+MFPI)/5 --(1)

CCI= ∑(FWI+TNTFPI+QNTFPI)/3 -----------------------------(2)

Where, AI is the mean agriculture income, BI is the mean business income, SI is the mean service income, LWI is the mean income from labour wage and MFPI is the income from minor forest products. FWI is the households whether the collection of fuelwood increased, TNTFPI implies whether the time taken for the collection of non-timber forest products (NTFPs) increased and QNTFPI implies whether the quantity of non-timber forest products increased.

Study Area, Data Collection and Descriptive Statistics

Study area

Bankura is one of the most backward districts of West Bengal and within Bankura the study area consisting of five tribal inhabited blocks namely Ranibandh, Hirbandh, Raipur, Khatra and Chatna is the most deprived part of the district. The percentages of tribal population of Ranibandh, Hirbandh, Raipur, Khatra and Chatna are 47.28, 28.54, 28.50, 22.24, and 21.82, respectively. Out of these five blocks, Ranibandh and Raipur blocks fall under Jungle-Mahal area of the state West-Bengal. Most of the regions of the village is forested and drought-prone area. Agriculture is dependent on rains and a single crop of paddy is produced once in a year if there are timely rains. Cultivation of some vegetables is undertaken irregularly by almost all households who have some land. In some areas babui grass is cultivated mainly for rope making. The forest - which was once a source of food, fuel, fodder, and livelihood - still provides fuel and some income from minor forest products. However collection of Kendu and Sal leaves, Mahua flower, Neem, Mahua,Zamun, Amlaki, Haritaki, Kusum and Sal fruits, and various kinds of medicinal herbs and barks still constitute a supplementary source of livelihood for the tribal.

Sampling Procedure

Ranibandh has the highest tribal population that is why we have selected Ranibandh through stratified sampling procedure. All the villages are not significantly tribal dominated. Kamo is the village which has majority of its population belongs from tribal community. After the selection of villages, 40% of households from each village are selected randomly. The distribution of sample households has been given in Table 1.

Table 1: Distribution of sample households of Kamo

KAMO	No. of households	No. of sample households
2015	220	50
2020	226	50

Source: Field survey in 2015 and 2020

The table depicts that 50 tribal households has been selected randomly in the Kamo village. The data has been collected in two point of time i.e., in 2015 and 2020. In both the times 50 households has been selected randomly. The above table also depicts that the number of households has been increased over time.

Socioeconomic Study

This section deals with the socioeconomic parameters of the sample households across the years. Education is one of the major indicators of development. We have also calculated the educational Index of the households across years. To formulate index, we take normalize value of each indicator. The normalize value lies between 0 to 1. “0” shows minimum and “1” shows maximum values. This normalization procedure was followed by the methodology of Human Development Index (UNDP, 2006).

Table 2: Education Distribution of sample households

KAMO	2015	2020
Illiterate	108(49.1)	97(42.9)
Primary	65(29.5)	81(35.8)
Secondary	35(15.9)	36(15.9)
Above secondary	12(5.5)	12(5.3)
Educational Index	0.356	0.413

Source: Field survey in 2015 and 2020

*In the parentis the percentage has been given across households.

Majority of the households are still illiterate, though the percentage has been decreasing over time. The household primary level education has been increasing over time. The secondary level and above secondary level education remain same over the years across the households. The educational index gives the overall educational scenario of the households. Index reveals that the education has been increased to 0.413 from 0.356 of 2020 comparing to 2015.

Table 3: Distribution of Land holding (acre)

KAMO	2015	2020
Land less	11(22)	10(20)
<1 Acre	22(44)	23(46)
>= 1 Acre	17(34)	17(34)

Source: Field survey in 2015 and 2020

*In the parentis the percentage has been given across households.

Land holding is another important indicator of development. Data reveals that percentage of land less has been decreasing over time whereas percentage of households less than 1-acre land holding has been increasing over time. The households acquiring more than 1-acre land remains same over the years. So, the land holding scenario across households over the years has been increasing.

Table 4: Distribution of Housing Condition

KAMO	2015	2020
Pucca	5(10)	5(10)
Kachha	43(86)	45(90)
Thatch Hut	0(0)	0(0)
Traditional Tribal Hut	1(2)	0(0)
Others	1(2)	0(0)

Source: Field survey in 2015 and 2020

*In the parentis the percentage has been given across households.

The housing conditions of the households remains same over the year. Number of kachha house has been increasing whereas number of pucca house remains same over the years.

Table 5: Distribution of Major Sources of Livelihoods (%)

KAMO	2015	2020
Agriculture	32.6	30.9
Forest product collection	42.1	37.4
Casual Labour	22.8	28.7
Business	1.2	1.3
Service	1.3	1.7

Source: Field survey in 2015 and 2020

Tribal livelihood is living closely to nature. They are mainly dependent on forest. As their livelihood is dependent on forest though they are acquaintance of doing multiple occupation at a time. The above table deals with the sources of livelihood of the tribal households over the years. Majority of the sources of the tribal livelihood generates from forest product collection though the percentage has been decreasing over the years. Household dependent on agriculture also decreasing over time. Tribal livelihoods are now mainly dependent on labour wage. Other sources of livelihood such as business and service remain same over the year.

Table 6: Distribution of Monthly income in the village Kamo

KAMO	2015	2020
≤5000	37(74)	35(70)
5001-10000	11(22)	10(20)
10001-15000	1(2)	4(8)
Above 15000	1(2)	1(2)
All	50(100)	50(100)

Source: Field survey in 2015 and 2020

*In the parentis the percentage has been given across households.

The income distribution of the households over the years has been discussed in table 3. In 2015 74 percentage of household's mean monthly income is less than 5000, though it becomes 70 percent in 2020. Whereas 22 percent of household mean monthly income lies between 5000 to 10000 in 2015 though it becomes 20 percent in 2020. Other remaining household's income remains same over the years.

RESULT AND DISCUSSION

As the paper based on household data, so the variables have been calculated based on household questionnaire. The variable climate change has been estimated through the perception of households. From the perceptions of households, the climate change index has been formed. Since this analysis has been based on two point of time it is quite significant that in accordance with climate change tribal livelihood should shift from forest dependency and agriculture to wage labour and/or other income sources. Again, if deforestation has been incurred then the tribal livelihood also shifts to other occupational sources from forest dependency due to climate change over time.

Table 7: Description of the variables

Variables	Sub Variables	Descriptions
Livelihood Index	Mean Agricultural Income	Monthly in Rupees
	Mean Business Income	Monthly in Rupees
	Mean Service Income	Monthly in Rupees
	Mean Labour Wage Income	Monthly in Rupees
	Mean Minor Forest Product Income	Monthly in Rupees
Time Allocation		In years, 2015= 1, 2020= 0
Deforestation		If Yes= 1, No= 0
Perception of Climate Change Index	Collection of Fuelwood by the HH Increased	If Yes= 1, No= 0
	Time taken for the Collection of NTFPs Increased	If Yes= 1, No= 0
	Quantity of Non-Timber Forest Products Increased	If Yes= 1, No= 0

Source: Author's Calculation

Multiple regression models have been used to estimate the factors responsible for change in tribal livelihood.

Table 8: Mean, Standard Deviation, Minimum and Maximum Values of the Variables

Variables	Mean	Std. Dev.	Min	Max
Dependent Variable				
Tribal Livelihood Index	0.170	0.081	0.035	0.431
Independent Variables				
Time allocation	1.50	0.503	0	1
Deforestation	0.34	0.476	0	1
Perception of Climate Change	0.177	0.244	0	1
Total Sample	**100**			

Source: Author's Calculation

Linear regression model

Model specification: To investigate the perception of climate change and sustainable development on change in tribal livelihood at the household level, the linear regression models are applied. The specification of the OLS type linear model is as follows:

$Yi = \alpha + \beta 1\ X1i + \beta 2\ X2i + \beta 3\ X3i + \varepsilon i$ -----------------(3)

Where Yi is Tribal Livelihood Index (TLI) of the ith household.

X1i = Time allocations

X2i = Deforestation

X3i = Perception of Climate Change Index

εi – is the random disturbance term.

Table 9: Multiple Regression Model

	Coefficient	Std. Dev.	*t*	Number of obs = 100
Time allocation	-0.102	0.012	-8.33***	F (3,96) = 31.98
Deforestation	-0.011	0.013	-0.88^{+}	Prob > F = 0.000
Perception of Climate Change Index	0.076	0.026	3.02**	R-squared = 0.4999
Constant	0.314	0.022	14.43***	Adj R-squared = 0.4842

Source: Author's Calculation

Note: ** indicates significant at 5% level, *** shows significant at 10% level and + shows insignificant.

Regression analysis reveals that time allocation has a negative significant impact on change in tribal livelihood that means over time tribal livelihood has been shifting to other livelihood sources rather than forest dependence and agriculture. In case of perception of climate change, it has positive significant impact on tribal livelihood. That means as climate has been changed the tribes are also shifting their livelihood. So, it is quite evident that tribal livelihood will shifting their occupation due to climate change and deforestation to maintain their sustainability.

CONCLUSION

Tribal livelihoods are often highly dependent on local natural resources such as forests, hence are far more vulnerable to the impacts of climate change. Tribal communities face difficult social and economic conditions that may be exacerbated by climate change and there is a question of their sustainability also. This paper is to document the linkages between tribal livelihoods and climate changes with their sustainable development in the Kamo village of Bankura district of West Bengal. Data reveals that over time the education level of the tribal livelihood has been increasing. Again, housing conditions and land holding have showing an upward trend. Finally, OLS model has been estimated that deforestation and climate change have a significant impact on changing tribal livelihood. This paper is important due to the identification of factors responsible for changing tribal livelihood at a micro level. Due to climate change and deforestation tribal livelihood has been forced to shifting their occupation to labour wage especially as migrated labour and/or labour on government programs. That means over times tribes are accustomed with the climate change and deforestation and as a result their dependency on forest has been diminishing.

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A Study on the Digital Economy in BRICS Countries: Prospects & Challenges

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ABSTRACT

The present paper attempts to analyze the role of ICT for the development of the BRICS nations, which plans to help creating nation individuals to catch the open doors towards advancement introduced by the Internet and developing innovations. In spite of the requirements, the majority of these nations have accomplished consistent development in the Internet take-up and utilization as of late by effectively growing inclusion administrations and bringing the cost of access down. Considering these issues, our paper looks at the present scene of Internet networks in these nations. It distinguishes the two bottlenecks and chances to build up the Internet biological system from the stock side and use and administrative points of view. This paper advocates for the BRICS countries to proactively digitize open, business, and social projects, and gives a lot of approach suggestions to make ready to change toward an advanced economy and society.

Keywords: Digital Economy, BRICS, Bottlenecks

INTRODUCTION

The Internet is, in the speech of market analysts, a General-Purpose Technology (GPT) (Clarke, Qiang & Xu, 2015). That implies in addition to the fact that it creates an interest and supply for Internet products and ventures, for instance Internet access and substance administrations, yet it likewise turns into the bedrock of an advanced computerized economy as the Internet broadens its venture into every single other corner of the economy and society (Basu & Fernald, 2008).

The products and enterprises make straightforwardly comprise of, in addition to other things, Internet Protocol (IP) parts and segments for PCs and other "associated gadgets", Internet access and administrations by cell phones utilizing portable broadband remote access systems, and applications and substance over the World Wide Web. For instance, the up and coming age of TV sets and games gadgets associate straightforwardly to the Internet, offering stimulation, data administrations, web-based life network, etc. (Bugmann, Siegel & Burcin, 2011). At the point when the Internet gets accessible all through society, it progressively turns into the methods by which all organizations and markets work independent of which modern segment they fall into. The Internet turns into the establishment for all non-Internet parts of the economy, and hence, business analysts allude to it as a broadly useful innovation. Strengthening this methodology are the discoveries from an ongoing report by the World Bank surveying proof from more than 100 developing economies. The report found that organizations become quicker and are increasingly gainful in nations where Internet get to be more broadly accessible. All the more altogether, the investigation uncovered that, while firms all things considered, regardless of the degree of innovation, size or fare direction, advantage from the Internet, it is little and medium undertakings (SMEs) that advantage relatively more from the Internet.

The World Bank report (2019) utilizes the three conditions supporting general access and administration-accessibility, reasonableness, and openness-to analyses the inventory side of Internet availability, the reason being that each of the three conditions should be met to drive the take up of access and utilization. In any case, concentrating on supply side network just reveals to one piece of the story, and given the transformational effect of Internet get to-an effect that is getting all the more generally perceived and acknowledged-implies that beginning, or un-acknowledged interest, isn't being considered as a potential driver of development in its very own right. This has significant outcomes.

As it were, the interest for broadband availability crosswise over a considerable lot of the networks in these nations will be driven by what should be possible with it (for example access to online life, spilled content, money related administrations, human services, and so on), instead of just network or correspondences. This changes principal contemplations, for example, the reasonableness of a broadband association. From an end client's point of view, what may somehow, or another seem "excessively expensive" in interchanges terms may become sensible when the entrance empowers other fundamental administrations, for example, instalments, training, and human services. For governments, digitizing key financial administrations and giving them over the Internet is likewise a more practical method for conveying open administrations. In any case, such e-taxpayer supported organizations might be viable if residents are on the web and can utilize them. This accordingly turns into a significant end to land at both for approach creators just as for those hoping to produce an arrival on infrastructural speculations.

A second and interrelated reason of the paper is that as gainful utilization of the Internet gets unavoidable all through society, a change happens toward a completely created advanced economy. This change, and the conditions that are important for it to happen. For this change to succeed two conditions are required: that the systems interconnect (so any client of one system can speak with any client of another), and that their product stages are intended to be interoperable with each other (so applications and substance can be utilized crosswise over systems, and give ascend, for instance, to shared working at any separation). Neither of these conditions is ensured, even though sometimes they might be the consequence of an administrative requirement.

The significance of interconnectivity and interoperability is that, when built up, they open the path for, and empower, creative extra administrations, substance, and applications. A considerable lot of these may call for changes in the plans of action related with customary merchandise and ventures. These improvements in business systems are a piece of the move from a simple Internet economy toward a computerized economy in which a wide scope of non-IT merchandise and enterprises use the Internet in their plan, generation, conveyance and utilization. Significant to this improvement is the far-reaching presence of open and private interchanges arranges that use IP that empower the interconnection and interoperability to occur. Utilizing this reasonable system is especially appropriate for lower-pay nations experiencing quick system, and particularly fast versatile system, advancement. If they can accomplish exhaustive degrees of national inclusion, interconnectivity and interoperability, the establishments of a move from an incipient Internet economy toward a completely created computerized economy and society can be built up.

Socioeconomic Context:

The financial and demographical qualities of the 6 nations under survey in this paper-Brazil, Russia, India, China, South Africa-show a lot of 'normal detriments' going about as hindrances to Internet dissemination, for example, low populace densities now and again and immense country zones and hinterlands in others that can be hard to cover by physical systems, i.e., they are 'uneconomic'. As a rule, in any case, the nations have encountered quick paces of monetary development as of late-all things considered around 5% to 6% per annum. The socioeconomics additionally point to nearly youthful populaces who are probably going to be the early adopters of new and portable advancements (see Table 1), and who will be specialists of reception, dispersion, and change.

Table 1: Socio-Economic Development indicators for the BRICS nations (2018)

Countries	GDP per- capita (current US$)	Population	Population Density (People per sq km)	Urban Population (% of total)	Median Age
BRAZIL	8920.762105	209469333	25.06171624	181335507	32 years
RUSSIA	11288.87244	144478050	8.822079555	107539347	39.6 years
INDIA	2009.978857	1352617328	454.9380726	460295677	27.9 years
CHINA	9770.847088	1392730000	148.3488333	823827650	37.4 years
SOUTH AFRICA	6374.028196	57779622	47.63011978	38339668	27.1 years

Source: World Development Indicators (2019), http://data.worldbank.org/indicator, Age Structure: http://worldpopulationreview.com/countries/median-age/

However, some of the nations has experienced elevated levels of neediness and joblessness and has brought about impressive difficulties of change in accordance with the structure of their economies. This is particularly valid for the vitality sending out nations—quite India, Brazil, and South Africa. Every one of these three nations additionally experience the ill effects of restricted access to essential administrations, for example, power, water and sanitation, instruction, social welfare, transport, and others, with the absence of such administrations regularly intensely felt in rustic zones. Moreover, various nations in this gathering face critical security issues.

The BRICS nations in this paper are all at altogether different phases of financial advancement. As per the World Bank's pay groupings, China, Russia, South Africa and

Brazil are viewed as upper-center pay nations, where only India is low-pay nation. Table 1 delineates the fluctuating degrees of monetary improvement, populace size and thickness, and urbanization of the nations that are taken up in our study. The financial advancement differential is best exemplified in contrasting Russia (with the most elevated GDP per capita at USD 11,283) and India (with the least GDP per capita at USD 2,010). The tremendous landmass of a large number of these nations is reflected in the populace thickness measurements, with Russia the least thickly populated at approx. 9 individuals for every square km. Be that as it may, conversely, India has a populace thickness of 455 and a populace of more than 135crore—more than every other nation in this investigation joined except China.

Now, the paper is organized as follows: Section 2 depicts the sub-regional overview of digitalization in terms of internet usage, e-commerce, digital financial services, digital context & firm level adoption of digital technology. Section 3 deals with the conclusion and policy recommendations part.

Sub-regional overview of digitalization:

This section reviews the sub-regional overview of digitalization in terms of internet usage, e-commerce, digital financial services, digital context & firm level adoption of digital technology.

Internet Usage:

BRICS has among the most noteworthy paces of Internet use on the planet, with a normal of 7.628 hours spent on versatile Internet consistently. Clients in Brazil are logging about 9.24 hours out of every day, trailed by South Africa at 8.53 hours out of each day, which is far more prominent than the two hours out of each day in the United States and 1.8 hours out of each day for the United Kingdom. Table 2 and Figure 1 gives a feeling of the high paces of Internet utilization in the area.

Table 2: Time Spent on Internet (hours/day)

Country	Time Spent on Internet (hrs/Day)
Brazil	9.24
Russia	6.45
India	7.42
China	6.5
South Africa	8.53
Average Use Time	7.628

Source: Global Web Index, Hootsuite 2018

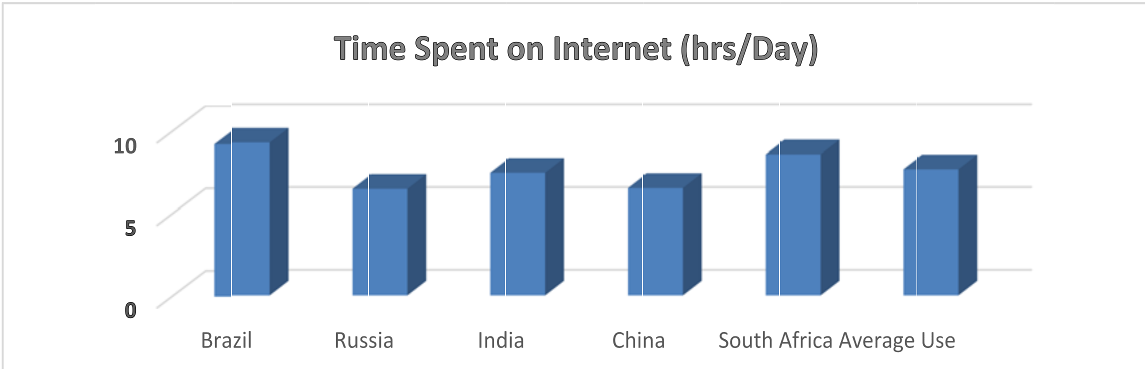

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Figure 1: Time Spent on Internet (hours/day)

In this regard, the normal internet penetration rate over the sub-region, starting at 2018, was 56.6%-altogether higher than the worldwide (53%). Table 3 and Figure 2 shows that Brazil has the highest rate of internet penetration (66%), whereas India has the lowest and it is only 33%.

Table 3: Internet Penetration Rate (%)

Country	Internet penetration (%)
Brazil	66
Russia	76
India	34
China	53
South Africa	54
Average	56.6
Worldwide	53

Source: Global Web Index, Hootsuite 2018

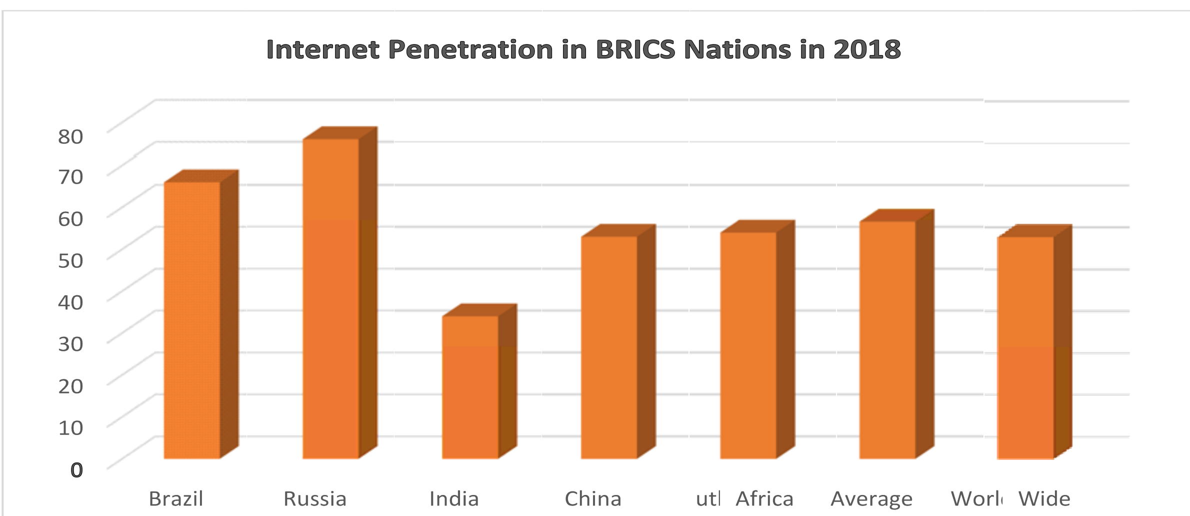

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Figure 2: Internet Penetration Rate (%)

oIn this regard, we can say that the low degrees of web infiltration imply that there is space for development in India. While arrangement producers cannot control for land factors, they can even now assume persuasive jobs in animating interest and supply through approach. Under different conditions, it may be normal that the lower the base the quicker the make up for lost time.

E-commerce:

Satisfactory advanced digital framework is the important condition for creating computerized economy and internet business. Regardless of whether and how well the computerized economy will really create relies upon various other financial and arrangement factors (ISOC, 2013). Information based advanced knowledge will change the fundamental association all things considered, offering ascend to completely new plans of action, while customary organizations likewise need to change themselves.

The current early-stage computerized economy situation is carrying on at two concurrent levels. At one level there is a blast of development and enterprising vitality, in type of many new businesses. At another level, enormous, advanced business is looking to settle into key lease looking for positions in the computerized economy structures at any expense. Advanced economy depends on solid information based carefully insightful systems which interestingly tend towards monopolistic, or barely oligopolistic, basic designs. Approach reactions must address both these levels and parts of computerized economy improvement.

A three-way approach for capturing digital value and business space can currently be witnessed among (1) established large digital corporations, which are often global, (2) digital start-ups, and (3) traditional businesses in different sectors that are being disrupted by the digital phenomenon (ISOC, 2015). Since the digital sector has extraordinary monopolistic tendencies, cut-throat attempts are being made at digital supremacy in each sector, and each service element, cornering the first mover advantage. At the same time, there are moves towards digital ecosystems development, with different kinds of economic actors in complementary, if often hierarchical, roles. Sectoral digital ecosystems get dominated and then driven by one, or at the most 2-3, companies, and it is these pole positions that are being bitterly fought over. It involves huge amount of upfront investments, which have been scrutinized at times as capital dumping. In the computerized business game are both worldwide organizations - advanced companies and some worldwide new companies, and household organizations – which could be new companies or customary organizations in various segments. Worldwide capital is additionally trying to take early key positions in the advanced economy through putting resources into locally developed computerized organizations, particularly those focusing on sectoral administration.

In this regard the e-commerce penetration can be presented by the following table (Table 4 & Figure 3).

Table 4: E-commerce penetration (%) in 2018

Country	E-commerce penetration (%)
Brazil	45
Russia	46
India	26
China	45
South Africa	29
Average Use	38.2
Worldwide	54

Source: Global Web Index, Hootsuite 2018

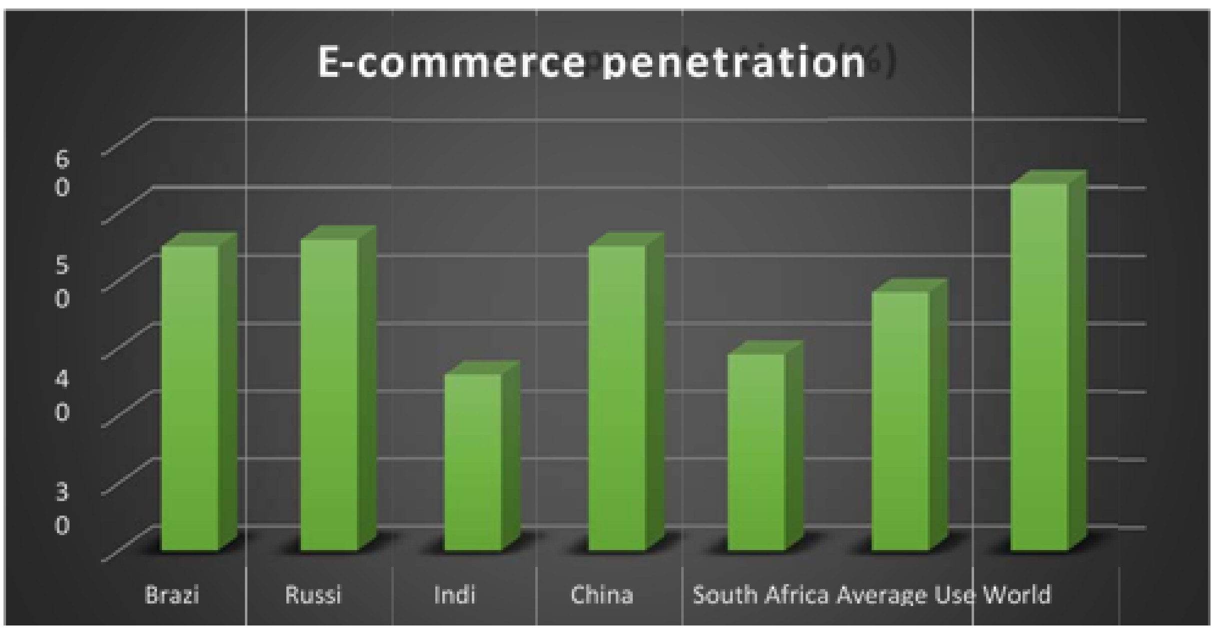

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Figure 3: E-commerce penetration (%) in 2018

From the above table, we can say that the BRICS nations still lagging with respect to the e-commerce penetration when we compared with the world average. Russia has the highest ecommerce penetration among all BRICS nations, while India has the lowest ecommerce penetration. Therefore, we may say that there is still scope and hope to enlarge the market opportunity in terms of e-commerce business.

Digital Financial Services:

Digital technologies have given rise to new ways of delivering financial services in BRICS nations, particularly in facilitating payment and lending, promoting financial inclusion. Financial technology (FinTech)-based credit market in BRICS nations emerges with a great-prospects, while the advancement in technologies further improved the competence of the payments system and strengthened BRICS's position as the largest payments market in the world. In the following table (Table 5), we have presented the percentage of consumer who have adopting the FinTech based credit system across the BRICS nation in 2018.

Table 5: Consumer FinTech adoption (in %) across BRICS nation in 2018

Country	Consumer FinTech adoption (%)
Brazil	64
Russia	82
India	87
China	87
South Africa	82
Global	64

Source: https://fintechauscensus.ey.com/

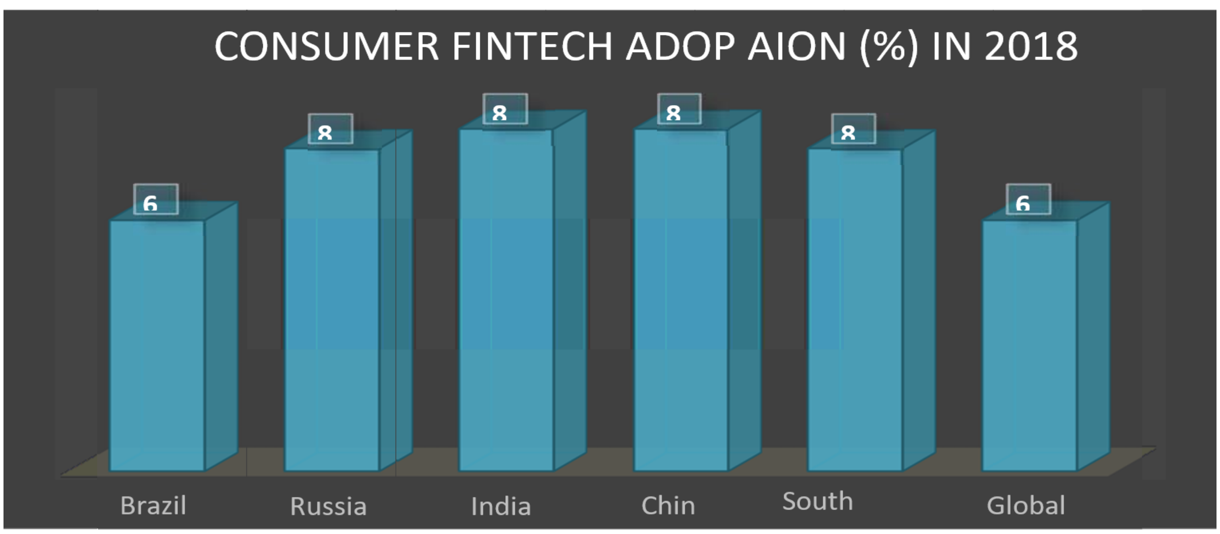

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Figure 4: Consumer FinTech adoption (in %) across BRICS nation in 2018

From the above table and figure, we can say that the tendency to adopt the FinTech across the consumers of BRICS nations is very much high than the rest of the world. Therefore, we can say that in the BRICS nations, the process of financial inclusion to its people is mush high.

Digital context

Clients in BRICS countries have become ardent buyers of online video content.

Advertisement based video-on-demand (AVOD) or client produced content stages, for example, YouTube, tik-tok are mainstream. The developing volume of nearby substance exhibits the expanding selection of advanced stages, for example, YouTube for the conveyance of news and amusement by neighborhood media organizations. The video-on-demand (VOD) showcase is developing, although it remains generally little. Now, table 6 shows the media penetration across BRICS nation.

Table 6.: Media Penetration (in %) across BRICS nation in 2018

Country	Media Penetration (%) in 2018
Brazil	57
Russia	39
India	17
China	65
South Africa	28
Average	41.2
Global	39

Source: Global Web Index, Hootsuite 2018

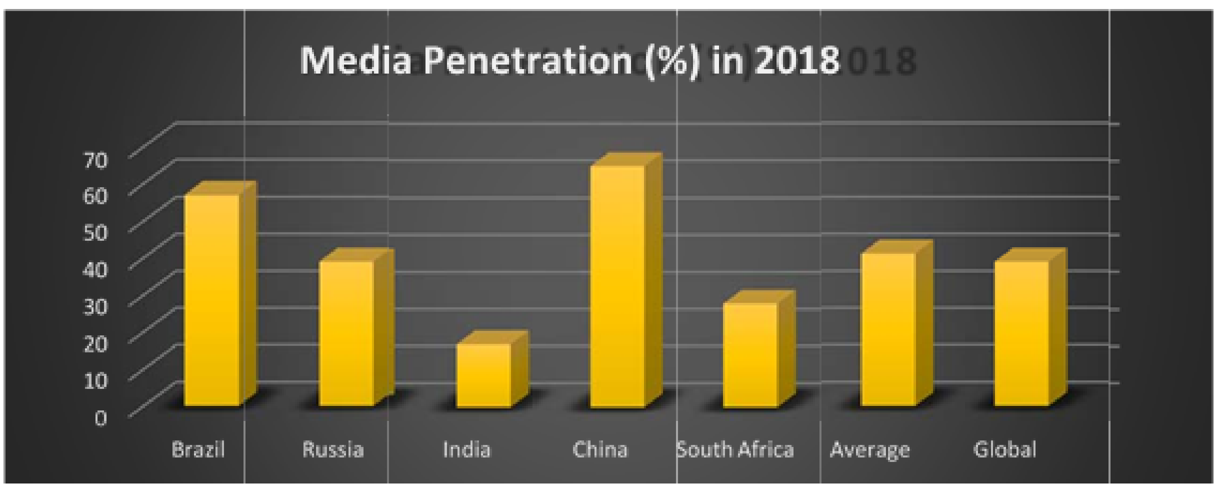

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Figure 5: Media Penetration (in %) across BRICS nation in 2018

From the above table, we can say that in terms of media penetration BRICS nations scores high than the world as the average media penetration percentage is 41.2 for BRICS is higher than its global average 39%. Though there is a major possibility to enhance the digital media market in India and in South Africa.

Firm level adoption of digital technology:

As opposed to the significant level of advanced media use, the dispersion of digitalized advances among organizations in BRICS countries stays moderate (UN, 2014). As indicated by the World Bank's Digital Adoption Index (DAI), the business portion of every one of the BRICS nations perform adequately contrasted with the individuals and inadequately when compared with the government sectors, implying that organizations are behind the government fragments in digital adoption. Now, the following Table 7 & Figure 6 shows the data and its representation on digital adoption index.

Table 7: Digital Adoption Index

Country	DAI	DAI-BSI	DAI-PSI	DAI-GSI
Brazil	0.68	0.68	0.55	0.82
Russian	0.74	0.71	0.70	0.82
India	0.51	0.50	0.23	0.80
China	0.59	0.55	0.52	0.69
South Africa	0.64	0.69	0.50	0.73
Average	0.63	0.63	0.50	0.77

Source: World Bank Digital Adoption index, BSI= Business Sub-Index, PSI= Public Sub-Index, GSI= Government Sub-Index

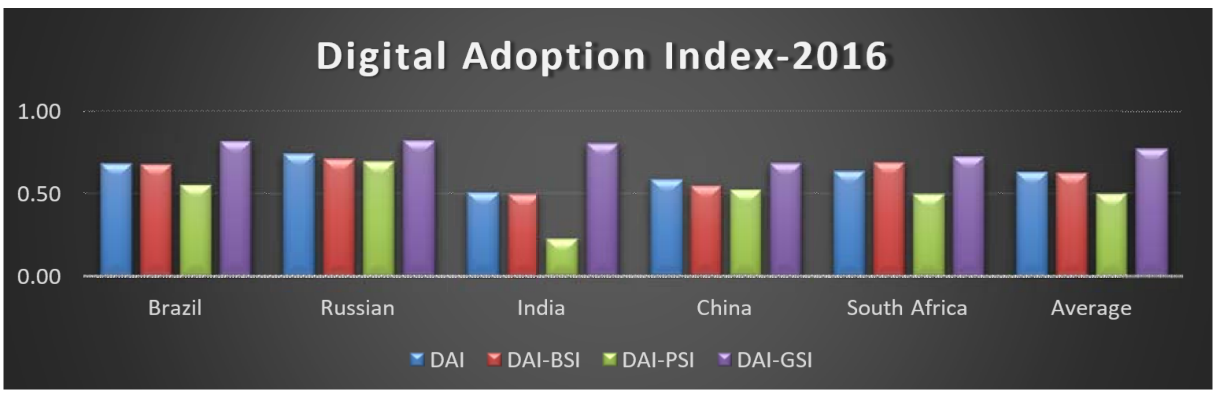

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Figure 6: Digital Adoption Index

From the above data, we can say that the BRICS nations average DAI scores (0.63 out of 1), and its score for government is 0.77, which is superior to every BRICS nation.

All together for the digital economy to prosper, firms in the locale - including MSMEs - need to completely grasp advanced technologies to support profitability, advance, and extend their organizations. Advanced innovations offer new open doors for firms, remembering for bringing boundaries down to section. As referenced in the past segment, advanced innovations can encourage cross-outskirt web based business and investment in worldwide worth chains (for instance, WeChat or Line for interchanges, Google and Dropbox for record sharing, LinkedIn for discovering ability, PayPal for exchanges, and Alibaba and Amazon for deals). Upgrading access to systems and empowering SMEs to participate in online business can be a pathway for little firms to go worldwide and even develop crosswise over outskirts where they can become rivals in specialty markets. The advantages from the advanced economy could be excessively huge for SMEs, as once exorbitant registering force, stockpiling, and improvement stages become less expensive (for instance, by means of distributed computing), distinguishing ability gets simpler and arriving at business sectors they couldn't reach in the past turns out to be progressively open. The moderately low degree of advanced appropriation by organizations in the nations is likewise featured by results from World Bank Enterprise Surveys.

RECOMMENDATION

In this regard, the major polices to achieve development with the help of digitalized economic structure can be proposed as follows:

Needs and Enable Wireless Access

The BRICS nations are quickly 'jumping' to portable first network. Versatile access has gotten about omnipresent, while portable broadband gives off an impression of being following intently behind. This has three significant approach repercussions:

(a) Connectivity development progressively should be characterized as far as portable availability. This shouldn't be to the rejection of fixed line network, yet rollout and availability arrangements and projects do need to perceive that versatile is the specialist of progress and a great many people coming on the web currently are doing so by means of a cell phone;

(b) Assumptions around 'uneconomic' endorsers should be tested—as purposes of social consideration and potential financial interest, distant or minimized people and networks ought to be proactively focused for portable availability; and

(c) Internet access and national advanced economy plans should be changed in accordance with perceive the expanding versatile centricity of the populace. Thusly, applications and procedures should be structured and made locally for versatile stages.

Distinguish and Stimulate Nascent Demand:

To legitimize the speculation required to proactively advance—and at times rollout—portable availability, measures to animate interest, a lot of which is dormant, additionally should be set up. Strategy producers and industry need to cooperate on the two significant determinants of interest: availability and moderateness. In general terms, for most residents this implies obtaining entrance through remote systems, and the most immediate approach to invigorate request is to support the augmentation of remote systems to unserved and under-served zones. Governments themselves have the chance to show authority in the manner advanced administrations can be conveyed, especially through e-government, social insurance, and consideration (e.g., financial inclusion) programs.

i. Advance the Development of Carrier-Neutral IXPs:

To guarantee reasonableness of access, ISPs and other specialist organizations who need to rent data transmission should have the option to do as such at focused costs. Be that as it may, discount costs must be cut down if there is a progressively abundant inventory of data transfer capacity accessible on an equivalent access premise. In theprimary occurrence focused and open access over all degrees of access ought to be empowered. One of the hugest limitations to broadband access is a significant expense, and one of the prime supporters of significant expenses is the absence of rivalry at different degrees of Internet get to. Where responsibility for foundation is cornered, steps should be taken to guarantee it is accessible on reasonable business terms base on the guideline of open access to augment customer welfare. One of the best approaches to diminish the travel costs is to advance transporter nonpartisan IXPs. Various models exist for getting this going, for example, guidelines on the prevailing bearer, an autonomous outsider discount model, or focused on state-speculation. The need here is to accomplish moderate system get to. By evacuating the data transfer capacity bottleneck, the full financial and social advantages of the Internet economy can be accomplished and the way toward a completely created advanced economy set out upon.

ii. Give Principles to Network Interconnection and Systems Interoperability:

System interconnection is not just the foundation of the Internet at the same time, alongside interoperability, gives the vital springboard into an advanced economy. Interconnection is critical to driving system impacts, which offer ascent to economies of scale. Consistent and practical association of various players over a system through interoperability of stages and administrations offers ascend to new administrations and advancement. All are crucial parts in changing an economy toward getting computerized. Any obstructions to interconnection, as have been nitty gritty at different occasions in the report, go about as hindrances by raising the expense of tasks. Governments and universal improvement accomplices can think about the accompanying key standards to advance interconnection in these business sectors:

(a) The terms must be founded on open space public domain systems.

(b) Due to limited numbers of service providers the rate should be depend on incremental cost occurred in long run.

(c) Rates and practices ought to be checked and unbiased regulatory authority; and

(d) In PSU and applications, interoperability, particularly crosswise over versatile systems, ought to be incorporated with all future arranging necessities, with a definitive spotlight on improving end-client administrations.

iii. Build Regional Terrestrial Backbone Infrastructure:

While most of the BRICS nation have accomplished portable entrances keeping pace with, or above, worldwide averages, regardless they slack in broadband infiltration. To help developing broadband use and information traffic, including—and maybe especially-over versatile and invigorate the advancement of online taxpayer supported organizations and business advancements, considerable fiber-based national spines and backhaul framework will be basic. Without it, broadband encounters will endure and disintegrate, retail costs will increment (as utilization slacks) and the computerized gap will increment. To help network development and utilization, and to expand moderateness, strategy producers need to likewise advance overhauled spine availability and interregional data transfer capacity supply.

iv. Improve the Ease of Doing Business:

Encouraging investment and market participation requires transparency and, even more importantly, regulatory clarity. This extends to regulations and policies toward imports of software and hardware (such as handsets) and equipment type approval procedures. To this end, the BRICS countries should look at developing and accelerating Mutual Recognition Arrangements (MRAs) that simplify and speed up certification of imports. Policy makers should also ensure that the device distribution and retail networks are fully competitive, and carefully review any tie-in arrangements imposed by carriers that might be considered discriminatory and therefore anticompetitive.

CONCLUSION

In conclusion, while there are constraints in estimating the degree to which the digitalized economy has changed the monetary scene of each nation considered in our study, though there are solid signs that the digital economy structure emerges strongly in BRICS. This can be seen by the development of advanced business, the fast selection of FinTech, the ascent in digitalized content, and the developing digitalization of organizations and taxpayer supported organizations. In any case, all together for the advanced economy to significantly affect neediness decrease and incorporation, its key empowering influences should be better comprehended.

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Sustainable Agriculture and Information Technology

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ABSTRACT

Economic development is a continuous process of change in macro variables of any economy in desirable direction. Economic development includes both quantitative and qualitative aspects. Economic growth is a subset of economic development where we consider only the quantitative measures. Now-a-days the term sustainable development is much more widely circulated. By sustainable development we mean the use of natural resources in a manner such that the future generation cannot be affected from the use of these natural resources. In this light of sustainable development study of environment is most essential. In any economy there are three main pillars-primary, secondary and tertiarysectors. In primary sector main contribution is given by agriculture. Agriculture is the base of any economy because it meets the basic need food. In this situation of pandemic also everyone is worried about availability of food. Thus, agriculture sector should be improved. Agriculture production use land intensively. Agriculture often places significant pressure on natural resources and the environment. Sustainable agricultural practices are intended to protect the environment, expand the Earth's natural resource base, and maintain and improve soil fertility. Information technology also helps improving sustainable agriculture. In this backdrop this paper will concentrate on sustainable agriculture process. Information technology also helps in improving sustainable agriculture.

Keywords: Sustainable Development, Agriculture, Information Technology

INTRODUCTION

Agriculture is a way of life, a tradition, which, for centuries, has shaped the thought, the outlook, the culture, and the economic life of the people of India. Agriculture, therefore, is and will continue to be central to all strategies for planned socio-economic development of the country. Rapid growth of agriculture is essential not only to achieve self-reliance at national level but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in poverty levels.

India has made impressive strides on the agricultural front during the last threedecades. Much of the credit for this success should go to the several million smallfarming families that form the backbone of Indian agriculture and economy. Policysupport, production strategies, public investment in infrastructure, research andextension for crop, livestock and fisheries have significantly helped to increase foodproduction and its availability. During the last 30 years, India's food grain production nearly doubled from 102 million tons in the triennium ending 1973 to nearly 200 million tons (mt) in the triennium ending (TE) 1999. Virtually all the increase in theproduction resulted from yield gains rather than expansion of cultivated area. Availability of food grains per person increased from 452 gm/capita/day to over 476 gm/capita/day, even as the country's population almost doubled, swelling from 548 million to nearly 1000 million.Increased agricultural productivity and rapid industrial growth in the recent yearshave contributed to a significant reduction in poverty level, from 55 percent in 1973 to 26 percent in 1998. Despite the impressive growth and development, India is still hometo the largest number of poor people of the world.

In this backdrop our study is concentrated on glimpses on India agriculture and its sustainability during post reform period. This paper has five sections. Section I the pattern and trend of Agricultural production, area under agricultural production will be discussed in section II. Section III represents crop diversification and sustainable agriculture is discussed in section IV. Section V highlights the use of information technology (Mitra, 2019; Yojona Magazine, 2019).

Section I: Pattern and Trend of Agriculture Production

Agricultural products can be divided into two categories: a) Food grain and b) Commercial crop

A) Food Grain

Under food grain four types of grains are taken into consideration. These are rice, wheat, coarse cereals, and pulses. The percentage share of rice production has increased from 42.12% in 1990/91 to 43.18% in 2000/01 and then decreased to 39.26% in 2010/11 and again increased to 41.36% in 2015/16. Thus, production of rice has experienced a fluctuating trend during the period under study. Same trend has been followed by coarse cereal. The respective figures are: 18.54%, 15.79%, 17.75% and 15.04. Compared to this the production of wheat has been experiencing an increasing trend. It has increased from 31.26% in 1990/91 to 35.40% in 2000/01 to 35.53% in 2010/11 and to 37.07% in 2015/16 (refer to table 1). Production of pulses follows a decreasing trend. Now we consider the time trend of food grain production. Rice production has grown at 1.44% during the total period under study. The growth rates are 2.03%, 1.46%, 1.31% for wheat, coarse cereals, and pulses respectively during the period under study. Compared to this the total food grain production has been grown at 1.63% in total period. Our estimates reveal that the growth rates are higher in period II (2000-01-2015/16) for all food grains than period I (1990/91-2000/01) (refer to table 2).

Table 1: Food Grain Production during 1990/91-2015/16

Year	Rice	Wheat	Coarse Cereals	Pulses	Total
1990-91	42.12	31.26	18.54	8.08	100
1991-92	44.35	33.07	15.44	7.14	100
1999-00	42.75	36.40	14.46	6.39	100
2000-01	43.18	35.40	15.79	5.62	100
2001-02	43.85	34.19	15.68	6.28	100
2002-03	41.09	37.62	14.92	6.37	100
2008-09	42.30	34.41	17.08	6.21	100
2009-10	40.85	37.05	15.38	6.72	100
2010-11	39.26	35.53	17.75	7.46	100
2011-12	40.61	36.59	16.20	6.59	100
2014-15	41.85	34.33	17.01	6.81	100
2015-16	41.36	37.07	15.04	6.53	100

Source: Reserve Bank of India and Calculations are done by Scholars

Table 2: Annual Compound Growth rates of Food Crops

Time	Rice	Wheat	Coarse Cereals	Pulses	Total
Total	1.44	2.03	1.46	1.31	1.63
PI	1.80	3.10	0.00	-0.26	1.78
PII	1.83	2.49	2.25	3.07	2.21

Source: Reserve Bank of India and Calculations are done by Scholars

A) Commercial Crop

Commercial crops are Oilseeds, Sugarcane, Tea, Coffee, cotton, Raw Jute & Mesta, and Tobacco. Among oilseeds Groundnut, Rapeseed & Mustered and Soybean are taken into consideration. Among these commercial crops the share of tea is higher during the period under study. The major share of commercial crops is contributed by Tea during the period under study (refer to table 3). The share of tea in commercial crop production has decreased from 61.77% in 1990/91 to 57.25% in 2000/01 and then increased to 61.77% in 2015/16. Thus, it has followed a fluctuating trend during the period under study. Compared to this the share of coffee has decreased from 14.55% in 1990/91 to 20.32% in 2000/01 and then decreased to 17.43% in 2015/16. The share of sugarcane has followed the decreasing trend during the period. The shares of other crops are very negligible during the period under study. The total commercial crop has grown at the rate of 2.08% during the period under study. The growth rates are higher in period II than period I for all commercial crops (refer to table 4).

Table 3: Commercial Crop Production during 1990/91-2015/16

Year	Oilseeds			Coffee	Cotton (Lint)	Raw Jute & Mesta	Sugarcane	Tea	Tobacco	Total %
	Groundnut	Rapeseed & Mustard	Soybean							
1990-91	0.644	0.449	0.223	14.555	0.844	0.792	20.672	61.774	0.048	100
1991-92	0.579	0.479	0.203	14.703	0.793	0.841	20.748	61.606	0.047	100
1992-93	0.752	0.422	0.298	14.877	1.001	0.754	20.025	61.819	0.053	100
1999-00	0.357	0.394	0.482	19.879	0.785	0.718	20.377	56.972	0.035	100
2000-01	0.433	0.283	0.356	20.325	0.642	0.713	19.972	57.253	0.023	100
2001-02	0.472	0.341	0.400	20.181	0.671	0.784	19.953	57.160	0.037	100
2002-03	0.286	0.269	0.323	19.096	0.598	0.782	19.933	58.679	0.034	100
2007-08	0.553	0.351	0.661	15.776	1.558	0.675	20.966	59.433	0.026	100
2008-09	0.454	0.456	0.628	16.627	1.412	0.657	18.067	61.661	0.036	100
2009-10	0.333	0.405	0.610	17.749	1.472	0.724	17.915	60.749	0.042	100
2010-11	0.491	0.486	0.756	17.925	1.959	0.630	20.322	57.380	0.052	100
2011-12	0.378	0.358	0.662	17.032	1.909	0.618	19.583	59.419	0.041	100
2012-13	0.252	0.430	0.785	17.037	1.832	0.585	18.269	60.774	0.035	100
2013-14	0.500	0.406	0.611	15.676	1.848	0.602	18.129	62.229	0.000	100
2014-15	0.378	0.321	0.530	16.714	1.779	0.569	18.519	61.190	0.000	100
2015-16	0.339	0.342	0.430	17.434	1.510	0.525	17.642	61.777	0.000	100

Source: Reserve Bank of India and Calculations are done by Scholars

Table 4: Annual Compound Growth rates of Commercial Crops

	Oilseeds			Coffee	Cotton (Lint)	Raw Jute & Mesta	Sugarcane	Tea	Tobacco	Total
Time	Groundnut	Rapeseed & Mustard	Soybean							
Total	-0.5068	1.550549	5.794163	2.448962	5.892647	0.842629	1.53241	2.107463	1.711499	2.084071
PI	-1.71388	-0.69629	10.40232	6.012176	0.865022	1.752169	2.569876	1.873069	-1.7584	2.697286
PII	0.951014	2.82809	5.571244	1.072063	10.13995	0.019863	2.074114	2.641104	4.779109	2.313408

Source: Reserve Bank of India and Calculations are done by Scholars

Section II: Pattern and Trend of Area under Agricultural Production

In this section a glimpse of distribution of land in agricultural production has been taken into consideration. Distribution and growth of land under food crop and commercial crop production will be analysed in this section.

A) Food Grain

The maximum area of food grain production will be borne by rice production. The share of area of land under rice production has increased from 33.39% in 1990/91 to 36.94% in 2000/01 and then decreased to 35.38% in 2015/16. Thus, the share of area of land under rice production has been following fluctuating trend (refer to table 5). On the contrary the share of area of land under wheat production has been experiencing increasing trend during the period under study. The figures are 31.26% in 1990/91, 34.19% in 2000/01 and 37.07% in 2015/16. The share of area under cereal production has decreased from 18.54% in 1990/91 to 15.79% in 2000/01 and 15.04% in 2015/16. Similar trend has been followed in case of area under pulses production during the period under study. Our estimates (refer to table 6) reveals the growth rates of area under different food crops during the period under study.

Table 5: Area under Food Grain Production

Year	Cereals			Pulses	Total Food grains
	Rice	Wheat	Coarse Cereals		
1990-91	33.39	18.91	28.41	19.29	100
1991-92	35.00	19.09	27.42	18.50	100
1997-98	35.08	21.56	24.89	18.47	100
1998-99	35.79	21.99	23.44	18.78	100
1999-00	36.68	22.33	23.83	17.16	100
2000-01	36.94	21.26	25.00	16.81	100
2001-02	36.57	21.45	24.04	17.93	100
2002-03	36.16	22.13	23.70	18.00	100
2008-09	37.08	22.59	22.35	17.98	100
2009-10	34.55	23.46	22.81	19.19	100
2010-11	33.84	22.95	22.37	20.84	100
2011-12	35.28	23.94	21.18	19.61	100
2014-15	35.93	25.37	19.78	18.92	100
2015-16	35.38	24.65	19.39	20.60	100

Source: Reserve Bank of India and Calculations are done by Scholars

Table 6: Annual Compound Growth rates of Area under Food Grain Production

	Cereals			Pulses	Total Food grains (5+6)
Time	Rice	Wheat	Coarse Cereals		
Total	0.07	0.94	-1.29	0.33	-0.01
PI	0.66	1.32	-1.85	-0.94	-0.15
PII	0.02	1.38	-1.41	1.09	0.21

Source: Reserve Bank of India and Calculations are done by Scholars

B) Commercial Crops

The percentage distribution of area under production of commercial crops is higher for cotton production, ground nut and mustered and rapeseed production. The area under cultivation of cotton has increased from 24.92% in 1990/91 to 26.33% in 2000/01 and to 29.24% in 2015/16. The area under production of ground nut has decreased from

27.84% in 1990/91 to 20.25% in 2000/01 and to 11.23% in 2015/16 (refer to table 7). Thus, it has followed decreasing trend. Same trend has been followed by the area under production of mustard and rapeseed oil. The area under production of soybeans. Our estimates (refer to table 8a & 8b) reveals the rate of growth of area under production of different commercial crops during the period under study. The area underground nut production has been experiencing decreasing trend thus the growth rate is negative during the period under study and two sub-periods also.

Table 7: Area under Major commercial crop

Year	Oilseeds			Sugarcane	Tea	Coffee	Cotton (Lint)	Raw Jute & Mesta	Tobacco	Total
	Ground nut	Rapeseed & Mustard	Soybean							
1990-91	27.84	19.36	8.58	12.36	1.41	0.74	24.92	3.42	1.37	100.00
1991-92	27.03	20.42	9.91	11.97	1.31	0.69	23.88	3.46	1.34	100.00
1994-95	24.62	18.85	13.55	12.14	1.35	0.72	24.68	2.92	1.19	100.00
1998-99	20.50	18.03	17.98	11.22	1.30	0.83	25.87	2.85	1.41	100.00
1999-00	20.02	17.57	18.12	12.30	1.43	0.90	25.38	3.03	1.25	100.00
2000-01	20.25	13.83	19.81	13.33	1.54	0.96	26.33	3.15	0.80	100.00
2001-02	18.67	15.17	18.97	13.20	1.53	0.96	27.32	3.14	1.05	100.00
2002-03	19.16	14.65	19.71	14.58	1.68	1.06	24.74	3.35	1.06	100.00
2005-06	18.31	19.77	20.94	11.41	1.52	1.03	23.57	2.44	1.00	100.00
2010-11	14.36	16.91	23.53	11.96	1.37	0.98	27.55	2.13	1.20	100.00
2011-12	12.89	14.43	24.77	12.35	1.37	1.00	29.85	2.21	1.13	100.00
2015-16	11.23	14.19	28.74	12.19	1.40	1.06	29.24	1.95	0.00	100.00

Source: Reserve Bank of India and Calculations are done by Scholars

Table 8a: Annual Compound Growth rates of Area under Commercial Crop Production

Time	Oilseeds			Sugarcane	Tea	Coffee	Cotton (Lint)	Raw Jute & Mesta	Tobacco	Total
	Groundnut	Rapeseed & Mustard	Soybean							
Total	-2.26	-0.01	5.32	1.35	1.58	3.05	1.92	-0.84	2.25	1.23
PI	-2.48	-1.03	9.28	1.74	1.72	4.24	2.18	0.60	-1.08	1.30
PII	-2.11	1.32	4.82	1.42	0.84	2.23	3.33	-1.63	7.78	2.01

Source: Reserve Bank of India and Calculations are done by Scholars

Table 8b: Annual Compound Growth rates of Yield per Hector of Food Crops

	Cereals			Pulses	Total Food grains
	Rice	Wheat	Coarse Cereals		
Total	1.36	1.10	2.75	1.01	1.65
PI	1.13	1.75	1.88	0.58	1.93
PII	1.61	0.94	3.56	1.79	1.71
PIII	1.85	0.52	4.09	1.22	2.00

Source: Reserve Bank of India and Calculations are done by Scholars

Section III: Crop Diversification

To account for compositional changes brought about in the composite agricultural cropwe use crop diversification (DI) based on Theil (1967) Entropy measure: DI= E/log n,

$E = \sum x_i \log (1/x_i)$-------------------(1)

where x_i : share of i- thccropin the total agricultural production

n: number of crops.

When E=0, DI=0. In this case the crop distribution is completely inegalitarian and the whole agricultural production is completely shared by only one crop.

For E = log n, DI= 1. The agricultural production pattern is completely diversified among the crops. Crops are shared equally in agricultural production. It thus follows that 0≤ DI≤1. DI varies from zero when the agricultural production becomes completely concentrated (only one crop appropriates the total production), to unity when the agricultural production becomes completely diversified (all the crops have equal share. The crop diversification index (refer to table 9) reveals that the value of crop diversification is more than 0.5 during the period under study. Thus, we can see crop is diversified during the period under study.

Table 9: Crop Diversification Index during 1990/91-2015/16

Year	DI
1990-91	0.573
1991-92	0.563
1998-99	0.580
1999-00	0.583
2000-01	0.572
2001-02	0.582
2002-03	0.557
2006-07	0.576
2010-11	0.602
2011-12	0.585
2012-13	0.577
2013-14	0.571
2014-15	0.566
2015-16	0.566

Source: Reserve Bank of India and Calculations are done by Scholars

Section IV: Sustainable Agriculture

It is the era of sustainable development. Thus, sustainable agriculture is important. Sustainable agriculture helps in increasing profitable farm income, promote environmental sustainability, enhance quality of life for farm families and communities, and increase production for human food and fibre needs. Sustainable agriculture helps in both conventional and organic farming. Organic farming is less harmful. Sustainable agriculture helps in protecting land fertility and produce less harmful crops. True sustainable system produces no “waste”. To show the agricultural sustainability we have to concentrate on ecosystem.

The term sustainable agriculture has been used and interpreted in many ways. Sustainable agriculture includes site-specific ranching and farming practices designed to meet present and future needs for food, fibre, energy, and ecosystem. Sustainable agriculture emphasizes on production ofcrops those are profitable, environmentally sound, energy efficient. These crops improve the quality of life for both farmers and the public. Sustainable agriculture systems are designed to use existing soil nutrient and water cycles, and naturally occurring energy flows for food production. In sustainable farming food crops are cultivated without using harmful chemicals, pesticides etc. It also considers the human health for using such types of food crops.

Improve Sustainability in Agriculture:

Sustainable agriculture process requires three steps. First, one should know that agro-ecosystems are ecologically complex units where soil, water, air, wildlife, insects, pathogens, plants, and humans are present and interact. Farmers has to make decisions to influence interactions among crops, livestock, beneficial organisms, pests and the physical environment. Secondly, because of the ecological complexity of agricultural systems, sustainable farming requires the adoption of a systems-level and interdisciplinary perspective. As with any system, farms consist of a set of parts acting in coordination to achieve desired actions or results for the whole. In addition, a farm exists in a landscape where adjacent land use and community objectives should be considered. Consequently, one should clearly define the goals of the production system and search for the actions that will achieve those goals.

Finally, sustainable farming aims at maximizing many ecosystem services including yields, clean water and air, the presence of wildlife and other organisms valued by society, carbon sequestration, and recreation. Clearly, these goals are competed at times. Thus, achieving sustainability must be considered an optimization process that engages all participants including farmers, laborers, policy makers, retailers, consumers, and researchers.

Factors affecting the rejection or adoption of new approaches to farming

Forces that discourage the adoption of sustainable agricultural practices.
• Agricultural subsidies that favour excessive production of a single commodity
• Economic incentives that reward growers for externalizing environmental costs to the rest of the society. For example, policies .... that do not penalize water contamination due to pesticide run-off or soil erosion
• Political pressure to minimize environmental restrictions
• Consumers insufficiently or wrongly trained about agricultural issues
• Large populations seeking inexpensive food
Forces acting to re-couple agriculture with ecological integrity
• Kno wledge about the resources and process provided by agriculture such as clean water, soil conservation and recreation.....Collectively, these benefits are known as ecosystem services
• Understanding of the impact of agricultural management practices on ecosystem services
• Policies or incentives that pay or reward producers for providing ecosystem services
• Policies that help alleviate pressure on marginal lands
• Public education to inform consumers and those involved in policy making about the environmental costs and benefits of alternative

Source: Robertson & Swinton (2005)

Enhance the Sustainability of the Farming Enterprise

The path to sustainability is long and complex. Each farm represents a unique combination of biological, climatic, soil and management conditions such that no single "silver bullet" exists to secure sustainability. However, there are principles that will help farmers move in the direction of more sustainable agro-ecosystems. Among them most important are:

i. Use water and nutrients efficiently

ii. Keep soil covered throughout the year

iii. Reduce or eliminate tillage in a manner consistent with effective weed control

iv. Diversify your farming enterprise to spread agronomic and economic risk

v. Rotate crops to enhance yields and facilitate pest management

vi. Use cover crops and green manure and/or animal manure to build soil quality and fertility

vii. Protect water quality

viii. Develop ecologically based pest management programs

ix. Integrate crop and livestock production

x. Increase energy efficiency in production and food distribution

xi. Maintain profitability

Designing an economically viable, sustainable, and productive modern agricultural system is based on enhancing the health of the land and rural communities and concentrating on long-term solutions rather than short-term treatment of symptoms.

Conservation of crop diversity:

Cultivation of high yielding fertilizer responsive hybrid varieties over large areas has resulted in the loss of land varieties (desi varieties) which need to be conserved not only for the maintenance of the crop diversity but also for their future use in crop improvement programme as these varieties have several useful traits like disease, pest and drought resistance, nutritive value etc. The priority to local or land varieties over hybrid varieties and simultaneously providing protection to wild relatives of crops will avoid the problem of genetic erosion.

Watershed management:

Watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the area through a single outlet into a river or other body of water. Watershed management is a holistic approach to bring about development of integrated farming systems on watershed basis. It aims at optimizing use of land, water, and vegetation in an area to mitigate drought, moderate floods, prevent soil erosion, improve water availability, and increase fuel, fodder and crop production on sustainable basis.

Efficient water management:

Water management is key to the success of sustainable agriculture as water is an important natural resource. Water management can be divided into rainwater management and irrigation water management. The important aspects of rainwater management are water harvesting, supplemental irrigation, and reduction of evapo-transpiration. Irrigation water management involves scheduling irrigation at appropriate time with adequate quantity of water without causing water logging, soil salinity and alkalinity.

Conservation tillage:

Tillage practices in sustainable agriculture aims at reducing soil degradation and losses by erosion. A common way is to provide optimal condition for beneficial soil organisms, thereby enhancing organic matter decomposition and nutrient cycling. Managing the top 8 cm of soil is vital because most of the biological activity, micro-organisms and organic matter are found in this soil layer.

Nutrient management:

Haphazard use of chemical fertilizers in modern agriculture to enhance the crop yield has abused the land resources resulting into stagnation in food grain production. Therefore, Integrated Nutrient Management (INM) is key to success of sustainable agriculture. Integrated nutrient management which emphasizes on the use of renewable sources of nutrients ameliorates the soil health in long run. The sources of nutrient include manures, green manures, compost, vermin-compost, bio-fertilizers, and concentrated organic manures

Organic fertilizers have a slower action, but they supply available nitrogen over a longer period. Moreover, they protect useful flora and fauna of the soil, ameliorate yields and quality of products.

Weed management:

Weed control include cultural, physical, biological, and chemical methods. In sustainable agriculture cultural, physical, and biological methods are at priority. Weeds are generally controlled by rotation, tillage, and hand-weeding. Chemical weedicides are also used to control the weeds if the above methods fail to overcome the problem of weeds. However, in sustainable agriculture weeds are often tolerated and encouraged up to some extent as weeds play valuable function like nutrient cycling, disease and pest control, soil and moisture conservation and organic matter improvement as green manure (Davis, 2005).

Pest management:

In modern agriculture practices the overuse of chemical pesticides has led to the problem of pesticide resistance and pest resurgence. Besides this, many of the pesticides are non-biodegradable causing the problem of environmental pollution. This has led to the emergence of the concept of Integrated Pest Management (IPM). It refers to an ecological approach of pest management in which all available necessary techniques are practiced in a unified programme so that pest population can be managed in such a manner that economic damage is averted and adverse effects are minimized. It includes mechanical, physical, cultural, biological, and chemical methods.

In addition to these methods, sometimes friendly insects and spiders are also encouraged. Spiders are farmer friendly as they destroy pests in many crops, especially rice (Altieri, Nicholls & Fritz, 2005).

Crop diversification:

Crop diversification is important factor for enhancing crop production and maintaining the sustainability. Crop rotation, mixed cropping and intensive cropping is the methods of crop diversification which not only enhances yield but also reduce the erosion. Crop rotation which refers to the alternate growing of crops is important for successful sustainable farming. Crop rotation practices are not only important for soil fertility management but are also helpful in weed, pest, and disease control. In any rotation, leguminous crops are essential for nitrogen supplement to the soil. Mixed cropping is practice of growing two or more crops together in same piece of land. The major advantage of this type of cropping is that even under adverse conditions all crops are not destroyed. Mixed cropping with leguminous crops increases the yield of non-leguminous crop therefore it is necessary for the success of sustainable agriculture. In intensive cropping several crops are grown simultaneously in the same piece of land in one agricultural year. Multiple cropping and relay cropping are the examples of intensive cropping. Multiple cropping aims at maximizing production per unit of land and per unit of time by taking three or four crops from the same piece of land in a year. Relay cropping is a system of cropping where one crop hands over the land to the next crop in a quick succession (Gliessman & Rosemeyer, 2009).

Enhancing Yield of Major Commodities:

Yield of major crops and livestock in the region is much lower than that in therest of the world. Considering that the frontiers of expansion of cultivated area arealmost closed in the region, the future increase in food production to meet thecontinuing high demand must come from increase in yield. There is a need tostrengthen adaptive research and technology assessment, refinement and transfercapabilities of the country so that the existing wide technology transfer gaps arebridged.

Integrated nutrient management:

Attention should be given to balanced use ofnutrients. Phosphorus deficiency is now the most widespread soil fertility problem inboth irrigated and unirrigated areas. Correcting the distortion in relative prices ofprimary fertilizers could help correct the imbalances in the use of primary plant nutrients-nitrogen, phosphorus, and potash and use of bio-fertilizers. To improve efficiency offertilizer use, what is really needed is enhanced location-specific research on efficientfertilizer practices (such as balanced use of nutrients, correct timing and placement offertilizers, and, wherever necessary, use of micronutrient and soil amendments),improvement in soil testing services, development of improved fertilizer supply anddistribution systems, and development of physical and institutional infrastructure.

Arresting deceleration in total factor productivity:

Public investment in irrigation, infrastructure development (road, electricity), research and extension and efficient useof water and plant nutrients are the dominant sources of TFP growth. The sharpdeceleration in total investment and more so in public sector investment in agriculture isthe main cause for the deceleration. This has resulted in the slow-down in the growth ofirrigated area and a sharp deceleration in the rate of growth of fertiliser consumption.More than half of the required growth in yield to meet the target of demandmust be met from research efforts by developing location specific and low input usetechnologies with the emphasis on the regions where the current yields are below therequired national average yield.Literacy had a positive and significant relation with crop productivity and a stronglink exists between literacy and farm modernisation.

Bridging Yield Gaps:

Vast untapped potential in the yield exists for all crops in most of the state's accounting for more than three-fourths of crop area. Emphasis must begiven to the states in which current yield levels are below the national average yield.

Water for Sustainable Food Security:

India will be required to produce more and more from less and less land andwater resources. Alarming rates of ground water depletion and serious environmentaland social problems of some of the major irrigation projects on one hand, and themultiple benefits of irrigation water in enhancing production and productivity, foodsecurity, poverty alleviation, as mentioned earlier, are well known to be furtherelaborated here: In India, water availability per capita was over 5000 cubic metres (m3)per annum in 1950. It now stands at around 2000 m3 and is projected to decline to 1500m3 by 2025. Further, the quality of available water is deteriorating. Also, there are grossinequalities between basins and geographic regions. Agriculture is the biggest user of water, accounting for about 80 percent of thewater withdrawals. There are pressures for diverting water from agriculture to othersectors.

Emphasis on Rain-fed Ecosystem:

Resource-poor farmers in the rain-fed ecosystems practice less-intensiveagriculture, and since their incomes depend on local agriculture, they benefit little fromincreased food production in irrigated areas. To help them, efforts must be increased todisseminate available dry land technologies and to generate new ones. It will benecessary to enlarge the efforts for promoting available dry land technologies, increasing the stock of this knowledge, and removing pro-irrigation biases in publicinvestment and expenditure, as well as credit flows, for technology-based agriculturalgrowth. Watershed development for raising yields of rainfed crops and widening ofseed revolution to cover oilseeds, pulses, fruits, and vegetables. Farming system research to develop location specific technologies must be intensified in the rainfedareas. Strategy to make grey areas green will lead to second Green Revolution, which would demand three-pronged strategy - watershed management, hybrid technology and small farm mechanisation.

Accent on Diversification of Agriculture and Value Addition

In the face of shrinking natural resources and ever-increasing demand for largerfood and agricultural production arising due to high population and income growths, agricultural intensification is the main course of future growth of agriculture in theregion. Research for product diversification should be yet another important area.

Accent on Post-Harvest Management, Value Addition and Cost-Effectiveness

Post-harvest losses generally range from 5 to 10 percent for non-perishablesand about

30 percent for perishables. This loss could be and must be minimized. Let usremember, a grain saved is a grain produced. Emphasis should therefore be placed to develop post-harvest handling, agro-processing, and value-addition technologies notonly to prevent the high losses, but also to improve quality through proper storage, packaging, handling, and transport. With the thrust on globalization and increasingcompetitiveness, this approach will improve the agricultural export contribution of India, which is proportionately extremely low.

Section V: Use of Information Technology

Smart farming

In the year of 60s there was “Green Revolution” in Indian agriculture. At that time HYV seeds, chemical fertilizers and irrigation systems were introduced for increasing production. Now a fourth revolution is introduced by using information and communication technology (ICT) increase agricultural production exponentially. Many technologies are introduced under ICT like autonomous, robotic vehicles have been developed for farming purposes, mechanical weeding, application of fertilizer, or harvesting of fruits. The development of unmanned aerial vehicles with autonomous flight control , together with the development of lightweight and powerful hyper spectral snapshot cameras that can be used to calculate biomass development and fertilization status of crops), opens the field for sophisticated farm management advice. Moreover, decision-tree models are available now that allow farmers to differentiate between plant diseases based on optical information.

Smart farming reduces the ecological trail of farming. Minimized or site-specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases. With current ICT, it is possible to create a sensor network allowing for almost continuous monitoring of the farm. Similarly, theoretical, and practical frameworks to connect the states of plants, animals, and soils with the needs for production inputs, such as water, fertilizer, and medications, are in reach with current ICT globally.

Smart farming can make agriculture more profitable for the farmer. Decreasing resource inputs will save the farmer money and labor, and increased reliability of spatially explicit data will reduce risks. Optimal, site-specific weather forecasts, yield projections, and probability maps for diseases and disasters based on a dense network of weather and climate data will allow cultivation of crops in an optimal way. Site-specific information also enables new insurance and business opportunities for the entire value chain, from technology and input suppliers to farmers, processors, and the retail sector in developing and developed societies alike. If all farming-related data are recorded by automated sensors, the time needed for prioritizing the application of resources and for administrative surveillance is decreased.

Smart farming also has the potential to boost consumer acceptance. In principle, optimizing management also permits increased product quality (e.g., higher amounts of antioxidants and other secondary metabolites. Smart farming can provide a concerted path out of locked-in technologies and practices characterized by strong polarization and market- segmentation based on optimal fruiting densities in orchards; or physiologically more amenable milk products based on individualized feeding rations of livestock).

These products are not only healthier but can also sell at higher prices, a key strategy in using land more efficiently. In addition, the transparency of production and processing will increase along value chains because ICT allows registration as to which farm produced a certain product under which circumstances. This offers the potential for new, more direct forms of interaction among farmers and consumers.

ICTs for Improved Prediction and Monitoring

To make farming more profitable and sustainable monitoring of environmental and soil are important. These lead to increased productivity, significant profits, and savings. In addition to that, ICT tools can enable farmers to exploit their farming potential by getting timely, accurate and relevant information on sustainable agricultural practices, water management, pest and disease control, soil testing and post-harvest management techniques.

Information Sharing

Information and knowledge play a key role in enhancing sustainable agricultural development and addressing food security.

ICTs can provide farmers with useful and beneficial information, such as new farming techniques, weather reports, and crop prices.

Practical examples of this use of ICTs:

Rural Radio: Radio is a relatively inexpensive communication medium and has wide coverage. It can provide farmers with information about farming conditions. These radios do not only aim at modifying agricultural methods, but they also aim at changing the state of mind through profound behaviour modifications.

Mobile Phones: The use of mobile phones to distribute food market information offers great advantages for consumers and food producers. Farmers can use mobile phones to receive text messages with market information on commodities (market price, supply, and demand).

Tele-centres: Community telecentres in rural areas with access to the Internet, telephone and fax services can play a vital role to make relevant information available to the farmers. Farmers can use these services to enhance communication with potential buyers and to access information on improved farming techniques.

ICTs and Agri-Markets: With the help of ICTs farmers can get information on the location of profitable agri-markets, enquiring about who is paying the highest price and even contact their potential buyers to sell their products online. They can also benefit from mobile banking and government credit programs with reduced transaction costs. Apart from this, there are more-specialized applications, esp. software, for supply chain and financial management that can increase the accuracy of the farm operations.

ICT-enabled marketing and access to markets plays a major role, especially for information on market prices and demand. ICT-enhanced marketing and certification strengthen the capacity of small-scale producers to increase revenue by improving their position on local and international markets.

Bridge the Communication Gap

ICTs can help bridge the communication gap and improve the interaction between farmers and agri-scientists to better identify farmers' specific problems. Researchers can get critical agricultural information like the incidence of pests and crop-yields using mobile-based applications. Data collection is faster than traditional methods; more people can be interviewed in less-time using minimum resources. By 2015, when monitoring of the Millennium Development Goals ended, 72 of 129 countries reached the Millennium Development Goal 1 to halve the number of hungry people or reduce it to below 5 percent, from 1990 to 2015.

CONCLUSION

India is a developing economy. It has three sectors viz. Primary sector, secondary sector, and tertiary sector. After liberalisation, the share of all three sectors has changed. Though the share of primary sector has been decreasing during the period under study, India has made impressive strides on the agricultural front during the last threedecades. India is producing both food grains and commercial crops. Indian agriculture is diversified in nature. Now-a-days India is practicing sustainable farming. Different policies are adopted for developing Indian agriculture. Since agriculture supplies food crops so development of this sector is important. But intense use of land may cause loss of fertility so sustainable farming is important now-a-days. Smart farming also helps in increasing the agricultural production exponentially.

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Information Technology: Economics

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ABSTRACT

Information technology in economics is a branch of micro economic theory. Information has special characteristic; it is easy to create but hard to trust. Information has a signal which has been described as a negative measure of uncertainty. It includes the completed and scientific knowledge of special cases. In the recent decades there has been the influence advance in the study of information asymmetries i.e. deal with the study of decision in transaction where one party has more or better information than other. Information asymmetries extend to non-economic behavior. As private firms have the better information than regulators about the actions.

Keywords: IT, E-Governance, Artificial Intelligence, Block Chain

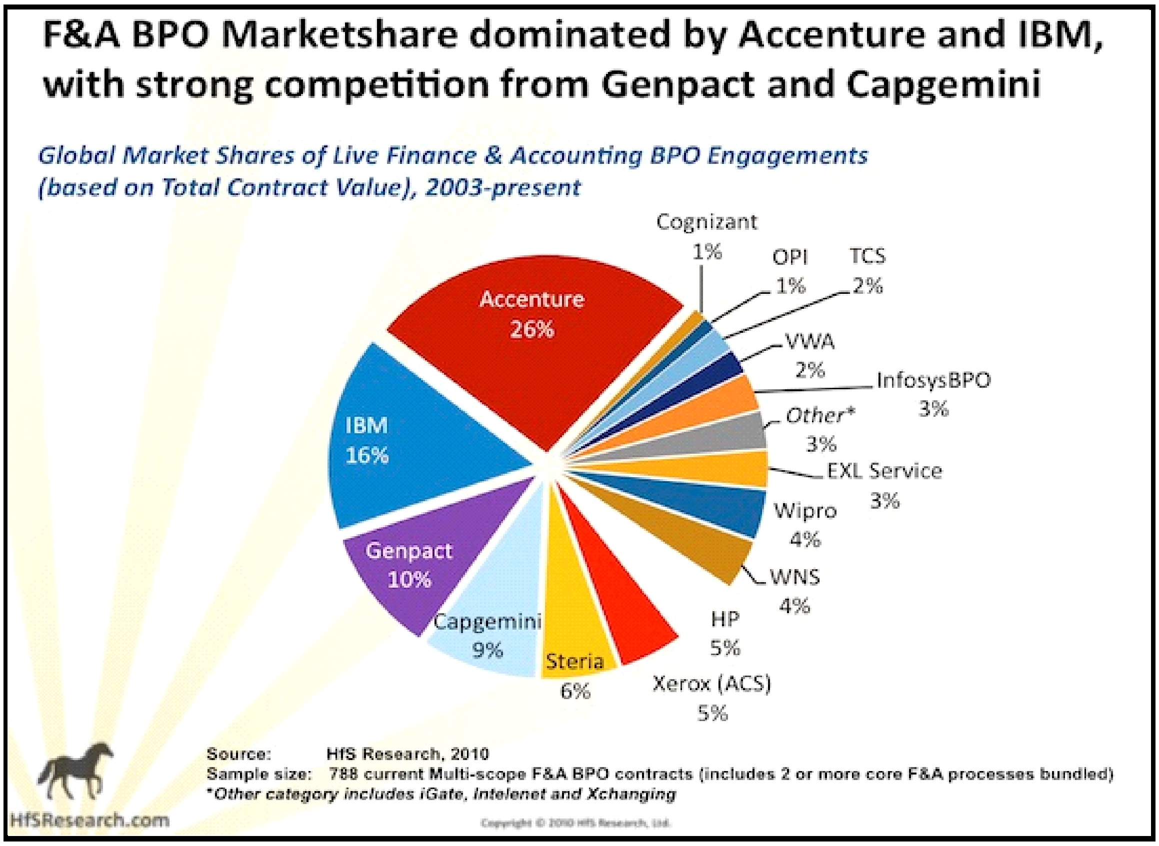
INTRODUCTION

Origination of Information Technology in Economics

India's IT Service industry was born in Mumbai in 1967 with the establishment of the Tata groups in partnership with Burroughs. The Indian economy underwent a major change in economic reform in 1991 leading to a new era of a globalization and international economic integration and annual economic growth over 6% from 1993-2002. Within the 90 days of its establishment the taskforce produced an extensive background of the report on the state of technology in India and an IT action plan with 108 recommendation. Much of what it is proposed was also consistent with the thinking and the recommendation of international bodies like world trade organization, International telecommunication union, and World bank. Information technology is an example of general purpose that has potential to play an important role in Economic growth (Allen & Morton, 1994).

IT-BPO Industries: Business process outsourcing services in India catering mainly to the western operation of a multinational corporation. In the second half of 1980's American express consolidated its (JAPAC) back office operation in Gurgaon. In 1990's Jack Welch was influenced by K.P Singh to look at Gurgaon office in the NCR region as a base for back office operation (Mather, 2018).

Third Party BPO: Until General electric most of the work was being done by “captives” a term used for in housework being done for the parent organization. At the same time of an organization called E-funds started in Mumbai and Gurgaon. One of the current big BPO firm EXL services started in April 1999 and in 2012 hit around dollar 440 million. However recently most of the India's BPO even smaller and midsized one's are setting up their onshore presence in the market they serve. Apart from the BPO, KPO, transformation and Consulting opportunities are gaining momentum.



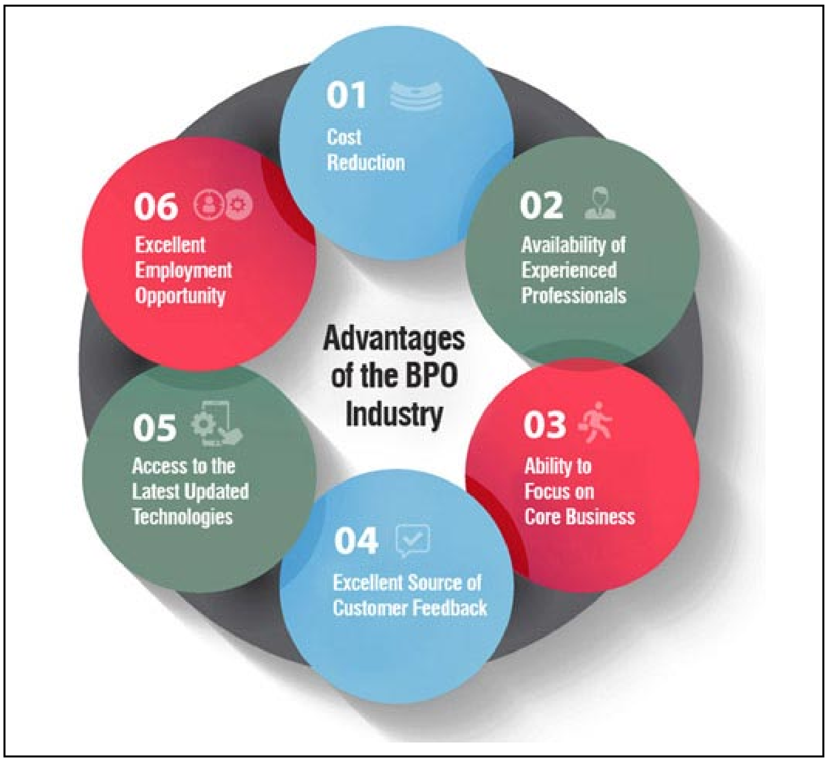
Source: Grandview research.com

Figure 1: F&A BPO Marketshare dominated by Accenture and IBM, with strong competition from Genpact and Capgemini

Future of outsourcing service to India: Analyst believe that India remains a vital destination for outsourcing and expect its annual GDP to grow at 8-10% for the next decade. In addition, outsourcing effort to India are held up as an effective remedy for the concern about Chinese government policy and the labor force issue such as increasing cost and shortages.

Service Insight: The service segment has been further segmented into Finance, Accounting, Human resources, Knowledge process outsourcing, Supply chains etc. The customer service segment share over 30% in 2019 and is predicted to grow at the highest rate in the future.

Regional Insight: The Latin American market for business process outsourcing is projected to witness a CAGR exceeding 6% over forecast period. The cost-effective pricing language in Spanish and Portuguese language skills are further generating revenues in the market for BPO in Latin America (refer to figure 2).



Source: Grandview research.com

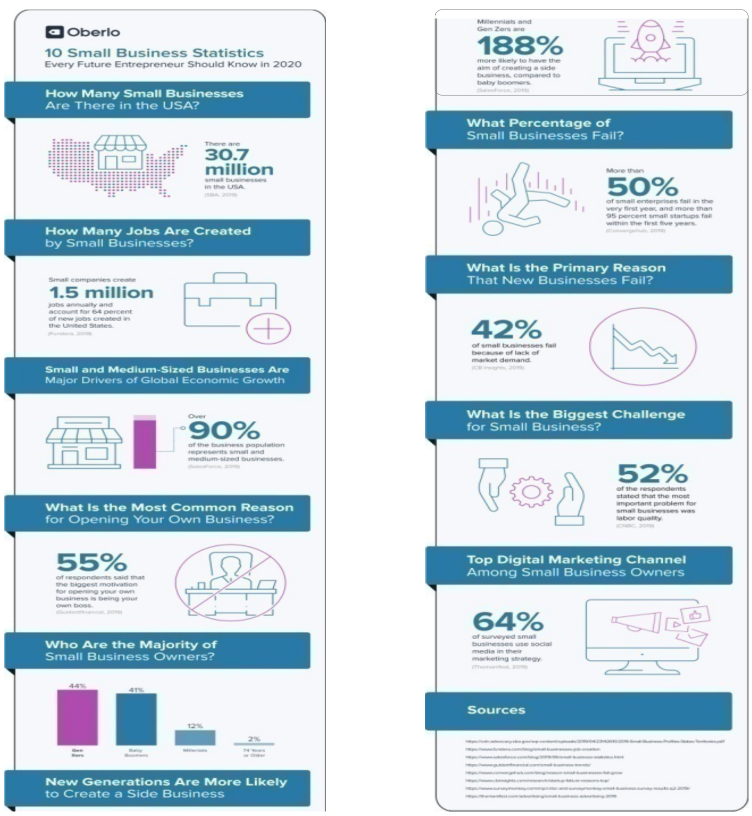
Figure 2: Advantages of the BPO Industry

E-COMMERCE: "European retailers learned from the mistakes of their US counterparts, but it didn't do them much good". After all, at that time fewer than 7,50000 German household had access to the worldwide web and the internet was widely regarded as being only for teenage technology enthusiast. It was very early for Germany, but we had known about the scenario in the US says Holger Pleines manager of E-Commerce at Karstadt. We had seen that we could have the problem in the future through Internet technology. Because Europe was 2 year behind the US in adopting the internet as a retail channel. Most of the leading retail sites in Europe either owned by the American internet companies notably amazon.inc. Karstadt started early but had to re- launch its online mall, my world.de at the end of 1997 after consumers complained that its initial version is quite difficult to navigate.

1. For companies promising technology that will transform business, the best way to prove is to use it.
2. Kare Swisher's five e-commerce ideas guaranteed to change the world and bring her fame and fortune.
3. It is the Patent and the critics says it threatens to undermine the very nature of the internet.
4. Some thoughts on the online privacy through the lens of marketers, techies, and lawyers.

Statistics of the E-Commerce (refer to figure 3)

1. It is estimated that there will be 2.05 billion global digital buyers in 2020.
2. In 2020 E-commerce sales are expected to account 15.5% of retail sales worldwide.
3. The single reason people shop online is that they can shop at all hours of day.
4. 65% of shoppers look up the price comparison on their mobile device as compare to physical store.
5. 85% of the consumer conduct online research before making purchase.
6. 81% of the consumers trust the advice of the friends and family over the business.
7. 80% of the people stop doing business with a company because of poor customer experience.
8. On an average only 2.86% of E-commerce website visits convert into a purchase.
9. 69% of shopping carts are abandoned
10. Unexpected extra cost is the sole reason shoppers abandon carts.
11. 52% of online stores have omni channels.
12. Longer mobile page load times drastically increases a bounce.



Source: Grandview research.com

Figure 3: Statistics of the E-Commerce

Infographics of a Business and Employment Scenario

Rural development: Rural development form an important agenda for the government. However the application of information technology in rural development sector has been slow due to poor information technology infrastructure in rural areas, poor information technology awareness in the people in the rural areas and with more than 70% of the population living in the rural areas where they earns a livelihood by agriculture and allied means of income (Arunachalam, 2002). Information technology can be interpreted broadly as "technologies that facilitate communication, processing, and transmission of the information by electronic means. In India information technology application such as WARANA, DRISTEE, E-CHAUPAL, CYBERMOHALLA, BHOOMI, E-MITRA, DEESHA, STAR, E-SEVA, LOKMITRA, E-POST. Information technology plays a significant role in combating rural and urban poverty and fostering sustainable development through creating information (South, 2011).

IT AND AGRICULTURE:

How the farmers make a use of information technology to meet their agriculture informational needs?

Research study on the effectiveness of information technology in the rural area reveals some factor which is influenced using Information tools. The use of information technology requires positive attitude. It exerts a directive or dynamic influence upon individual response to all object and influence.

What is the attitude of farmers towards information technology?
A positive attitude of the farmer needed while intrigue towards Information technology. However, the lack of information technology knowledge prohibits them from using information technology frequently. So, to ensure the effectiveness of the Information technology the rural community specially the leader must have positive attitude towards information technology.

What are the farmers challenges with Information Technology?
Information technology plays a vital role in empowering these farmers to improve their livelihood. Important information regarding sowing, improving soil, seeking best practices in production and the way to combat pests and diseases all empowers the farmer in decision making. Update knowledge of the information through information technology allow farmer to survive and even benefit from challenges and changes.

What are the needs of farmers regarding the use of Information technology?
Information technology plays a significant role in achieving such as transformation. It consists of three main technologies. 1. Computer technology 2. Communication technology 3. Information management technology. These technologies are applied for processing, exchanging, and managing data information and knowledge. Extensive use of information technology must be promoted between researcher, workers, and the farmers (Doms, Dunne & Troske, 1997).

What points to be considered?

1. How AMIS providers the use of information technology as an excellent tool for agriculture development.
2. What are the attitudes of the farmers in obtaining new buyers by using Information technology?
3. How the traders manage and beneficial sales from Information technology.
4. Why agricultural officers say information and communication technology is a better communication mode.

(INFORMATION AND COMMUNICATION TECHNOLOGY

(Increase in production) - (Marketing operation) - (Financing opportunity)

(Improve Livelihood)

IT AND EDUCATION: As the head of United nation organization for Education, UNESCO guide international effort to help the countries under the role such technology can play a role in sustainable development goal. As the vision captured in Qingdao declaration:

1. New vision of education 2030 articulated in the declaration adopted at the world education forum 2015 Incheon. Within a lifelong perspectives access, equity, quality and learning outcomes.
2. Inspired by a humanistic vision of education based on human rights. With the rapid expansion of the information technology one must render knowledge and familiarity and must be essential for all boys and girls, women, and man (Gleick, 2011).
3. Information technology including mobile learning must be harnessed to strengthen education system knowledge dissemination, information access.
4. Open education resources provide education stakeholder with an opportunity to improve the quality and expanding the access of a textbook, to catalyze innovative use of content to foster knowledge creation.
5. Free and open software (FOSS) for the development of information technology solution (Anchordoguy, 2000).
6. Successful integration of information technology in teaching and learning requires rethinking the role of teachers and reforming their preparation and professional development. It calls for promoting a culture of quality in all its aspects.

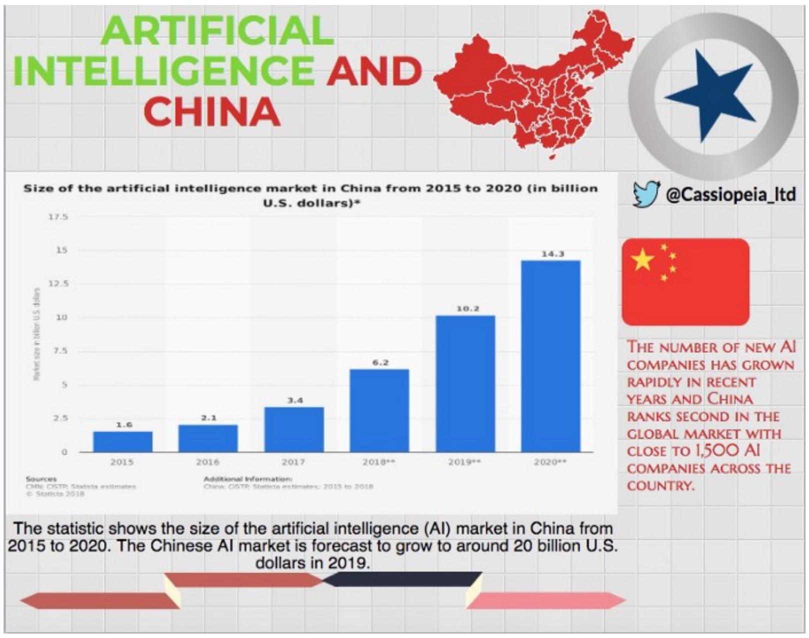
International Conference on Artificial Intelligence:

Planning education in Artificial intelligence era:

1. Debate whether skills needed to successfully cope in artificial intelligence era can be anticipated and share such experience on development of such skills that will enable humans to adopt to a society to AI.

2. Exchange reformation on the latest trend in Artificial intelligence, Deep learning, Machine learning
3. Access lesson learned from emerging national policies and strategies for leveraging AI to achieve sustainable goals.

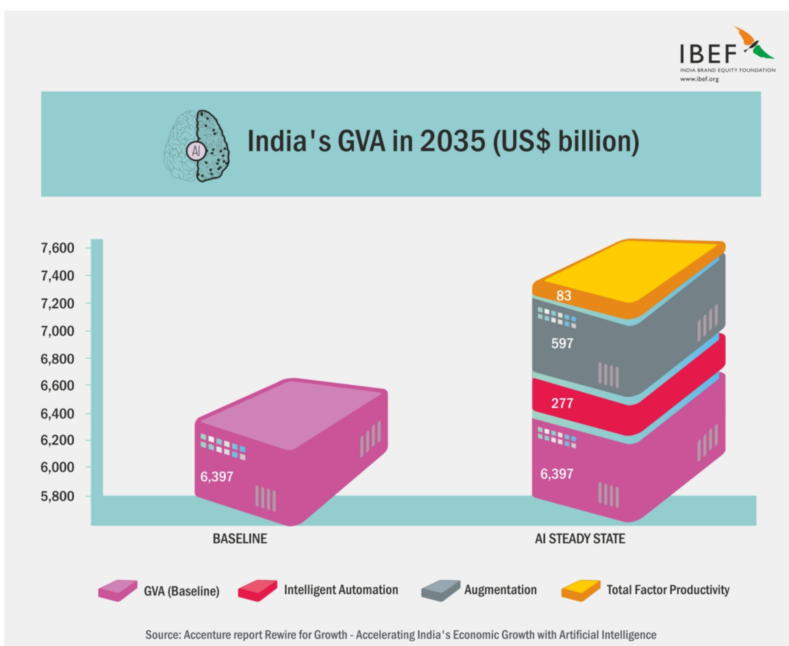
CHINA'S INFOGRAPHICS ON AI (refer to figure 4):



Source : http://www.ibef.org

Figure 4: Artificial Intelligence and China

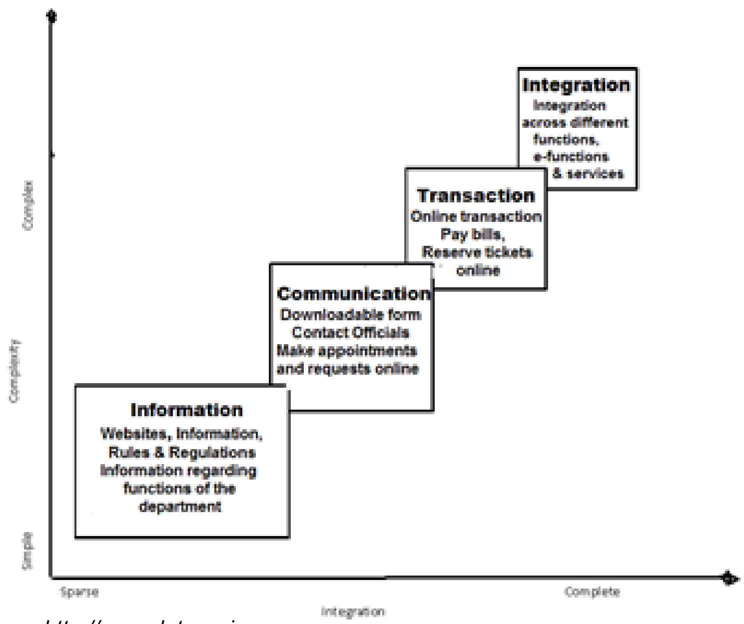
INDIA'S INFOGRAPHICS ON AI (refer to figure 5):



Source: http://source.www.ibef.org

Figure 5: India's GVA in 2035 (US$ billion)

IT in E-Governance: E-governance is the application of information and communication technology for delivering the government service, exchange of information, communication transaction and integration of various stand-alone system between (G2C), (G2B), (G2G) and (G2E). Though e-governance, government service is made available to the citizens in a convenient, efficient, and transparent manner. However e-government has no provision for governance of information technology. The governance of information technology typically requires a substantial increase in the regulation and policy making abilities. Further e-government uses one-way communication whereas e-governance is a two-way communication process. Relevance of business intelligence analytics has brought forth a paradigm shift in assimilating and visualizing huge chunks of data in a real time manner. Data analytics could change the colors and the complexion of e-governance (Hall, 1993). The public-private partnership based in e-governance projects are highly successful in India (refer to figure 6).



Source: http://www.dot.gov.in

Figure 6: The Dimension and the Stages in E- Governance

IT in Capacity Building:

Government of India providing a support for capacity building. Different training program is being conducted under the project for capacity building of government employee. A part from the training like IT security policy, E-procurement, Project management, Business model, and Public private partnership, Change management, Government process reengineering, E-governance projects lifecycle and other progressive action plan like District wise information technology, center set up. Digital India vision provide vision intensified set up of an initiative for the momentum and progress of E- governance. This promote inclusive growth that covers electronics service, product devices, manufacturing, and the job opportunities. The objective of the scheme is to provide professional sources and the trainings to the policy level decision makers for all the states and union territories.

Major components:

1. Development of competency framework, training, guideline, contents, case studies.
2. Developing a pool of certified trainers.
3. Develop online and web-based training.
4. Specialized training programs (STEP), technical training and workshops.

Level at which institutional framework and capacity building needed:

POLICY FORMULATION
COMMITTING RESOURCES ____________ LEADERSHIP VISION
TAKING HARD DECISION
PREPARING ROAD MAP
PRIORITIZATION __________ PROGRAM DEVELOPMENT
FRAMEWORK GUIDELINE
MONITORING PROGRESS
INTER AGENCY COLLABORATION ___________ PROGRAM MANAGEMENT
CAPACITY MANAGEMENT
CONCEPTUALISATION
ARCHITECTURE ______________ PROJECT DEVELOPMENT
DEFINITION
BID PROCESS MANAGEMENT
PROJECT MONITORING ______________ PROJECT MANAGEMENT
QUALITY ASSURANCE

Following illustration provide a conceptual overview of a capacity building and institutional framework in the state government.

State government
|
Program steering council
|
State apex committee
| | ______ Departmental committee
DIT
| |
SeMT _____________ PeMT

Approach for capacity building:

a. It should be a state government owned / controlled agency working in the area of a information technology and registered as a company/ society.
b. The company/society should be a going concern in a healthy financial condition.
c. E-governance and capacity building activity should find necessary prominence within the organization and it is not relegated to insignificance by other activities
d. The agency should have its own capacity building and logistic support.
e. It is possible designated agency for capacity building and would be involved in the implementation of e- governance project too.
f. Capacity building by the state government should undertake appropriate of the following two option:
g. From the presence of the Government or PSU or any state agency or Central agency with background experience. In such case required post to be created in the concerned department or the state nodal organization identified as a setting up for the deputation.
h. From outside the government set up- by engaging consulting agencies having requisite skills. The consulting agencies are required to provide the skilled manpower having skill experience and expertise.

IT AND HEALTH:

HIN+ Artificial intelligence is a mobile first intelligent health IT platform conceived around a Blockchain HER AND XDS compatible clinical content manager, cloud deployed, multiple- tenant PAS and Practice management with adhoc data query and analysis capabilities.

Deep Learning: It is all about identifying pattern by connecting dots. HIN+AI uses deep learning approaches to translate extensive data to gain knowledge and provide actionable insight.

Blockchain Architecture: Blockchain enabled HIN+AI support health data interoperability, integrity, and security. Portable user owned data through exchange system that are cryptographically secured and irrevocable.

Precision Medicine: Information coming from the wearable health trackers and sensors could be analyze together with health condition to provide patients with instructive pieces of information and help the physicians to design healthcare based on the needs and the habit of patients.

Designing for Physicians: The EHRAPPLICATION has an extremely configurable user interface which can be tailored to physician's taste and convenience. From arranging information and defining the layout selecting a color them all the aspects of personalization endorse ease and simplicity. The availability of a complete patient information in a single page. It improves the physician's ability to make well informed treatment decision quickly and safely.

Designing for Radiologist: The process of care involves the interpretation of multiple images acquired from modalities spread across a care setting and after beyond the boundaries of one hospital. The system is unique in its ability to easily acquire images from the modalities of multiple vendors, stream them onto a central archive, facilitates instant access to clinician for viewing and reporting.

Designing for Nurses: Now the nurse can sort things, get timely notifications and be informed of meaningful alerts for error free administration and efficient tasks management.

Designing for Administration: Smart planning requires seeking the big picture and specific details at the same time. Schedulers help to define shifts with a set of hard constraints that must be followed and a set of soft constraints which define relative quality of solution.

Designing for Patient delight: It is important for a hospital to make its patients feel that they are supported in the post care process. Future with Health information Network + Artificial intelligence.

CONCLUSION

A blockchain provide an immutable record of transaction performed by a cross of network without the need to rely on an intermediary such as central bank. It is a concept that bring together economics and digital technologies in a way never be conceived. Blockchain enable not just the new means by which to deliver financial services and support but also reshape and redefine Government legal service, Accounting, Insurance, Supply chain, and Energy distribution. Blockchain can also create new insight to the regulators. A key challenge with the Blockchain is ensuring that industrialized system based on the technology are robust and secure enough to handle the volume of transaction that occur in large supply chain. Technology innovation in the realm of robotics and artificial intelligence is fundamentally transforming education and updating the skills required to succeed in workplace and classroom. As per as the “university of Helsinki” has garnered a report more than 1,30000 registered students and is intended to gradually educate larger swathes of population about artificial intelligence for a new economic era. While specialized education should provide in demand skills for new and existing worker and address the disconnect between employer needs and existing instruction, public awareness must be built regarding impact of AI AND ROBOTICS (Mather, 2018). When it came to the jobs that are dangerous and take a heavy toll on physical well-being, artificial intelligence and robotics can play a helpful role. In England alone about 1.5 million jobs are at a high risk according to the report of national statistics 2019. One must be educated about those part in artificial intelligence where humans are still involved.

Optimism and Disillusionment exists in equal measure: There is a general sense that while internet or informational technology still offers a great opportunity mainly for the developing countries .The tool that was in the word of one participant “democratize society”.

We need to reassess what we believe we know: Internet of things and Artificial intelligence are set to redefine our understanding of the world around us reshaping economies and societies in unprecedented ways and necessitating new thinking, new approaches, new models .The future of information technology is ours and ours alone to shape.

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Connect Between Cosmetics and Climate Change: A Study With Reference to High Sun Protection Factor (H-SPF) Based Sunscreen for Treating Dermatological Disorders in Indian Context

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ABSTRACT

Purpose

This research aims to evaluate the impact of sunscreen with high Sun Protection Factor (SPF) for treating different dermatological diseases and disorders caused by the heavy temperature due to climate change.

Design / Methodology / Approach

The study primarily based on the quantitative research approach. Study period had been chosen from April 2019 to June 2019 i.e. three (3) months generally considered to be the summer season in Indian context. Primary data has been collected with the help of a questionnaire consisting with 5 focussed questions to satisfy the research objective. The questionnaire had been prepared by following the principles of 5 Point Likert Scale. The questionnaire had been designed and presented through Google Form and the same had been communicated electronically to the Indian Dermatologists, bona fide members of the Indian Association of Dermatologists, Venereologists and Leprologists (IADVL), the largest representing official society of Indian Dermatologists; authorized to treat and clinically evaluate all dermatological diseases and disorders. Appropriate social media platforms (Linkedin, Whatsap Group, Twitter and Facebook) had been adopted to reach the wide participants. Total number of 165 responses received from Indian's 28 states and 8 Union Territories (UTs), out of 165 respondents, 100 respondents had provided desired response applicable for all 5 questions and the consolidated response sheet had been prepared to carry forward the research work. Stratified sampling technique has been adopted in the study. For data analysis and interpretation software package Microsoft Excel, version-16 has been used. Different functions (f) like COUNTA, COUNTBLANK, SUM, COUNTIF and SUM followed by appropriate syntax have been incorporated in the study one after another during data analysis process. Different referencing criteria Relative, Absolute and Mixed Referencing have been used in the study during data analysis and interpretatation. Transpose formatting technique has been adopted in the

study for interpreting the dataset during data visualization. For visual representation, clustered horizontal pyramid chart has been incorporated in the study and the chart has been prepared by using Microsoft Excel, version-16 software package.

Findings

After interpreting the dataset and analyzing the visual representation with regard to the sample respondents in the study for each one question presented in the questionnaire it has been found that a significant percentage (%) of health care providers (HCPs) are providing their "highly satisfied" and "satisfied" views while treating patients fraternities with high different SPF (h-SPF) based sunscreens like SPF 15+, SPF 30+, SPF 50+ for treating many dermatological diseases and disorders like photo ageing, melasma, blisters, sun burn, suntan, pigmentation caused by high temperature which is the outcome of climate change in Indian context. It has also been found in the study that Indian dermatologists are recommending high SPF (h-SPF) based sunscreens to the patient fraternities which include paediatric to geriatric patients and ensuring all safely measures by recommending high SPF (h-SPF) based sunscreens and catering their healthcare needs. Finally it has been observed that Indian dermatologists are adopting SPF (h-SPF) based sunscreens in their prescription (Rx) behaviour for providing safety measures to the needy patients for protecting them from UV-A as well as UV-B radiation which affect human health at large in many ways. One or the other way in every questions presented in the questionnaire set consisting with 5 questions, Indian dermatologists are recommending high SPF (h-SPF) based cosmetic sunscreens to manage high temperature condition which is the outcome of climate change and prescribing (Rx) SPF (h-SPF) based sunscreens for treating different dermatological diseases and disorders for ensuring patients' dermatological healthcare need as well as combating the effect of climate change.

Keywords: Health, Climate, Drugs, Cosmetics

Jel Classification: P46, Q54, L65, L66

INTRODUCTION

Climate change is the global phenomenon of climate transformation characterized by the changes in the usual climate of the planet (regarding temperature, precipitation, and wind) that are especially caused by human activities. As a result of unbalancing the weather of Earth, the sustainability of the planet's ecosystems is under threat, as well as the future of humankind and the stability of the global economy.

Climate Change: Definition

According to National Aeronautics and Space Administration (NASA) climate change is “a broad range of global phenomena created predominantly by burning fossil fuels, which add heat-trapping gases to Earth's atmosphere. These phenomena include the increased temperature trends described by global warming, but also encompass changes such as sea-level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events."

The impact of Climate Change on Society

Climate change is already challenging and can further challenge our societies in a significant manner. In global context, with the increase in temperatures in some countries, especially in Equatorial regions *(Equatorial regions are located in a band around the Equator and cover about 6% of the Earth's surface. They are often in lowland areas and have a climate that is hot and wet all year round. Tropical rainforests grow in the equatorial regions.)*, the flow of climate refugees is changing and increasing, putting pressure in other countries to host them, help them strive and overcome different political as well as socio-economic barriers. The reasons for this move have to do with natural resources, such as drinking water, that are getting more limited and many crops and livestock that are unlikely to survive (affecting locals but also the global economy of the several industries that rely on raw materials) in specific locations because of the temperature being too hot or too dry, too cold or too wet. And as it turns out, existing studies validate that the wealthiest countries of the world will be the ones experiencing fewer changes in their local climate compared to the poorest regions if the global average surface temperatures reach the between 1.5º and 2º Celsius.

The impact of climate change on economy

Finally, businesses are also likely to be affected by climate change. Indeed, in a context where the climate is changing, companies need to be aware of the risks that they may face and be prepared to deal with them by developing CSR strategies that evaluate the impacts they may suffer. Events such as damaged crops, the loss of infrastructures, unexpected changes in market stocks, investors that ask for sustainability reports and the growing expectations of society for business to be transparent are variables to keep an eye on.

Combating Climate Change

To fight climate change, we must first reduce our greenhouse gases (GHG) emissions. To accomplish this, the first step is to embrace renewable energies that are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat, and avoid creating energy by the burning of fossil fuels. As well, besides the types of energy we produce, we must also make everything more efficient, because even if the energy comes from a renewable source, it still won't be carbon neutral and will still contribute to the ozone depletion. We need to adapt our lifestyles to overcome these growing challenges that climate change is bringing. For this to happen, we should start to create a worldwide culture of sustainable development, where the energy is wised wisely and efficiently, where a circular economy is a strong bet, as well as durable and eco-friendly products. One thing is for sure, we need to choose responsibly the products we buy because our demand as consumers influences what we are supplied with.

In the context of this study, sunscreen product has been chosen to carry forward the study to establish a link between sunscreen with high sun protection factor (SPF) and climate change.

Sunscreen with high Sun Protection Factor (SPF) and its impact on combating Climate Change

Sunscreen, also known as sun block, is a lotion, spray, gel, foam (such as an expanded foam lotion or whipped lotion), stick or other topical product that absorbs or reflects some of the sun's ultraviolet (UV) radiation and thus helps protect against sunburn. Diligent use of sunscreen can also slow or temporarily prevent the development of wrinkles, dark spots, and sagging skin. Depending on the mode of action, sunscreens can be classified into physical sunscreens (i.e., zinc oxide and titanium dioxide, which stay on the surface of the skin and mainly deflect the UV light) or chemical sunscreens (i.e., UV organic filters, which absorb the UV light).

Medical organizations such as the American Cancer Society (ACS) recommend the use of sunscreen because it aids in the prevention of squamous cell carcinomas (refer to figure 1). Basically Ultraviolet (UV) rays from the sun or from a tanning bed are the main cause of basal cell carcinoma. When UV rays hit the skin of human elements, over time, they can damage the DNA in human cells. The DNA holds the code for the way these cells grow. Over time, damage to the DNA can cause cancer to form.

Source: https://www.medicinenet.com/

Figure 1: Picture of Basal Cell Carcinoma

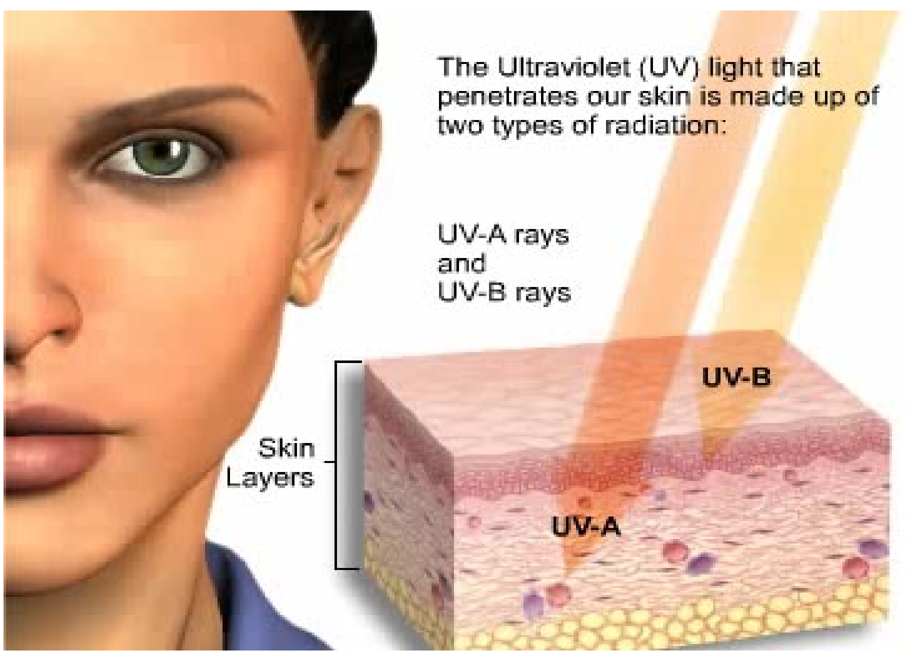
The routine use of sunscreens may also reduce the risk of melanoma. However, many sunscreens do not block UVA radiation, yet protection from UVA has been shown to be important for the prevention of skin cancer. To provide a better indication of their ability to protect against skin cancer and other diseases associated with UVA radiation the use of broad-spectrum (UVA/UVB) sunscreens has been recommended. The use of the term *"broad spectrum"* on the label sunscreen products is regulated by the U.S. Food and Drug Administration (U.S.F.D.A)

Sunscreens are commonly rated and labelled with a sun protection factor (ASPF) that measures the fraction of sunburn-producing UV rays that reach the skin. For example, "SPF 15" means that 1⁄15 of the burning radiation reaches the skin through the recommended thickness of sunscreen. Other rating systems indicate the degree of protection from non-burning UVA radiation. Sunscreens are designed to remain effective at original strength for up to three years and are typically of doubtful value after that period. Some sunscreens include an expiration date, a date indicating when they are no longer expected to be effective.

Ultraviolet light (UV) and Sun Protection Factor (SPF)

Ultraviolet light (UV) is invisible to humans because it has shorter wavelengths than the light we can see. Within the UV spectrum, there are two types of rays that can damage the DNA in your skin cells and lead to skin cancer. It is important to protect your skin from both types (refer to figure 2):

- UVB rays has a shorter wavelength (290 nm to 320 nm) and is associated with skin burning. It causes sunburn and play a key role in developing skin cancer.



Source: Australian Photo Biology Testing Facility, University of Sydney

Figure 2: Visual Representation of UV-A and UV-B

- A sunscreen's SPF number refers mainly to the amount of UVB protection it provides.
- UVA rays has a longer wavelength (320 nm to 400 nm) and is associated with skin aging. It causes skin damage that leads to tanning as well as skin aging and wrinkles. The shortest wavelengths of UVA rays also contribute to sunburn. It's important to look for the words “broad spectrum” on the label, which means the product has ingredients that can protect you from UVA as well as UVB rays.
- While UVA and UVB rays differ in how they affect the skin, they both do harm. Unprotected exposure to UVA and UVB damages the DNA in skin cells, producing genetic defects, or mutations, that can lead to skin cancer (as well as premature aging.) These rays can also cause eye damage, including cataracts and eyelid cancers. UV radiation is a proven cause of basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), which often appear on sun-exposed areas of skin. Fortunately, when discovered early enough, these common forms of skin cancer are almost always curable. UV exposure that leads to sunburn has proven to play a strong role in developing melanoma, the most dangerous of the three most common types of skin cancer. Recent research shows that the UV rays that damage skin can also alter a gene that suppresses tumours, raising the risk of sun-damaged skin cells developing into skin cancer.

Concept of High Sun Protection Factor (h-SPF)

SPF, or Sun Protection Factor, is a measure of how well a sunscreen will protect skin from UVB rays, the kind of radiation that causes sunburn, damages skin, and can contribute to skin cancer. If your skin would normally burn after 10 minutes in the sun, applying an SPF 15 sunscreen would allow you to stay in the sun without burning for approximately 150 minutes (a factor of 15 times longer). This is a rough estimate that depends on skin type, intensity of sunlight and amount of sunscreen used. SPF is a measure of protection from amount of UVB exposure and it is not meant to help you determine duration of exposure. For best protection, experts recommend using a minimum SPF sunscreen of 15, applying the proper amount (2mg/cm2 of skin, or about one ounce for full body coverage), and reapplying every 2 hours. Most people under-apply sunscreens, using ¼ to ½ the amount required. Using half the required amount of sunscreen only provides the square root of the SPF. So, a half application of an SPF 30 sunscreen only provides an effective SPF of 5.5.

The SPF (Sun Protection Factor) scale is not linear:

SPF 15 blocks 93% of UVB rays

SPF 30 blocks 97% of UVB rays

SPF 50 blocks 98% of UVB rays

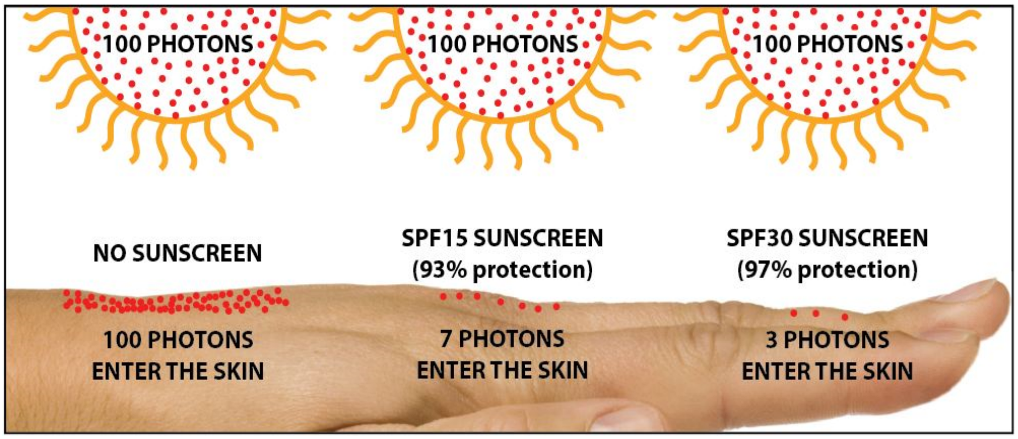
So, one way of looking at this is that SPF 30 sunscreen only gives you 4% more protection than SPF 15 sunscreen.

Or another way of looking at it is:

SPF 15 (93% protection) allows 7 out of 100 photons through

SPF 30 (97% protection) allows 3 out of 100 photons through.

So, while doubling the level of protection, an SPF 30 will block half the radiation that an SPF 15 would let through to human skin.



Source: Fitzpatrick's Textbook of Dermatology

Figure 3: SPF (Sun Protection Factor) scale

Measurement of High Sun Protection Factor (h-SPF)

The sun protection factor (SPF rating, introduced in 1974) is a measure of the fraction of sunburn-producing UV rays that reach the skin. For example, "SPF 15" means that 1⁄15 of the burning radiation will reach the skin; assuming sunscreen is applied evenly at a thick dosage of 2 milligrams per square centimetre (mg/cm2). A user can determine the effectiveness of a sunscreen by multiplying the SPF by the length of time it takes for him or her to suffer a burn without sunscreen. Thus, if a person develops sunburn in 10 minutes when not wearing a sunscreen, the same person in the same intensity of sunlight will take 150 minutes to develop sunburn of the same severity if wearing a sunscreen with an SPF of 15. It is important to note that sunscreens with higher SPF do not last or remain effective on the skin any longer than lower SPF and must be continually reapplied as directed, usually every two hours.

The SPF is an imperfect measure of skin damage because invisible damage and skin aging are also caused by ultraviolet type A (UVA, wavelengths 315–400 or 320–400 nm), which does not primarily cause reddening or pain. Conventional sunscreen blocks very little UVA radiation relative to the nominal SPF; broad-spectrum sunscreens are designed to protect against both UVB and UVA. According to a 2004 study, UVA also causes DNA damage to cells deep within the skin, increasing the risk of malignant melanomas. Even some products labelled "broad-spectrum UVA/UVB protection" has not always provided good protection against UVA rays. Titanium dioxide probably gives good protection, but does not completely cover the UVA spectrum, as early 2000s research suggests that zinc oxide is superior to titanium dioxide at wavelengths 340–380 nm. Owing to consumer confusion over the real degree and duration of protection offered, labelling restrictions are enforced in several countries. In the EU, sunscreen labels can only go up to SPF 50+ (initially listed as 30 but soon revised to 50). Australia's Therapeutic Goods Administration increased the upper limit to 50+ in 2012. In its 2007 and 2011 draft rules, the US Food and Drug Administration (USFDA) proposed a maximum SPF label of 50, to limit unrealistic claims (refer to table 1).

Table 1: High SPF (h-SPF) Sunscreen prescription (Rx) brands available in India

Sl. No.	Brand Name	Marketed By	SPF	Price INR (₹)	Pack Size
1	SUNCROS MATTE FINISH SOFT GEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	75+	671	50GM
2	SUNCROS SOFT SPF 50+ LOTION	SUN PHARMACEUTICAL INDUSTRIES LTD.	60+	748	60ML
3	SUNCROS TINT GEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	58+	795	50GM
4	SUNCROS 50 AQUA LOTION	SUN PHARMACEUTICAL INDUSTRIES LTD.	50+	442	60ML
5	PHOTOSTABLE SPF 40+ SUNSC EMULGEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	50+	570	75GM
6	PHOTOSTABLE INSTA SUNSCREEN GEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	50+	675	50GM
7	PHOTOSTABLE GOLD SUNSCREEN GEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	50+	690	50GM
8	SUNCROS SPF 26 AQUA GEL	SUN PHARMACEUTICAL INDUSTRIES LTD.	50+	394	100GM
9	UV DOUX SILICONE SUNSCREEN GEL	BRINTON PHARMACEUTICALS PVT LTD	50+	675	50GM
10	ZORAY APS NEXT SUNSCREEN	OAKNET HEALTHCARE PVT LTD	50+	875	50GM
11	ZORAY SUNSCREEN LOTION	OAKNET HEALTHCARE PVT LTD	50+	228	60ML
12	SUNCOTE GEL	CURATIO HEALTCARE INDIA PVT LTD	50+	425	100GM
13	PHOTOBLOC CREAM	CURATIO HEALTCARE INDIA PVT LTD	50+	490	50GM
14	ELFRID KIDS SUNSCREEN LOTION	CURATIO HEALTCARE INDIA PVT LTD	50+	800	60GM
15	LA SHIELD LITE GEL	GLENMARK PHARMACEUTICALS LTD	50+	980	30GM
16	SUNGRACE SUNSCREEEN LOTION	GLENMARK PHARMACEUTICALS LTD	50+	450	100ML
17	SUNGRACE TOTAL SUNSCREEEN LOTION	GLENMARK PHARMACEUTICALS LTD	50+	607	60ML
18	SUNGRACE ULTRA GEL	GLENMARK PHARMACEUTICALS LTD	50+	750	60GM
19	EPISOFT AC SUNSCREEN CREAM	GLENMARK PHARMACEUTICALS LTD	50+	525	75GM
20	LA SHIELD SUNSCREEN GEL	GLENMARK PHARMACEUTICALS LTD	50+	790	60GM
21	LA SHIELD ANTI POLLUTION SUNSCREEN GEL	GLENMARK PHARMACEUTICALS LTD	50+	840	60GM
22	LA SHIELD LITE GEL	GLENMARK PHARMACEUTICALS LTD	50+	980	30GM
23	SOLASAFE SPF 50+ SUNSCREEN GEL	REGALIZ INDIA LTD	50+	649	50GM
24	SUNMATE GEL-CREAM	PALSONS DERMA	50+	625	50GM
25	XUV SPF 50 PA+++ SUNSCREEN GEL	GENO PHARMACEUTICALS LTD	50+	450	30GM

Source: Author's Own

- There are more than 100 sunscreen brands with high SPF (h-SPF) available in Indian marketplace.
- Brand information extracted from electronic pharmacy (e-pharmacy) website: 1mg, Sasta Sundar, PharmEasy and MedPlus.
- Only prescription (Rx) brands have been considered for the study purpose.
- Over the counter (OTC) sunscreen Indian brands with high SPF (h-SPF) not considered for the study.
- Only 25 high SPF (h-SPF) Sunscreen prescription (Rx) brands represented in this study.
- Above information extracted on 23rd May 2020.

LITERATURE REVIEW

Tan *et al.*, (2002) in their study entitled *"Randomized Placebo-controlled Trial of Metronidazole 1% Cream with Sunscreen SPF 15 in Treatment of Rosacea"* discussed on the safety and efficacy of a formulation combining metronidazole 1% cream with sunscreen SPF 15 in the treatment of moderate to severe rosacea.

Gaspar & Maia Campos (2003) in their study entitled *"Rheological behaviour and the SPF of sunscreen"* determined the physical stability of five sunscreens SPF 15 (FA to FG), containing or not PVP/ Eicosene Copolymer (PVP/EC), and two different self-emulsifying bases (SEB), and also evaluated the influence of the vehicle in their SPF.

Crowther (2017) in his study entitled *"Understanding sunscreen SPF performance using cross-polarized UVA reflectance photography"* studied for understanding sunscreen behaviour in vitro before they are applied to the skin have failed to keep pace with the ever-increasing demands for higher SPF scores where the products are absorbing more and more similar levels of UV. A novel method for visualizing the spreading and location of SPF ingredients based on cross-polarized UVA reflectance photography is described here which gives new insights into the formation of final film morphology and how it correlates with in vivo SPF efficacy for a set of test products.

Couteau *et al.*, (2007) in their study entitled *"Study of the photo stability of 18 sunscreens in creams by measuring the SPF in vitro"* evaluates the photo stability of various sunscreen agents incorporated into an O/W emulsion. The concept of photo stability is very important in the field of solar protection. The effectiveness of the anti-solar products is quantified using a universal indicator: the sun protection factor (SPF).

Russak *et al.*, (2010) in their study entitled *"A comparison of sunburn protection of high–sun protection factor (SPF) sunscreens: SPF 85 sunscreen is significantly more protective than SPF 50"* studied the US Food and Drug Administration (FDA) released and proposed amendment to the 1999 sunscreen monograph. They have also touched upon an important aspect of this amendment and wanted to evaluate that the FDA has proposed that manufacturers label their products with a specific sun protection factor (SPF) value up to 50; sunscreens with SPFs >50 would be labelled as 50+. They conducted a double-blind, randomized, split-face clinical study to evaluate whether a statistically significant difference exists between the sunburn protective effects of a SPF 50 sunscreen versus a SPF 85 formulation.

Bates *et al.*, (2008) in their study entitled "Climate Change and Water" focussed on observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems.

Alley *et al.*, (2003) in their study entitled *"Abrupt Climate Change"* emphasized on Large, abrupt, and widespread climate changes with major impacts have occurred repeatedly in the past, when the Earth system was forced across thresholds. Although abrupt many reasons, it is conceivable that human forcing of climate change is increasing the probability of large, abrupt events. Were such an event to recur, the economic and ecology potentially serious. Unpredictability exhibited near climate thresholds in simple models shows that some uncertainty will always be associated with projections. In light of these consider expanding research into abrupt climate change, improving monitoring systems, and taking actions designed to enhance the adaptability and resilience of ecosystems.

Thomas *et al.*, (2004). In their study entitled *"Extinction risk from climate change"* touched upon on Climate change over the past 30 years has produced numerous shifts in the distributions and abundances of species and has been implicated in one species-level extinction. Using projections of species' distributions for future climate scenarios, we assess extinction risks for sample regions that cover some 20% of the Earth's terrestrial surface. Exploring three approaches in which the estimated probability of extinction shows a power-law relationship with geographical range size, we predict, on the basis of mid-range climate-warming scenarios for 2050, that 15–37% of species in our sample of regions and tax will be 'committed to extinction'. When the average of the three methods and two dispersal scenarios is taken, minimal climate-warming scenarios produce lower projections of species committed to extinction (18%) than mid-range (24%) and maximum-change (35%) scenarios. These estimates show the importance of rapid implementation of technologies to decrease greenhouse gas emissions and strategies for carbon sequestration.

Karl *et al.*, (2003) in their study entitled *"Modern Global Climate Change"* discussed on Modern climate change is dominated by human influences, which are now large enough to exceed the bounds of natural variability. They have also discussed that the main source of global climate change i atmospheric composition. These perturbations primarily result from emissions associated with energy use, but on local and regional scales, urbanization and land use changes has been progress in monitoring and understanding climate change, there remain many scientific, technical, and institutional impediments to precisely planning for, adapting to change. In their study they have also stated that there is still considerable uncertainty about the rates of change that can be expected, but it is clear that these changes will be increasingly manifested in important an extremes of temperature and precipitation, decreases in seasonal and perennial snow and ice extent, and sea level rise. Anthropogenic climate change is now likely to continue venturing into the unknown with climate, and its associated impacts could be quite disruptive.

Oreskes (2004) in their study entitled "The Scientific Consensus on Climate Change" worked on Policymakers and the media, particularly in the United States, frequently assert that climate science is highly uncertain. Some have used this as an argument against adopting strong measures to reduce greenhouse gas emissions. In their study they have also discussed about the scientific consensus is clearly expressed in the reports of the Intergovernmental Panel on Climate Change (IPCC). Created in 1988 by the World Meteorological Organization and the United Nations Environmental Programme, IPCC's purpose is to evaluate the state of climate science as a basis for informed policy action, primarily on the basis of peer-reviewed and published scientific literature.

Thompson, Jolley & Marks (1993) in their study entitled *"Reduction of Solar Keratoses by Regular Sunscreen Use"* have discussed about the incidence of and mortality from skin cancer are increasing in many countries. They have also expressed their concern about ozone depletion; many organizations are promoting the regular use of sunscreens to prevent skin cancer, despite the absence of evidence that these products have this effect. Solar (actinic) keratosis is a precursor of squamous-cell carcinoma of the skin.

Gasparro, Mitchnick & Nash (2008) in their study entitled *"A Review of Sunscreen Safety and Efficacy"* discussed about the use of sunscreen products has been advocated by many health care practitioners as a means to reduce skin damage produced by ultraviolet radiation (UVR) from sunlight understand the efficacy and safety of sunscreen products given this ongoing campaign encouraging their use. They have also discussed about the approach used to establish sunscreen efficacy, sun protection assessment of primarily UVB (290–320 nm) filters. The SPF test, however, does not adequately assess the complete photo protective profile of sunscreens specifically against nm). Moreover, to date, there is no singular, agreed upon method for evaluating UVA efficacy despite the immediate and seemingly urgent consumer need to develop sunscreen spectrum UVB and UVA photo protection. With regard to the safety of UVB and UVA filters, the current list of commonly used organic and inorganic sunscreens has favourable to sub chronic and chronic animal or human studies. Further, in most studies, sunscreens have been shown to prevent the damaging effects of UVR exposure. Thus, based on th it is concluded that sunscreen ingredients or products do not pose a human health concern. Further, the regular use of appropriate broad-spectrum sunscreen products could h impact on public health as part of an overall strategy to reduce UVR exposure.

Diffey (2001) in their study entitled *"When should sunscreen be reapplied?"* discussed the purpose to determine how the time of sunscreen reapplication affects the solar ultraviolet exposure of the skin. A mathematical model was derived that took into account typical amounts of sunscreen application and sunscreen substantively to determine how these factors, when combined with the time of sunscreen reapplication, influence the photo protection provided by sunscreen during exposure for several hours around mid-day in strong sunshine.

Wright, Wright & Wagner (2001) in their study entitled *"Mechanisms of sunscreen Failure"* have discussed that Sunscreen is used as a primary strategy to prevent sunburn and later skin cancer. In their study they have also expressed that sunscreen use has paradoxically been associated with the increasing incidence of skin cancer. One explanation for this puzzling observation is sunscreen failure (sunburn in the setting of sunscreen). Our purpose was to evaluate mechanisms of sunscreen failure in a sunscreen-using population.

Burnett & Wang (2011) in their study entitled *"Current sunscreen controversies: a critical review"* emphasized that Sunscreens that are believed to be a valuable tool in providing photo protection against the detrimental effects of UV radiation, a known carcinogen. However, several controversies have developed regarding their safety and efficacy. This review summarizes the relevant studies surrounding these controversies.

Research Gap

Based on the review of existing literatures, it has been found that incredible work has been performed by the distinguished researchers and academicians on the different activities regarding climate change, sunscreen, and sun protection factor (SPF). But none of the studies have so far established a link with regard to cosmetic product i.e. sunscreen with high sun protection factor (SPF) and climate change in Indian context and hence an attempt has been taken to provide some light on the research gap area as well as to explore further research in the distant future.

Theoretical Foundation of the Study

Some scientists have also questioned the human origin of global warming, explaining that CO_2 released into the atmosphere by human activities does not really affect the climate or the ecosystems of Earth. They argue that these gases are either regulated by ecosystems that they are not released in sufficient quantities to have an impact, or that other gases (such as water vapour) have a greater impact on ecosystems. Although all these positions are partly true, they do not call into question the human origin of global warming. Thus, CO_2 is well absorbed in part by the ocean and by plants, but not fast enough to be regulated due to the huge contribution of human activities.

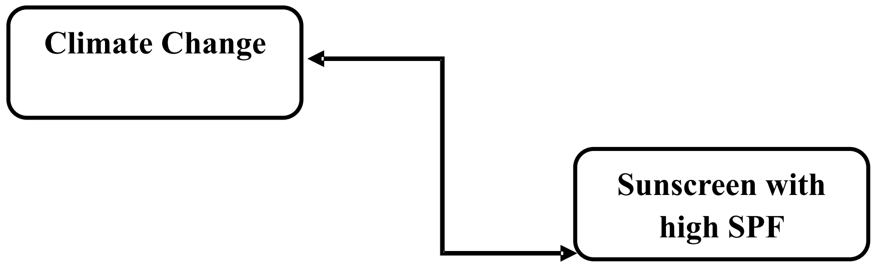
An increase in temperature due to global warming it is not only about a heat increase that can be felt by humans or glacial ice melting – it has the potential to affect the planet's entire ecosystem. As we have been watching in many different countries, from the US (California) to India or South Africa, the weather is getting disruptive. Extreme weather events are more regular, and their patterns are changing – they are more intensive, aggressive, and with more energy. This means more storms, floods, cyclones, and droughts will take place over the next years (refer to figure 4).

SPF, which stands for *"sun protection factor,"* indicates how much sun exposure human elements getting when they are outside or exposure to the sun. As discussed before,

SPF 15 blocks 93% of UVB rays

SPF 30 blocks 97% of UVB rays

SPF 50 blocks 98% of UVB rays



Source: Author's Own

Figure 4: Connect between Cosmetics and Climate Change with reference to High SPF (h-SPF) based Sunscreen

Objective of the study

The objective of the study is to understand the connection of cosmetic product sunscreen with high sun protection factor (h-SPF) for treating dermatological disorders and combating climate change in India.

RESEARCH METHODOLOGY

A research methodology is the specification of methods and procedures for acquiring the information needed. It is the over-all operational framework of a study that stipulates what information is to be collected from which sources and by what procedures. Complete step wise procedures what has been followed during the study discussed in the following as per the systematic order.

Data Collection

The study primarily based on the quantitative research approach. Primary data has been collected with the help of a questionnaire consisting with 5 focussed questions to satisfy the research objective. The questionnaire had been prepared by following the principles of 5 Point Likert Scale. The questionnaire had been designed and presented through Google Form and the same had been communicated electronically to the Indian Dermatologists, bona fide members of the Indian Association of Dermatologists, Venereologists and Leprologists (IADVL), the largest representing official society of Indian Dermatologists; authorized to treat and clinically evaluate all dermatological diseases and disorders. Appropriate social media platforms (Linkedin, Whatsapp Group, Twitter, and Facebook) had been adopted to reach the wide participants. Total number of 165 responses received from Indian's 28 states and 8 Union Territories (UTs), out of 165 respondents, 100 respondents had provided desired response applicable for all 5 questions and the consolidated response sheet had been prepared to carry forward the research work.

Significance of Likert Scale in Primary Data Collection

We know that a Likert scale is a psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research, such that the term is often used interchangeably with rating scale, although there are other types of rating scales. The most widely used is the Likert scale (1932). In its final form, the Likert scale is a five (or seven) point scale which is used to allow the individual to express how much they agree or disagree with a statement.

For the following specific reasons 5-point Likert Scale Technique has been incorporated in the study:

- Likert Scale questions are widely used to measure attitude and opinions to the great degree of human response/respondents.
- It is a type of survey questions that offer a range of questions from one extreme attitude to the other. For example, in this study "Very Satisfied" to "Very Unsatisfied" has been incorporated to know the mindset of health care providers (HCPs) who are none other than the Dermatologists treat different dermatological diseases and disorders.
- It's most popular because they are most reliable method of measurement of human opinions, perceptions and behaviour.

Sampling Technique

100 respondents have been chosen in the study based on the Stratified sampling technique criteria.

Software Package

For data analysis and interpretation software package Microsoft Excel, version-16 has been used. Different functions COUNTA, COUNTBLANK, SUM, COUNTIF and SUM followed by appropriate syntax have been incorporated one after another during data analysis process. For visual representation, clustered horizontal pyramid chart has been incorporated in the study and the chart has been prepared by using Microsoft Excel, version-16 software package (refer to table 2).

Table 2: Function and Syntax used in Microsoft Excel

Function (*fx*)	**Syntax used in the study**	**Explanation of the Syntax**	**Outcome**
COUNTA	=COUNTA(B3:B102)	To know the number of respondents participated in the survey.	*N=100*
COUNTBLANK	=COUNTBLANK(B3:B102)	To understand the nonparticipation of the respondents in the survey.	0
SUM	=SUM(B104:B105)	To know the total number of respondents participated in the survey	(100+0)=100
COUNTIF	=COUNTIF(B3:B102,"Very Satisfied") =COUNTIF(B3:B102,A109) =COUNTIF(B$3:B$102,$A109)	Mixed referencing performed to evaluate "Very Satisfied" and assignment of the following made as constant to perform the next level operations. B$3 B$102 $A109	54 with respect to Question No. 1

SUM	=SUM(B109:B113)	To know the total respondents from "Very Satisfied" to "Very Unsatisfied"	100
COUNTIF	=COUNTIF(B$3:B$102,$A110)	To obtain the "Satisfied" value	'23' with respect to Question 1
COUNTIF	=COUNTIF(B$3:B$102,$A111)	To obtain the "Neutral" value	'14' with respect to Question 1
COUNTIF	=COUNTIF(B$3:B$102,$A112)	To know the "Unsatisfied" value	'3' with respect to Question 1
COUNTIF	=COUNTIF(B$3:B$102,$A113)	To understand the "Very Unsatisfied" value	'5' with respect to Question 1
=(B110/B$115)	=(B110/B$115)	To define the percentage (%) of each response type from the extreme of "Very Satisfied" to "Very Unsatisfied"	

Source: Author's Own

Apart from the above Functions (fx) and Syntax following Referencing Criteria has also been incorporated during data analysis and interpretation (refer to table 3).

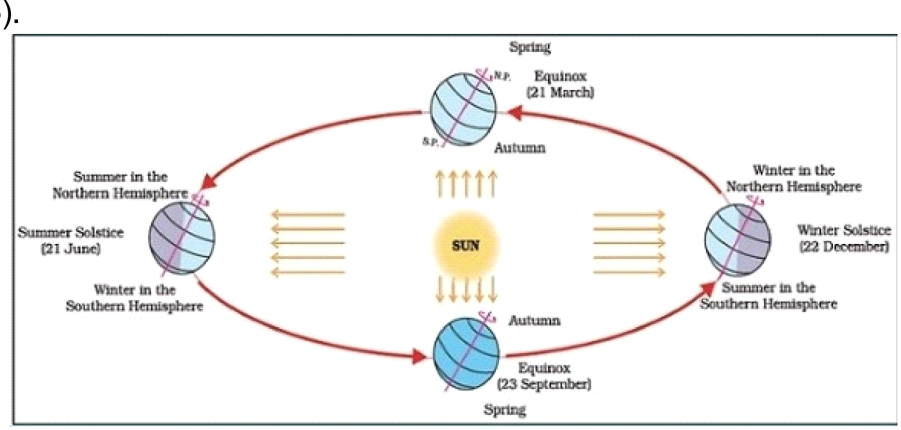
Table 3: Referencing Criteria

Referencing Criteria	Application
Relative Referencing	When the formula is copied to a new cell, the corresponding cell address changes with reference to reference to the new cell address.
Absolute Referencing	Sometimes it becomes necessary to keep the value of a cell constant in a formula. This behaviour is known as Absolute Referencing.
Mixed Referencing	Mixed Referencing is a combination of R elative and Absolute Referencing. In this reference, the data of one cell is kept absolute and other is made relative and they are operated together in a formula.

Source: Author's Own

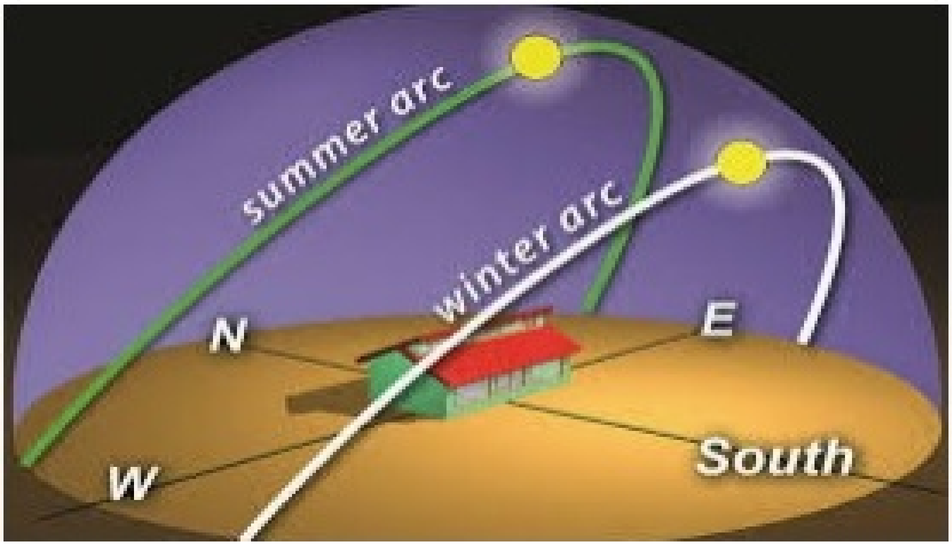
Study period and its significance

Study period had been chosen from April 2019 to June 2019 i.e. three (3) months (refer to figure 5 & 6).



Source: Permaculture Research Institute

Figure 5: Summer Solstice



Source: Permaculture Research Institute

Figure 6: Summer Solstice

We all know that summers are hotter, and winters are colder. Also, when it is summer in the northern hemisphere, it is winter in the southern hemisphere. But why is that? The summers are hotter because, the sun's path is higher in the sky. This makes the days longer and it makes the summer sun more intense. During summer, the North Pole is tilted towards the sun. Therefore, the sun's path is higher in the sky, causing the northern hemisphere to receive more light and heat. Around June 21st, the northern hemisphere is tilted the most towards the sun and is called as the Summer Solstice. On this day, which can be referred as the first day of summer, the sun's path is higher in the sky than it is on any other day in the year. In addition, because the sun is in the sky for more hours, the summer solstice is also the longest day in the year. These extra hours of sunlight give the sun more time to heat the earth and this is the main reason for summer to be the hottest season.

RESULT & DISCUSSION

Data Analysis and Interpretation

Table 3 represents the consolidated response of participants (CRP) and the same has been prepared with the help of transpose formatting technique in Microsoft Excel (version-16).

Table 3: Consolidated Response of Participants (CRP)

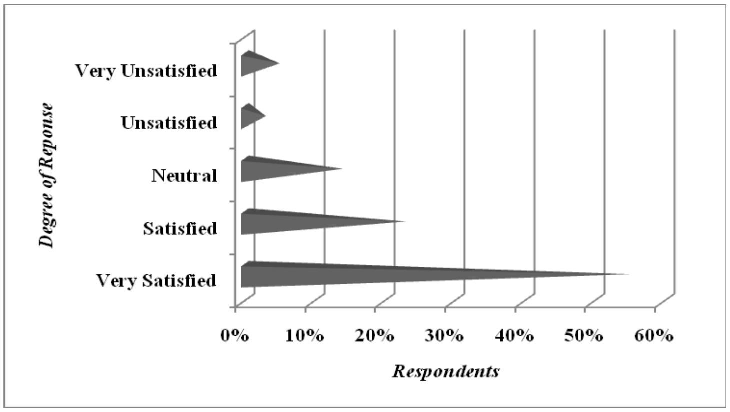
Question No.	Total Respondents (*N*)	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total Respondents
Q1	**100**	55%	23%	14%	3%	5%	**100%**
Q2	**100**	57%	21%	13%	3%	6%	**100%**
Q3	**100**	56%	18%	15%	1%	10%	**100%**
Q4	**100**	65%	13%	12%	2%	8%	**100%**
Q5	**100**	47%	24%	22%	2%	5%	**100%**

Source: Author's Own Calculation in Microsoft Excel, version 16

In the following detailed discussion and visual representation regarding each question is discussed one after another.

Q1: Are you satisfied with higher SPF (h-SPF) based sunscreen while treating dermatological disorder during increasing temperature due to climate change?

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total
Q1	55%	23%	14%	3%	5%	100%



Source: Author's Own Analysis in Microsoft Excel, version 16

Figure A: Visual Representation of Question 1 (Q1)

From the above visual representation, we can find that a significant percentage (%) of respondents (dermatologists) have expressed their views in favour of the question statement. 55% have expressed as “Very Satisfied” and 23% have expressed “Satisfied”, and it may be due to global temperature change which is responsible for radioactive cooling to space as infrared radiation, which increases strongly with increasing temperature. The insignificant response as Unsatisfied (3%) and Very Unsatisfied (5%) regarding the question statement has been recorded in the study. It may be due to adoption of any one of the following or combination for providing protection from different dermatological diseases and disorders caused by high temperature owing to climate change.

Cover up

Clothes can provide some protection from UV exposure. Tightly woven dry fabrics some dermatologists also recommend.

Stay in the shade

Limit your exposure to direct sunlight by staying in the shade. This is most important between 10 a.m. and 4 p.m., when UV rays are stronger. This advise is also being recommended by the dermatologists.

Wear a hat

Some dermatologists recommend that a wide-brimmed hat can provide additional protection to patients' ears and neck.

Wear sunglasses

Dermatologists choose sunglasses that offer UV protection to prevent damage to patients' eyes and the surrounding skin.

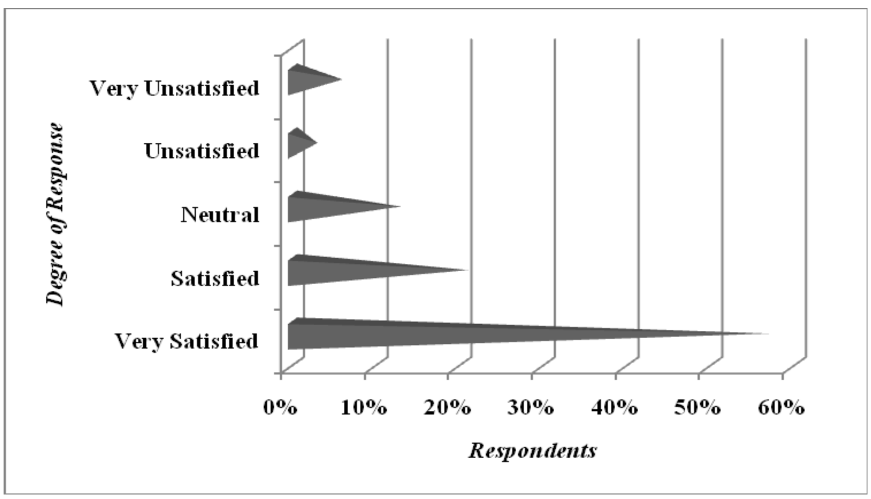
Chemical Sunscreens

Dermatologist also recommends chemical sunscreens (i.e., UV organic filters, which absorb the UV light).

In the study 14% respondents expressed their "Neutral" views it may due to the adoption of other means as expressed herein above and partially using high SPF (h-SPF) based sunscreen for treating different dermatological diseases and disorders owing to high temperature due to climate change.

Q2: Do you really feel satisfied in prescribing (Rx) sunscreen with higher SPF (h-SPF) and think it is essential for treating different dermatological disorders?

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total
Q2	57%	21%	13%	3%	6%	100%



Source: Author's Own Analysis in Microsoft Excel, version 16

Figure B: Visual Representation of Question 2 (Q2)

While analysing the responses regarding Question 2, it has been observed that significant percentage of respondents have expressed their views as "Very Satisfied" (57%) and "Satisfied" 21%.

The reason for significant response may be due to the following reasons:

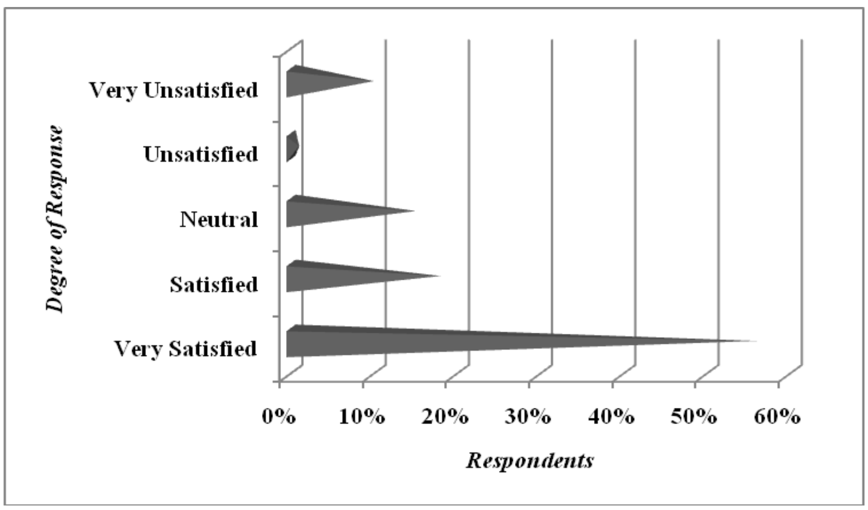
- SPF 15 blocks 93% of UVB rays
- SPF 30 blocks 97% of UVB rays
- SPF 50 blocks 98% of UVB rays

To ensure covering of critical wavelength (wavelength at which the sunscreen allows 10% of the rays to penetrate) over 370nm to provide excellent UVA protection by complying the norms as laid down in USFDA (US Food and Drug Administration).

Insignificant response Unsatisfied (3%) and Very Unsatisfied (6%) have been recorded and it may be due to the adoption of other means or clinical therapy for treating different dermatological disorders and diseases. 13% Neutral responses recorded in the study and it may be due to partially adoption of high SPF (h-SPF) based sunscreen and partially other means of treatment proceedings as per the clinical need of patient fraternities.

Q3: Do you support the views that 'sunscreen with higher SPF (h-SPF) many dermatological diseases and disorders can be treated well'?

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total
Q3	56%	18%	15%	1%	10%	100%



Source: Author's Own Analysis in Microsoft Excel, version 16

Figure C: Visual Representation of Question 3 (Q3)

In case of Question no. 3, significant response 56% recorded as Very Satisfied and 18% response as Satisfied and it may be due to the following reason.

Dermatologists can treat different diseases and disorders as mentioned below by adopting sunscreen with high SPF (h-SPF).

- Vitiligo
- Photo ageing
- Sunburn
- Melasma
- Pigmentation Disorder

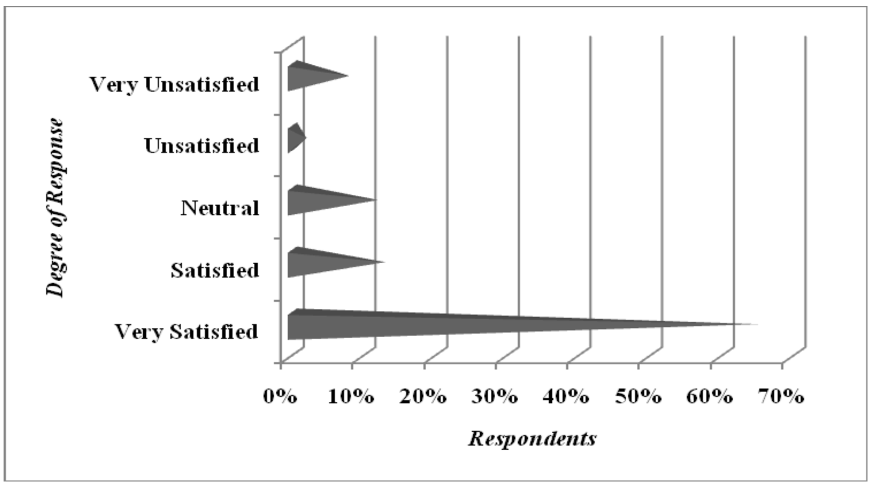
- Decrease the risks of skin cancer
- Early skin aging caused by the sun

Slow or temporarily prevent the development of wrinkles, dark spots and sagging skin

Insignificant response as Unsatisfied 1% and Very Unsatisfied 10% have been recorded in the study and it may due to non adoption of sunscreen with high SPF (h-SPF) by the Indian dermatological fraternities or they might not have obtained desired results in their clinical proceedings. Neutral 15% response has been recorded and it may be due to considering sunscreen with high SPF (h-SPF) partially as well as adoption of other clinical procedures to satisfy the healthcare need of the patient fraternities.

Q4: Do you feel satisfied with the high SPF (h-SPF) based sunscreen while treating paediatric to geriatric patients and providing sun protection in day to day use to combat with climate change?

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total
Q4	65%	13%	12%	2%	8%	100%



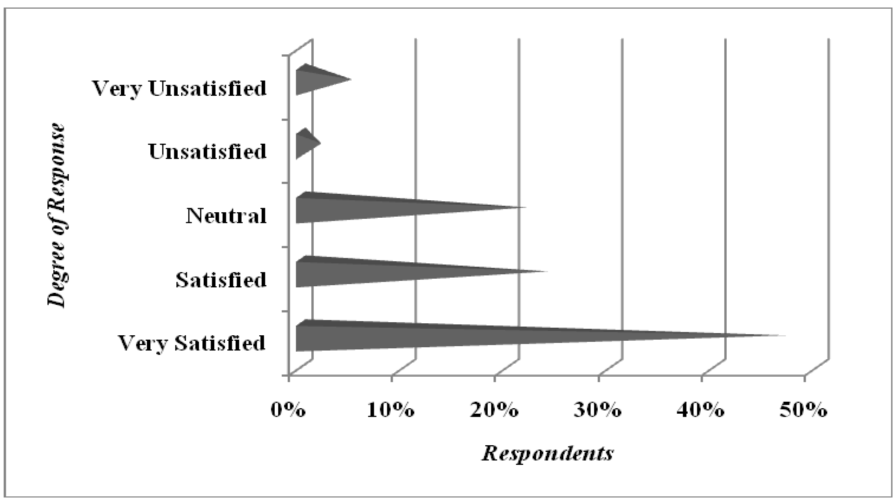
Source: Author's Own Analysis in Microsoft Excel, version 16

Figure D: Visual Representation of Question 4 (Q4)

While interpreting the responses regarding Question no. 4 it has been found that 65% respondents have expressed their views as Very Satisfied, 13% have been expressed as Satisfied. The reason for significant response may be due to sunscreen use during childhood and adolescence can significantly reduce lifetime incidence of melasma, photo ageing, pre mature dermatological pigmentation order and skin cancer; therefore, dermatologist in India recommending children to use high SPF (h-SPF) based sunscreen for providing protection for UV-A and UV-B radiation. For children dermatologist recommended SPF for sunscreen for children is 30+. In case of children they prefer to choose water-resistant sunscreen that offers broad-spectrum coverage and advice them to re-apply every two hours while they are outside more often while they are swimming or sweating. The dermatologists also recommend sunscreen for treating geriatric dermatological disorder since senior citizen (age > 60 years) store fat differently, which complicates heat-regulation in their body further. As the temperature rises, their internal body temperature, especially when they are exposed directly to the sun or extremely hot environments. For treating geriatric dermatological disorder owing to high temperature Indian dermatologists prefer to use high SPF (h-SPF) based sunscreen with SPF 30+ or SPF 50+. In Indian marketplace so many high SPF (h-SPF) brands are available as reported in the earlier section of this study. Insignificant response as Unsatisfied 2% and Very Unsatisfied 8% also have been reported in the study and it may be due to non adoption of high SPF (h-SPF) based sunscreen in the clinical proceedings of the dermatologists in India. Neutral response 12% has been also obtained in the study and it may due to partial adoption of sunscreen as well as partial adoption of other means in the treatment proceeding of Indian dermatologist fraternities.

Q5: Do you believe that sunscreen with higher SPF (h-SPF) can provide protection for both ultraviolet A and ultraviolet B (UV-A & UV-B) radiation?

	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied	Total
Q5	47%	24%	22%	2%	5%	100%



Source: Author's Own Analysis in Microsoft Excel, version 16

Figure E: Visual Representation of Question 5 (Q5)

Regarding Question 5 responses it has been found that 47% have expressed Very Satisfied and 24% have put forwarded their views as Satisfied. On the contrary 2% have expressed Unsatisfied and 5% have expressed as Very Satisfied. It has been observed Neutral response 22%.

The significant response may be due to the following reasons:

- UVA rays cause tanning, and the shorter wavelengths of UVA also cause sunburn. There is no such thing as a safe or healthy tan. UVA radiation is proven to contribute to the development of skin cancer.

- UVA is connected to the “broad-spectrum protection” which can be seen on the labels of sunscreen products. Early sunscreens only protected patients' skin from UVB rays, but once it was understood how dangerous UVA rays were, sunscreen manufacturers began adding ingredients like zinc oxide and titanium dioxide to protect patients' skin from both UVB and UVA across this broader spectrum and accordingly Indian dermatologist also adopted this principle in their prescription (Rx) behaviour to ensure patient safety and security.
- Whereas UVB penetrates and damages the outermost layers of human skin. Overexposure causes suntan, sunburn and in severe cases blistering.
- UVB is connected to the Sun Protection Factor (SPF) on labels of sunscreen products. The SPF number tells patients how long the sun's radiation (including some of the UVA) would take to redden human skin when using that product compared to the time without sunscreen.
- UVB intensity fluctuates. While the sun's rays are strongest and pose the highest risk late-morning to mid-afternoon from spring to fall in temperate climates and even greater time spans in tropical climates, UVB rays can damage human skin year-round, especially at high altitudes or on reflective surfaces like snow or ice.
- UVB rays can be filtered and do not penetrate glass.

Insignificant response has been reported here and it may be due to non adoption of high SPF (h-SPF) based sunscreen in the clinical proceedings of the dermatologists in India. Neutral response been also obtained here, and it may be due to partial adoption of sunscreen as well as partial adoption of other means in the treatment proceedings of Indian dermatologist fraternities.

CONCLUSION

After interpreting the dataset and analyzing the visual representation with regard to the sample respondents in the study for each one question presented in the questionnaire it has been found that a significant percentage (%) of health care providers (HCPs) are providing their "highly satisfied" and "satisfied" response while treating patients fraternities with high SPF (h-SPF) based sunscreens like SPF 15+, SPF 30+, SPF 50+ for treating different dermatological diseases and disorders like photo ageing, melasma, blisters, sun burn, suntan, pigmentation caused by high temperature which is the effect of climate change in Indian context. After analyzing the responses it has also been found that Indian dermatologists are recommending high SPF (h-SPF) based sunscreens to the patient fraternities which include paediatric to geriatric patients and ensuring all safely measures by recommending high SPF (h-SPF) based sunscreens and catering their healthcare needs. In the study it has also been found that Indian dermatologists are adopting SPF (h-SPF) based sunscreens in their prescription (Rx) behaviour for providing safety measures to the needy patients for protecting them from UV-A as well as UV-B radiation which affect human health at large in many ways. Finally, in the study it has been found that Indian dermatologists are expressing their valuable views in favour of high SPF (h-SPF) based sunscreens to strategically mange high temperature caused by climate change. This study is mainly restricted to the SPF (h-SPF) based sunscreens for combating climate change. In current context climate change is a very broad aspect and further study can be explored with respect to changes in crop production or any other relevant agricultural products impacted by climate change. In the study function (f) and syntax has been used in the Microsoft Excel (version-16) package. Further empirical analysis can be performed by using contemporary programming language like R or Python.

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Evaluative Study of Non-performing Assets (NPA) of Public and Private Sector Banks in India

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ABSTRACT

NPA as an asset or account of borrower which has been categorized by bank as second-rate suspicious or loss assets under the rule relating to assets classified issued by the RBI. The augment in NPAs shows the requirement of provisions, which get down the on the whole profitability of commercial banks. A lofty altitude of NPAs suggests a high probability of a high number of credit evasions that influence the profitability and liquidity of banks. Thus, a strong, rule-based and sustainable banking system is very vital for the overall advancement of an economy, the failure of which may lead to adverse effects on various segments and in various spheres of the economy. This paper is an attempt to study the present condition of NPA and how competently public and private sector commercial banks handled their NPAs. Secondary data have been collected for the selected classes of the Indian commercial banks from various RBI publications for four years i.e. from 2016 to 2019. Result in terms of independent t-test reveals that public sector banks have shown a continuous mounting trend in both gross and net NPAs whereas private banks were not at stride progress. Moreover, all commercial banks took a hard step to managing the problems in the best possible way. The individual banks also tried to trim down their doubtful and loss assets consistently due to the regulatory guideline and supervisory aspect issued by the competent authority.

Keywords: NPA, Prudential Norms, DRT, Bad Debt, CAGR

INTRODUCTION

The dealing of banking fundamentally involves intermediation-acceptance of deposits and canalizing these deposits into specific lending purposes. In the conventional banking business of lending financed by deposits from depositors, commercial banks have been experiencing with the risk of non-payment by the borrower in the payment of either principal amount or interest. Further, the presence of these doubtful or loss assets is a bottleneck of the banking system. That is why a high level of NPA is an area of great concern to all financial institutions and it has a profound effect on the economy. In most cases, the loan amount remained overdue and commercial banks were not in a position to recover the capital and interest as well. PA is definitely a major critical issue in the present context for the entire banking as well as non-banking systems across the globe.

Indian Banking system has also been facing this critical situation very badly in this globalized era for the past many decades. Narasimham committee reports I and II, Verma Committee Report, Basel I, II, and III have continuously been providing guidelines and regulations regarding this a blazing issue. Nowadays, NPA Management has become tantamount to the functional efficiency of the general banking system in India.

Moreover, the Securitization Reconstruction of Financial Assets and Enforcement of Security Interest Act (SARFAESI), 2002 defined NPAs as an amount of borrower, which has been classified as substandard, doubtful and loss asset in accordance with the instructions or guidance relating to asset categorization issued by the Reserve Banks of India.

Banks should classify their assets into the following broad groups, like - (i) Standard Assets, (ii) Sub-standard Assets, (iii) Doubtful Assets, and loss Assets.

NPAs = [(gross or net NPA)/total advances]*100 Where,

Net NPAs = Gross NPSs – Provision for NPA

As per RBI circular, gross advance means, all outstanding loans and advances counting advances for which refinance has been received but excluding re-discounted bills and press forward written off at the central level. RBI has advised that while reporting, banks have to reduce technical write off made at head office from gross advances too.

Net NPA can be calculated by deducting the following instruments:

- Balance in the interest suspense account.
- DICGC established and held pending adjustments.
- Total provisions made excluding technical write off made at head office.

Net NPA should be below 10 percent from July 2007 (RBI, 2007). This study endeavors to analyses the non-performing assets of public and private sector banks in India because NPAs are a sign of the performance of commercial banks in India. The earning competency and profitability of the banks are highly affected due to the existence of banks' bad debts. The NPA growth rivets the necessity of provisions, which reduces the overall earnings and shareholders' value in general. Like any other business enterprise, the efficiency of a bank is evaluated based on the profitability and quality of assets it possesses.

LITERATURE REVIEW

Gupta & Jaiswal (2020) examined the banking indicators i.e. liquidity, profitability, management efficiency, etc. and found that private banks were more successful in managing bad debt and performed better than public banks.

Koley (2019) studied the financial performance and efficiency of the public and private banks for the period of 2013-18 with the help of using CAMEL model and concluded that private banks have better capital adequacy ratio and comparative low NPA.

Kavitha & Muthumeenakshi (2016) studied that NPAs have always formed a big problem for the banks in India. It is not a big predicament for the banks but the Indian economy as well. The finance blocked up in NPAs has a direct impact on the profitability of the bank as Indian banks are very much reliant on returns from interest on funds lender. This paper indicates that the extent of NPA is comparatively very high in public sector banks as compared to private banks. Though many steps have been considered by the government to bring down the NPAs still some big effort needs to be done in order to curb the present problem.

Das & Dutta (2014) stated that NPAs have become the grim situation for all commercial banks and despites so many measures, it was very difficult to come out from this problem and the ratio was going up and up consistently. The study also dealt with various types of NPA and its sources as well as its contact on the banking system. The study has done for SBI and its associates, and the other public sector banks. Based on the secondary data collected from the annual reports of six years starting from 2008 to 2013 concluded the austere situation of NPA with help of valid statistical tool i.e. ANOVA.

Shalini (2013) coined that bankers should avoid sanctioning loans to non-creditworthy borrowers by adopting concrete measures. There should be a careful appraisal of the project which involves inspecting the economic viability of the venture. A banker must consider the return on investment (ROI) on a proposed project. There are many empirical studies conducted on the current issue of NPA of commercial banks in India and abroad as well. Profitability analysis of Indian banks, it is relevant to study the impact of priority sector lending, credit policies, and credit worthiness of a borrower. Many studies conducted on the analysis of NPA with the statistical tool, and found that it requires immediate reforms least it would be a serious concern of the Indian economy (Kumar & Dadhich, 2014; Reddy, 2002; Ahmed & Jegdeeshwaran, 2013; Uppal & Khanna, 2014).

Satpal, 2014; Selvarajan & Vadivalagan, (2013) outlined that NPAs are one of the major concerns for banks in India. A soaring level of NPAs recommends a high probability of credit defaults that have a profound effect on the profitability and net-worth of banks. Moreover, it also corrodes the value of the asset and posing menace on the quality of assets and survival of banks.

Objectives of the Study:

- To examine the trends of gross NPA of selected public and private sector banks in India.
- To analyze the trends of net NPA of selected public and private sector banks in India.
- To study the difference of NPA of public and private sector banks in India.

Research Design of Present Study

In this study, the following three methods will be adopted in the context of research design- the survey of concerning literature and statement, experiencing and framing of literature, analysis of the collection and analysis of NPA of Indian banks.

- **Collection of Data:** The study based on secondary data collected from the published records of banks, annual reports of RBI, websites, reports of economic survey, etc.

- **Tools of Analysis:** The collected data recorded, analyzed, and interpreted in a significant manner with the help of independent test.
- **Sample Unit:** In public sector banks- State Bank of India, Punjab National Bank, Union banks of India, Bank of Baroda and Canara bank have selected whereas in private sector banks were ICICI Bank, Axis Bank, HDFC Bank, Yes bank and IndusInd banks.
- **Period of Study:** The data was collected during March 2016-19.

Hypotheses

H_{01}: There is no significant difference between the percentage of gross NPA of public and private sector banks.

H_{02}: There is no significant difference between the percentage of net NPA of public and private sector banks.

RESULT AND DISCUSSION

Expansion of credit is a must for a country like India. But as mentioned below, high NPA growth may lead to a credit problem. Therefore, policymakers, economists, and administrators face the quandary to minimize such risks that arise from dilution in credit quality. Table 1 shows total advances in terms of gross and net which outlined the stride process during a given period i.e. 2014-17. Further, there was a significant augmented trend of gross and net NPA of all Scheduled Commercial Banks, Public Sector Banks, Old Private Sector Banks, and Foreign- Banks in India. Especially SCB and public sector banks delineated huge gross and net non-performing assets as compared to public sector banks which were an alarming concern for policymakers and regulators (refer to table 2).

Table 1: Gross and Net NPAs of Scheduled Commercial Banks (in crore)

Year (end - March)	Advances		Non-Performing Assets (NPAs)					
			Gross			Net		
	Gross	Net	Amt.	As % of Gross Advances	As % of Total Assets	Amt.	As % of Net Advances	As % of Total Assets
Scheduled Commercial Banks								
2014-15	7560666	7388160	322916	4.3	2.7	175841	2.4	1.5
2015-16	8171114	7896467	611607	7.5	4.7	349814	4.4	2.7
2016-17	8476705	8116109	791791	9.3	5.6	433121	5.3	3.1
2017-18	9266210	8745978	1039679	11.2	6.8	520679	6.0	3.4
Public Sector Banks								
2014-15	5616718	5476250	278468	5.0	3.2	159951	2.9	1.8
2015-16	5821952	5593577	539956	9.3	5.9	320376	5.7	3.5
2016-17	5866373	5557232	684732	11.7	7.0	383089	6.9	3.9
2017-18	6141698	5697350	895601	14.6	8.9	454473	8.0	4.5

Old Private Sector Banks								
2014-15	1607339	1584312	33690	2.1	1.3	14128	0.9	0.5
2015-16	1972659	1939339	55853	2.8	1.8	26677	1.4	0.8
2016-17	2266721	2219475	93209	4.1	2.6	47780	2.2	1.3
2017-18	2725891	2662753	129335	4.7	3.0	64222	2.4	1.5
Foreign Banks in India								
2014-15	336609	327599	10761	3.2	1.4	1762	0.5	0.2
2015-16	376504	363551	15798	4.2	1.9	2762	0.8	0.3
2016-17	343611	332335	13629	4.0	1.7	2137	0.6	0.3
2017-18	363305	351016	13850	3.8	1.6	1548	0.4	0.2

Source: Report on Trends and Progress of Banking in India, RBI, 2007

Table 2: NPAs of SCBs Recovered through Various Channels (in billions)

Year	S No.	Recovery Channel	Lok Adalat	DRTs	SARFAESI Act	Total
2012-13	1	No. of cases referred	840,691	13,408	190,537	1,044,636
	2	Amount involved	66	310	681	1,057
	3	Amount recovered*	4	44	185	233
	4	3 as percent of 2	6.1	14.2	27.2	22
2013-14	1	No. of cases referred	1,636,957	28,258	194,707	1,859,922
	2	Amount involved	232	553	953	1,738
	3	Amount recovered*	14	53	253	320
	4	3 as percent of 2	6	9.6	26.6	18.4
2014-15	1	No. of cases referred	2,958,313	22,004	175,355	3,155,672
	2	Amount involved	310	604	1,568	2,482
	3	Amount recovered*	10	42	256	308
	4	3 as percent of 2	3.2	7	16.3	12.4
2015-16	1	No. of cases referred	4,456,634	24,537	173,582	4,654,753
	2	Amount involved	720	693	801	2,214
	3	Amount recovered*	32	64	132	228
	4	3 as percent of 2	4.4	9.2	16.5	10.3
2016-17		No. of cases referred	2,152,895	28,902	28,902	2,261,873
		Amount involved	1,058	671	1,131	2,860
		Amount recovered*	38	164	78	280
		3 as a percent of 2	3.6	24.4	6.9	9.80

Source: RBI, 2007

Some measures are designed to maximize the NPA's recoveries in the Indian banking system. The Central government and RBI have taken steps for controlling the incidence of fresh NPAs and creating a legal and regulatory environment to facilitate the recovery of existing NPAs of banks. They are lime One Time Settlement Schemes, Lok Adalat, Debt Recovery Tribunals (DRTs), and Securitization and SARFAESI Act, 2002. The above table 3 shows the NPAs of commercial banks somehow managed with the help of Lok Adalat during the study period of 2013 to 2017. From the analysis of the table, it is cleared that the number of cases referred to Lok Adalat for the recovery of NPAs of commercial banks has increased largely in 2016 as compared to 2012-13. The same trend indicated by Debt Recovery Tribunals (DRTs) and Securitization and SARFAESI Act in terms of the amount involved and the amount recovered but these are minor instruments to control the NPA but not correct remedies to come out of it. Recovery of advances is the lifeline for Banks. Poor rate of recovery affects the recycling of funds. RBI introduced norms for NPAs in order to ensure discipline among banks in case of recovery. The higher level of NPAs reflects the deficiencies in the credit delivery mechanism of Banks. They also create a negative image of the bank.

Table 3: Gross and Net NPA of Public Sector Banks (In crore)

Banks	**Particular**	**2019**	**2018**	**2017**	**2016**
PNB	Gross NPA	78,472.70	86,620.05	55,370.45	55,818.33
	Gross NPA (%)	16	18	13	13
	Net NPA	30,037.66	48,684.29	32,702.10	35,422.56
	Net NPA (%)	7	11	8	9
SBI	Gross NPA	172,750.36	223,427.46	112,342.99	98,172.80
	Gross NPA (%)	8	11	7	7
	Net NPA	65,894.74	110,854.70	58,277.38	55,807.02
	Net NPA (%)	3	6	4	4
BOB	Gross NPA	48,232.77	56,480.39	42,718.70	40,521.04
	Gross NPA (%)	15,609.50	23,482.65	18,080.18	19,406.46
	Net NPA	9.61	12.26	10.46	9.99
	Net NPA (%)	3.33	5.49	4.72	5.06
Union Bank	Gross NPA	48,729.15	33,712.00	33,712.28	24,170.89
	Gross NPA (%)	15	16	11	9
	Net NPA	20,332.42	24,326.00	18,833.00	14,025.94
	Net NPA (%)	7	8	7	5
Canara Bank	Gross NPA	39,224.12	47,468.47	34,202.04	31,637.83
	Gross NPA (%)	9	12	10	9
	Net NPA	22,955.11	28,542.40	21,648.98	20,832.91
	Net NPA (%)	5	7	6	6

Table 3 depicted the gross and net NPA in amount and the percentage of selected banks i.e. Punjab national bank, State Bank of India, bank of Baroda, Union bank, and Canara bank. All the banks have been showing stride progress of both gross and net NPA for the past four years.

Table 4: Gross and Net NPA of Private Sector Banks (In crore)

Banks	**Particular**	**2019**	**2018**	**2017**	**2016**
ICICI	Gross NPA	45,676.04	53,240.18	42,159.39	26,221.25
Bank	Gross NPA (%)	7	10	9	6
	Net NPA	13,449.72	27,823.56	25,216.81	12,963.08
	Net NPA (%)	2	5	5	3
Axis Bank	Gross NPA	29,789.00	34,248.64	21,280.48	6,087.51
	Gross NPA (%)	5	7	5	2
	Net NPA	18,351.00	16,592.00	8,626.60	2,522.14
	Net NPA (%)	2	4	2	1
HDFC	Gross NPA	11,224.16	8,606.97	5,885.66	4,392.83
Bank	Gross NPA (%)	1.36	1.3	1.05	0.94
	Net NPA	3,214.52	2,601.02	1,843.99	1,320.37
	Net NPA (%)	0.39	0.4	0.33	0.28
Yes Bank	Gross NPA	7,882.56	2,626.80	2,018.56	748.98
	Gross NPA (%)	3.22	1.28	1.52	0.76
	Net NPA	4,484.85	1,312.75	1,072.27	284.47
	Net NPA (%)	1.86	0.64	0.81	0.29
IndusInd Bank	Gross NPA	3,947.41	1,704.91	1,054.87	776.82
	Gross NPA (%)	2.1	1.17	0.93	0.87
	Net NPA	2,248.28	745.67	438.91	321.75
	Net NPA (%)	1.21	0.51	0.39	0.36

Authors own

Table 4 outlined the gross and net NPA in amount and the percentage of the top five private sector banks i.e. ICICI, Axis bank, HDFC bank, Yes bank, and IndusInd bank. All the banks have been showing an upward trend except HDFC banks, which controlled both gross and net NPA for the past four years.

Table 5: Group Statistics of Gross NPA

Particular	**Types of bank**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Gross NPA	Public banks	20	11.3160	3.08506	0.68984
	Private bank	20	3.3750	2.98248	0.66690

Authors own

Table 5 outlines group statistics i.e. mean, standard deviation and standard error mean of the selected public and private sector banks in India.

Table 6: Independent Samples Test of Gross NPA

		Levene's Test for Equality of Variances		***t*-test for Equality of Means**						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gross NPA	Equal variances assumed	0.016	0.900	8.27	38	0.000	7.941	0.95950	5.9985	9.88341
	Equal variances not assumed			8.27	37	0.000	7.941	0.95950	5.9985	9.88348

Authors own

Table 6 shows *F*-value 0.016, *t*- value 8.27 at a significant level of 0.000 for Levene's test for equality of variances so it can be concluded that both variants are different. If variances differ significantly, then unequal-variance estimates may be used instead of the equal- variance. Furthermore, the *t*-test that uses unequal variances assumed (Sig. 2- tailed) figure is 0.000 which is less than 0.05, thus H0 is rejected and can say that there is a significant difference in gross NPA of public and private sector banks.

Table 7: Group Statistics of Net NPA

Particular	**Types of bank**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Net NPA	Public banks	20	6.0800	1.98392	0.44362
	Private bank	20	1.5735	1.54914	0.34640

Authors own

Table 7 shows group statistics i.e. mean, standard deviation and standard error mean of the selected public and private sector banks in India.

Table 8: Independent Samples Test of Net NPA

		Levene's Test for Equality of Variances		***t*- test for Equality of Means**						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Net NPA	Equal variances assumed	0.841	0.365	8.007	38	0.000	4.50650	0.56284	3.36709	5.64591
	Equal variances not assumed			8.007	35.89	0.000	4.50650	0.56284	3.36489	5.64811

Authors own

Table 8 shows *F*-value 0.841, *t*-value 8.007 at a significant level of 0.000 for Levene's test for equality of variances so it can be inferred that both variants are different. If variances differ significantly, then unequal-variance estimates should be used instead of the equal- variance. Furthermore, the *t*-test that uses unequal variances assumed (Sig. 2- tailed) figure is 0.000 which is less than 0.05, thus H0 is again rejected and can inferred that there is a notable difference in Net NPA of public and private sector banks. There is also a notion that Private Sector Banks including foreign Banks in India has a low level of NPAs, due to their scientific pre-sanction appraisal and effective post-sanction follow up of measures. But according to the latest reports, they also face the problem of rising NPAs. With this background, the researcher has attempted to analyze the level of NPAs in different sectors of the Indian Banking Industry.

CONCLUSION

The study outlines that there is a drastic uptick in gross and net advances from both public and private sector commercial banks during a given period. It is inferred based on the analysis that there is a huge expansion in non-performing assets in selected public sector banks rather than private sector banks in India. The NPAs have always formed a big problem for the banks in India for the past many decades. It is not the only problem for the Indian commercial banks but the economy. The money blocked up in NPAs has a direct impact on the profitability of the bank as Indian banks are highly dependent on income generated from interest on funds. This paper is an attempt to study the present condition of NPA and how efficiently public and private sector banks managed their NPAs. Secondary data has been collected for the selected categories of the banks from the RBI publications for a period of four years i.e. from 2016 to 2019. Result in terms of independent t-test reveals that public sector banks have witnessed a continuous mounting trend in both gross and net NPAs in comparison to private sector banks and there is a statistically significant difference in the mean of gross and net NPA of public and private sector banks in India. It also indicates that public and private sector banks are trying hard to trim down their NPAs ratios consistently by complying with regulatory and administrative frames. The problem of NPAs needs to address lots of serious efforts otherwise NPAs will keep damaging the profitability of banks which is not apt for the growing Indian economy at all. Besides, the decline in the ratio of NPAs indicates an improvement in the asset quality of Indian public sector banks and private sector banks.

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Sustainable Development and Climate Change: A Bird's-eye View of the Indian Story

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We have a word for it - it is Chivala. It means the warming of the Earth. And of course, people see that climate changes have come, but they do not really link them to the global issue. People hear about things on the radio, and they have knowledge of El Ninoa, but they do not understand how these things are linked up.

- Thomas Bwanali, Shire Highlands Milk Producers, Malawi, June 200

ABSTRACT

India is moving forward on the path of SDGs (Sustainable Development Goals) implementation to combine the element of 'sustainability' to economic development through well-designed initiatives for inclusive development enshrined in its policies. India's efforts towards the achievement of SDGs will contribute to their success at the global level. India's achievement in the composite SDG index is commendable. India's sustained actions on addressing climate change have helped her to achieve great strides which are reflected in reduction in the emission intensity. It is in this context, the present chapter portrays a bird's eye-view of the Indian story: sustainable and climate change, covering progress in India's Climate Change Policies, India's National Missions and their progress and its initiatives at the international stage in this perspectives.

Keywords: SDGs, NDCs, NAPCC, SAPCC, NMCG, IPSF, UNCCD, Green Finance

INTRODUCTION

We witnessed so far two landmark international events ever unseen before 2015: the historic climate change agreement under the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015 and the adoption of the SDGs (Sustainable Development Goals) in September 2015. The Paris Agreement focuses at keeping global temperature rise well below 2°C, which will move the world towards a low carbon, resilient and sustainable future, while at the same time, the Sustainable Development Goals, replacing the Millennium Development Goals, set the target of the development agenda for the next 15 years. On the domestic front too some important climate-related initiatives were undertaken, that include the launching of the historic International Solar Alliance (ISA) and the submission of the ambitious Intended Nationally Determined Contribution (NDC).

In the same vein, the year 2019 was a watershed year that marked the fourth anniversary of adoption of 2030 Agenda for Sustainable Development and the Paris Agreement. India is moving forward on the path of SDGs (Sustainable Development Goals) implementation to combine the element of 'sustainability' to economic development through well-designed initiatives for inclusive development enshrined in its policies: electrify rural households, augment the usage of renewable sources, eliminate malnutrition, eradicate poverty, access to primary education to all girls, provide sanitation and housing for all, equip young people with skills to compete in the global labor market, enable access to finance and financial services. India's efforts towards the achievement of SDGs will contribute to their success at the global level. India's achievement in the composite SDG index is commendable as the score has improved from 57 in 2018 to 60 in 2019. It is praiseworthy that India is among a few countries in the world where, despite ongoing developmental efforts, forest and tree cover are increasing considerably. A comparison with some other emerging economies shows that India's growth in forest cover has been in positive territory. Simultaneously, India's sustained actions on addressing climate change have helped her to achieve great strides which are reflected in reduction in the emission intensity of India's GDP by 21 per cent during 2005-2014. While India is on the path of sustained progress, global agenda of delivering sustainable development and addressing climate change can be delivered if and only if all nations exhibit the requisite momentum to act upon their fair share of responsibilities including the fulfillment of financial obligation by the developed world to the developing countries.

LITERATURE REVIEW

India and the SDGs

The SDGs are global goals, built upon the erstwhile Millennium Development Goals. They are exhaustive, universal, and integrated and emphasize on core areas of poverty and inequality, economic growth, innovation, sustainable consumption and production, climate change, peace and justice and partnerships with various countries.

India's sunlit path may be called a holistic approach for achieving these SDGs by implementing a comprehensive array of schemes. The progress towards SDGs has been assessed by SDG India Index 2019. As per the SDG Index (NITI Aayog, 2019) has come up with a single measurable index to track the progress of all the States and UTs across 13 out of 17 SDGs. This SDG index provides an aggregate assessment of India's progress. This index helps in informed policy formulations as it captures status of both national and state-level social, economic, and environmental parameters across a set of 62 select indicators. The score varies from 0 to 100. States with scores equal to/greater than 65 are considered as Front-Runners as Performers in the range of 50-64 and as Aspirants if the score is less than 50. States with an index score of 100 are classified as Achievers i.e. the states have achieved the national target set for 2030. A score of 0 denotes worst performance), Kerala, Himachal Pradesh, Tamil Nadu, Andhra Pradesh, Telangana, Karnataka, Goa, Sikkim, Chandigarh, and Puducherry are the front runners.

Overall, it is worthwhile to note that the composite score for India has improved from 57 in 2018 to 60 in 2019, which implores the impressive progress made by the country in its onward journey towards achieving the SDGs. This positive stride towards achieving the target is largely driven by commendable country wide performance in five goals — 6 (Clean Water and Sanitation), through the cleanliness of holy and mighty River Ganga through Namami Gange Mission, 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 15 (Life on Land) and 16 (Peace, Justice and Social Institutions) — where India has scored between 65 and 99. The goals that asks special attention are – 2 (Zero Hunger) and 5 (Gender Equality) – where the overall country score is below 50. The overall country score lies between 50 and 64. This indicates the scope for positive improvement in the upcoming years.

SDG Nexus: A New Paradigm Approach

There exist interlinkages among SDGs and targets, no doubt. Target-based approach can help reinforcement of policies and its implementation. With the adoption of SDGs, the focus of the government is to reinforce its development priorities with SDG indicators.

This approach aims to achieve the balance between environmental, social, and economic boundaries and simultaneously give a sure basis for wellbeing of the people. To follow this basic concept in India, the SDG goals are used as a medium which allows for interlinkages of different sectors and thematic areas.

Nexus between Health and Energy

We can give an example of Health and Energy Nexus. Many of the health improvement schemes—providing pediatric care, newborn emergency services, and successful vaccination is dependent on the availability of electricity at the health centers. With the growing importance of the indicators under the SDG goals, it is altogether important that reliable electricity connections are provided at the health care centers. As witnessed, there is a positive relationship between the electricity consumption and fall in the Infant Mortality Rate (IMR) in the country.

Climate Change

India submitted its Nationally Determined Contribution (NDC) under the Paris Agreement (the main aim of the Paris Agreement is to hold the increase in the global average temperature well below 20C above pre-industrial levels and pursuing efforts to limit the temperature increase even further to 1.5oC above pre-industrial levels (IPCC, 2019). The Paris Agreement sets a roadmap for all nations in the world to take actions against climate change in the post-2020 period) on a “best effort basis” keeping in mind the developmental imperatives of the country. In its NDC, India promised to reduce its emission intensity of GDP by 33 to 35 per cent below 2005 levels by the year 2030; 40 per cent of cumulative electric power installed capacity would be from non-fossil fuel sources by 2030 and increase its forest cover and additional carbon sink equivalent to 2.5 to 3 billion tons of carbon dioxide by 2030. The Paris Agreement is to be implemented in post-2020 period in line with the guidelines adopted under Paris Agreement Work Programme.

India has endeavored to ensure that it follows a growth path that delivers sustainable development and protects the environment by investing in various schemes aligned with its NDC, like Swachh Bharat Mission, National Smart Grid Mission, Atal Mission for Rejuvenation and Urban Transformation etc. Bereft of economic actualities, India's mitigation strategies have laid stress on clean and efficient energy system, enhanced energy efficiency, resilient urban infrastructure, safe, smart, and sustainable green transportation network, planned afforestation, as well as holistic participation across all sectors. Swachh Bharat Mission (Urban) was launched in 2014 with the twin objectives of ensuring 100 per cent scientific solid waste management and making urban India open defecation free (ODF), to achieve total environmental improvement. In a span of five years, the Mission has made significant progress—all urban areas of 35 States/ UTs have become ODF and the percentage of waste processing rose from around 18 per cent in 2014 to 60 per cent. This is a remarkable achievement. The year 2019 has seen a significant leap forward for renewable energy with India undertaking one of the world's largest renewable energy expansion programmes in the world. India had announced 175 Gigawatt (GW) targets for renewables by 2022 and has already achieved 83 GW. Further, Hon'ble Prime Minister in his Address at the UN Climate Action Summit in September 2019 has stated that "India's renewable energy capacity would be increased to much beyond 175 GW and later till 450 GW". As a Party to the UNFCCC (Since the adoption of United Nations Framework Convention on Climate Change (UNFCCC) in 2007, the global community has strengthened the response mechanisms to the threat of climate change through various milestones. The journey since then saw the adoption of various related instruments to address climate change including the adoption of Kyoto Protocol in 1997 and the latest most ambitious one being the Paris Agreement. The ultimate objective of UNFCCC is to stabilize GHG concentration in the atmosphere at a level that will prevent dangerous human interference with the climate system, in a time frame which allows ecosystems to adapt naturally and enables sustainable development), India submitted its Second Biennial Update Report (BUR) to the UNFCCC towards fulfillment of the reporting obligation under the Convention. As per the BUR, the emission intensity of India's GDP has reduced by 21 per cent over the period of 2005-2014 which is the result of India's proactive and sustained actions on climate change. India is on track to achieve its nationally determined targets. In 2014, the net national GHG emissions after including LULUCF (Land Use, Land Use Change and Forestry) were 23,06,295Gg CO_2 equivalent (around 2.306 billion tons of CO_2 equivalents).

Progress in India's Climate Change Policies

Launched in 2008, India's National Action Plan on Climate Change (NAPCC), formulated in the backdrop of India's voluntary commitment to reduce emission intensity of its GDP by 20 to 25 per cent by 2020 over 2005 levels, identifies a number of measures that simultaneously advance the country's development and climate change related objectives of adaptation and mitigation through focused National Missions. It also focuses on key adaptation requirements alongside with creation of scientific knowledge and preparedness for handling with climate change as climate change for the vulnerable groups acts as a "risk multiplier". There is incontrovertible evidence that recent and projected human activity (anthropogenic) threatens to significantly raise global temperatures with serious impacts on agriculture, water supply, sea levels, disease and living conditions (Stern *et al.*, 2006). This implies that climate change represents one of the greatest ever challenges to global governance: it is turbo–charged version of the other threats that the international financial system was created to counter, such as war or, financial crises or *COVID -19 (italic added)*. The scale of the threat is almost unimaginable: climate change can make large part of the globe uninhabitable, triggering species loss comparable to the end of dinosaurs (Green, 2012). The IPCC's 2007 Assessment Report concluded that, without urgent action to curb greenhouse gas emissions, the world's average surface temperature is likely to increase between 2°C and 4.5°C by the year 2100, with a 'best estimate' of 3°C. A growing body of scientific evidence supports the conclusion that warming beyond 2°C constitutes a 'dangerous' level of climate change. WHO suggests that the warming and precipitation trends attributable to man-made climate change harms 150,000 lives a year that continued for more than 40 years - most of the lives are in poor countries; 'those will be hardest hit through a queer blend of droughts, falling agricultural yields, more severe hurricanes, flooding and storm surges. Action to address this challenge will involve considerable expenditure on investment in new technologies which reduce and reverse the causes of temperature increases' (UNFCCC, 2007). The priorities for this investment will have to be based on careful economic analysis, as, one can remember, in 2006, former World Bank chief economist Sir Nicholas Stern's review made a strong case for urgent action, arguing that mitigation - rapid cuts in emission to avoid catastrophic climate change - 'must be viewed as investment, a cost incurred now and in the coming few decades to avoid the risks of every severe consequences in the future'. The Report concluded that: "tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth of rich or poor countries. The earlier effective action is taken, the less costly it will be". Urgency and leadership are thus central to acting, while there is still time.

Considering all sides, India has last of all decided to revise the NAPCC in line with the NDCs under the Paris Agreement to make it more comprehensive in terms of priority areas. States/Union Territories have also had same line of thought that is nothing but State Action Plans on Climate Change (SAPCC) in line with the NAPCC considering State's specific issues relating to climate change. The progress of implementation of eight national missions is given below. These actions reflect India's commitment to meet (and reconcile) the goals of climate change, and sustainable development. Sustainable development was defined by the World Commission on Environment and Development, or Brundtland Commission (named after its Chairperson, the Norwegian Prime Minister, Gro Harlem Brundtland at the time) in the following way: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' This report was the first overview of the globe which considered the environmental aspect of development from an economic, social, and political perspective. This report concerns with sustainability that has gathered pace in recent years as governments have begun to take on board the importance of 'green' issues. Neglect of such issues in the past has led to damage to the natural environment, pollution, and land being stripped of its natural resources. 'Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs… in the final analysis, sustainable development must rest on political will' (Brundtland, 1985).

However, following this definition, it is clear that 'needs' themselves, so it is unlikely (as the definition implies), that those of future generation will be same as those of the present generation. The second question, not covered by the definition, how needs are defined in different cultures. If in one society, for example, it is agreed that fresh air and open spaces are necessary before development can be sustainable, it will be increasingly difficult to marry this definition of 'needs' with those of other societies seeking more material wealth, even in the cost of increased pollution. It is precisely this kind of trade-off which is apparent in emerging developing countries today.

Furthermore, how do we establish which course of action is more sustainable? There is considerable confusion surrounding what is to be sustained. There are so many contradictory approaches to sustainable development. One reason may be that different countries identify the objectives of sustainability differently.

Sustainable development nowadays becomes a key global concern. This suggests an apparent paradigm shift or change in world view of the way in which countries should develop, from concentration upon pure economic growth to a wider concern with environmental, social, and economic sustainability.

National Mission and Progress

(i) The Perform, Achieve and Trade (PAT) scheme under National Mission for Enhanced Energy Efficiency (NMEEE), governed by the Ministry of Power and based on Energy Conservation Act, 2001, designed on the mission of reduction in Specific Energy Consumption. In PAT cycle –V (April 2019), 110 Designated Customers (DC) from the existing sectors have been focused for everybody's attention. The total energy consumption of these DCs comes out to be 15.244 Million Tons of Oil Equivalent (MTOE) and it will no doubt give total energy savings of 0.5130 MTOE. Implementation of this scheme implies that about 20 MTOE of energy savings will be achieved by 2020.

(ii) The Jawaharlal Nehru National Solar Mission, governed by Ministry of New and Renewable Energy, focuses on the increase of the share of solar energy in the total energy mix. The target for the launch for Grid Connected Solar Power Projects covers 40 GW Grid connected Rooftop projects and 60 GW large and medium size land based solar power projects.

(iii) The combined target is now set at 100 GW. The total investment in setting up 100 GW will be around Rs. 6,00,000 crores. A cumulative 32.5 GW of solar electric generation capacity has been installed.

(iv) National Water Mission governed by the Ministry of Water Resources, River Development and Ganga Rejuvenation, focuses on overall examining of ground water, aquifer mapping, capacity building, water quality monitoring and other baseline studies. There are 1071 assessment units categorized as over exploited. Directions have been issued by CGWA under Section 5 of "The Environment Protection Act, 1986" for mandatory Rainwater Harvesting and others for all target areas in the country including Union Territories. While granting 'No Objection Certificate' for drawing ground water, CGWA is very much careful.

(**v) National Mission for a Green India,** governed by the Ministry of Environment, Forest and Climate Change, with a specific focus on increasing forest cover & density and conserving biodiversity. It is a holistic view of greening and it focuses on multiple ecosystem services alongside with carbon sequestration and emission reduction. The mission laud stress on the landscape approach to treat large contiguous areas of both forest and non-forest, public and private lands with a key role of the local communities in planning, implementation, and monitoring. A sum of Rs. 343.08 crore has so far been released under the mission for undertaking afforestation activities over an area of 126916.32 ha in 13 states. To promote alternative energy sources in project areas energy efficient devices have been provided to 56,319 households, Convergence Guidelines with MGNREGS and Compensatory Afforestation Fund Management and Planning Authority have been passed by.

(vi) National Mission on Sustainable Habitat, governed by the Ministry of Urban Development is being launched through three programmes: Atal Mission on Rejuvenation and Urban Transformation, Swachh Bharat Mission, and Smart Cities Mission. Energy Conservation Building Rules 2018 for commercial buildings having connected load of 100 KW or above has been made mandatory. Mass Rapid Transit Systems are being implemented across the country. Standards have been enhanced for six sub-sectors namely, solid waste management, water and sanitation, storm water drainage, urban planning, energy efficiency and urban transport. Under Mass Rapid Transit System, 585 km of metro rail is in operation; 620 km is under construction. 223 kms of BRT corridors operational in 8 cities and 505 kilometers of BRT corridors are under construction in 14 cities, under the Bus Rapid Transit System (BRT).

(vii) National Mission for Clean Ganga (NMCG): This was given the Authority for fast track implementation and making policies for long term sustainability for Ganga rejuvenation efforts under the Environment (Protection) Act, 1986. This is a major policy priority of the Government towards achieving the SDG 6 (Ensure availability and sustainable management of water and sanitation for all) for the cleanliness of mighty River Ganga through Namami Gange Mission etc.

India and its Forests

Forest is the most important terrestrial reservoir of biodiversity (Karmakar, 2013). Time and again scientists have pinpointed them as the most biodiversity-rich ecosystems on Earth and they constitute a wealth of natural heritage not only in themselves, but also for the people who use this biodiversity for a variety of purposes, including for water, food and medicinal purposes. Impoverished rural populations rely heavily on the natural environment of forest as a source of livelihoods. Forests provide for the daily subsistence needs and essential livelihoods services of more than 1.6 billion people. These people directly rely on forests. In the period 2003-2018, wood removals alone valued over US$

150 billion annually. Historically, the forests have contributed to the global economy by providing products like cocoa, coffee, apples, apricots, walnuts, and pears.

India is among a few countries in the world where, despite ongoing developmental efforts, forest and tree cover are increasing considerably. A comparison with some other emerging and advanced economies shows that India's growth in forest cover has been in the positive territory.

India accounts for 2 per cent of the total global forest area in 2015 as per the Global Forest Resource Assessment (FRA) by FAO.

Forest plays a crucial role in adaptation and mitigation to climate change. Forests help to store more carbon than any other terrestrial ecosystem (PIB GOI, 2019). In the Forest Report, 2019 for India, the total carbon stock in forest is estimated as 7,124.6 million tons.

The forest and tree cover have reached 80.73 million hectare which is 24.56 per cent of the geographical area of the country. There is an increase of 42.6 million tons in the carbon stock of the country as compared to 2017.

India's Initiatives at the International Stage

Climate Finance

India's Nationally Determined Contribution (NDC) gives a bird's-eye-view of the post-2020 climate actions India is keen to undertake under the Paris Agreement on climate change adopted in December 2015. India ratified the Paris Agreement on October 2, 2016. But, without a hefty amount of climate finance, the proposed NDCs would not be fruitful. The three key elements of climate finance are:

(i) Scope: Climate finance should support both the adaptation and mitigation activities of the developing countries in accordance with the country needs and priorities. The Paris Agreement gives equal weightage to adaptation (i.e. the act of reducing GHG emissions with the goal of slowing or preventing climate change) and mitigation (i.e. the act of reducing vulnerability to the effects of climate change). The essential elements that need to be taken up as parameters for accounting climate finance are - public grants, unrequited equity, and grant—equivalent values of loans.

(ii) Scale: Developing countries have before them several developmental challenges and climate change puts additional burden on the already scarce resources. The climate finance requirements of developing countries are likely to be enormous. A recent report by Oxfam, 2018 indicated, "People in poorer countries are on average five times more likely than people in rich countries to be displaced by extreme weather events. Adaptation costs in developing countries are expected to be US$140 - 300 billion a year by 2025/30. By mid-century, the costs of climate change to developing countries are estimated to exceed US$1trillion per year, even if global average temperature remains below 2°C."

(iii) Speed: The speed of climate finance in the multilateral climate regime is not sufficient. As of February 2019, the pledge and approval of multilateral climate change funds shows lagged performance.

Aligning Financial System with Sustainability

Now the spotlight is on aligning the financial system with sustainable development. In December 2007, the Reserve Bank of India had sensitized banks in India to the various international initiatives and was asked to keep an equal speed to the developments in the field of sustainability and modify their lending strategies/plans in the light of such developments.

Climate Bonds remains focused on green bonds, linked specifically to climate-change mitigation, adaptation, and resilience. India has the second largest emerging green bond market after China. To scale up the environmentally sustainable investments, India joined the International Platform on Sustainable Finance (IPSF) in October 2019. The Platform acknowledges the global nature of financial markets which has the potential to help finance the transition to a green, low carbon and climate resilient economy by linking financing needs to the global sources of funding.

Green Finance

While there is no universal definition of green finance, it mostly refers to financial investments flowing into sustainable development projects and initiatives, environmental products, and policy initiatives that encourage the development of a more sustainable economy. Green finance includes climate finance but is not limited to it. It also refers to a wider range of other environmental objectives, for example industrial pollution control, water sanitation, or biodiversity protection. Green finance also includes different elements like greening the banking system, the bond market and institutional investment (Climate Bond Initiative, 2018, 2019).

Mitigation and adaptation finance is specifically related to climate change related activities: mitigation financial flows refer to investments in projects and programs that contribute to reducing or avoiding greenhouse gas emissions (GHGs) whereas adaptation financial flows refer to investments that contribute to reducing the vulnerability of goods and persons to the effects of climate change.

Green finance is often used interchangeably with green investment. However, in practice, green finance is a wider lens. Most important is that it includes operational costs of green investments.

The term green finance has gained a lot of attention in the past few years with the increased focus on green development. The Rio+20 document clearly states what green economic policies should result in and what they should not. The United Nations Conference on Environment and Development (UNCED) was held in 1992 Rio de Janeiro, from which its more popular title the 'Rio Earth Summit' was derived. The conference's aim was to formulate several voluntary frameworks and legally binding conventions for nation-states to catalyze a more sustainable global development. Most commentators agree that UNCED fell far short of this goal and its objective to stabilize the global climate within a timeframe that allows ecosystems to adapt naturally, ensuring food production, and enabling sustainable development to take place. The individual interests of national governments and business lobbies dominated negotiations. Many argue that a great deal was left unsaid at Rio. From the very beginning, the focus was not on altering the basic relationship between development and the environment, for which many NGOs lobbied. There were no binding agreements on debt, structural adjustment programmes, population control, North-South technological and financial transfer, the role of TNCs and global militarism (Connelly & Smith, 1999). This reflects the strong influence of international industrial and business interests. The intransigence of the USA was a serious limiting factor. The USA was ' prepared to veto any initiative that could be viewed as redistributing economic power at the global level, that would create new institutions, or that would require additional budgetary resources, technology transfers, or changes in domestic US policies' (Porter, Brown & Chasek, 1996). These problems raise two general issues of deeper concern for sustainable development: first, the tension between national sovereignty and international obligations; second the erosion of government accountability to the electorate, and its replacement with interest politics.

Despite these profound weaknesses in the UNCED process, some positive movement was achieved. Public awareness of environmental issues was raised. The need to renew democracy through an increased stress on participation ran throughout the conference, and especially in Agenda 21— the most far reaching and influential outcome of the Rio Earth Summit, signed by all 176 nations participating in UNCED—towards a more sustainable future in the 21st century. Government and NGOs were forced to find ways to talk to each other, and a great many relationships were forged which have strengthened the network of contacts and alliances that have contributed to more recent debates on sustainable development. Finally, but most tangibly, two Conventions were signed and Agenda 21, with all its flaws, has emerged as an important catalyst for further action towards a sustainable future (Grubb *et al.*, 1993).

Green Climate Bonds

At COP 25 of UNFCCC at Madrid, India reiterated its commitment to implement Paris Agreement in accordance with the principles of equity and common but differentiated responsibilities (PIB GOI, 2019). COP 25 decisions provide for balanced and integrated view of ambition that includes efforts for climate change mitigation, adaptation and means of implementation from developed country parties to developing country parties.

International Solar Alliance (ISA)

India has also launched a historic International Solar Alliance (ISA) which is envisioned as a coalition of solar resource-rich countries to address their special energy needs and will provide a platform to collaborate on addressing the identified gaps through a common, agreed approach.

This is the first treaty-based Intergovernmental Organization launched by India and France on 30 November 2015 in Paris and entered into force on 6 December 2017, headquartered in India. With 83 signatory countries, ISA creates a multi-stakeholder ecosystem where sovereign nations, multilateral organizations, industry, policymakers, and innovators work together to promote the common and shared goal of meeting energy demands of a secure and sustainable world. ISA's motto is, "let us together make the sun brighter". The ISA aims to pave the way for future solar generation, storage, and technologies for Member countries' needs by mobilizing over US$ 1000 billion by 2030. Achievement of ISA's objectives will also strengthen the climate action in Member countries, helping them fulfill the commitments expressed in their NDCs. ISA has launched five programmes so far: i) Scaling Solar Applications for Agriculture Use; ii) Affordable Finance at Scale; iii) Scaling Solar Mini Grids; iv) Scaling Solar Rooftop, and v) Scaling Solar in E-mobility and Storage.

ISA has taken up the role of an 'enabler' by institutionalizing 30 Fellowships from the Member countries; of a 'facilitator' by getting the lines of credit worth US$ 2 Billion from EXIM Bank of India and US$ 1.5 Billion from AFD, France; of an 'incubator' by nurturing initiatives like the Solar Risk Mitigation Initiative and of an 'accelerator' by developing tools to aggregate demand for 1000 MW solar and 270,000 solar water pumps.

India's NDC have been, though welcomed as fair and ambitious, comprehensive, covering all elements, i.e. adaption , mitigation, finance , technology and capacity building, specifically in the renewable energy and forestry sectors, the task still is daunting as can be seen from only an example through a comparison on some actuals with the targets (Table 1).

Table 1: India's NDC Targets

Items	Current NDC Targets	India's NDC Target
Wind Power Installed Capacity	25.08 GW	60 GW by 2022
Solar Power Installed Capacity	4.88 GW	100 GW by 2022

Source: Compiled from Ministry of New and Renewable Energy data and India's NDC quoted in Economic Survey, 2015-16

Coalition for Disaster Resilient Infrastructure

India launched the Coalition for Disaster Resilient Infrastructure (CDRI) on the sidelines of UN Secretary General's Climate Action Summit in September 2019. This international partnership of national governments, UN agencies, multilateral development banks, private sector, and knowledge institutions will promote the resilience of new and existing infrastructure systems to climate and disaster risks, thereby ensuring sustainable development.

CDRI will conduct country-specific and global activities and provide member countries technical support and capacity development, partnerships to facilitate and encourage investment in disaster resilient infrastructure systems.

India and the UNCCD

India hosted 14th session of the Conference of Parties (COP 14) to the United Nations Convention to Combat Desertification (UNCCD) from 2-13 September 2019. The commemoration of World Day to Combat Desertification 2019 envisaged the release of COP 14 Logo with the Slogan "Restore Land, Sustain Future". India, as President of COP to UNCCD stated that human actions have forced to accelerating climate change, land degradation, and biodiversity loss and that, similarly, strong human intent, intelligence as well as technology will be needed to reverse the damage. Hon'ble Prime Minister of India while addressing the High-Level Segment on 9th September, 2019 announced India's support for, among other actions, for enhanced South-South Cooperation that aims to share India's experiences with cost-effective and sustainable land management strategies; and a “Global Water Action Agenda” to maximize synergies through holistic land and water management.

DISCUSSION

India very well understands that action towards sustainability is a must for humanity. India's National agenda reflects tangibly the SDGs and its policies ensuring the balance among three pillars of development-economic, social, and environmental. SDGs can be achieved through high standards of governance, monitoring and implementation at all levels. In the spirit of cooperative federalism, the States and Central Government are walking together to bring a change that India needs.

India has reduced emissions intensity of GDP by 21 per cent during 2005-2014 and is on fine track to achieve the goals announced. India had announced 175 GW targets for renewables by 2022. Further, Hon'ble Prime Minister, Narendra Modi in his address at the UN Climate Action Summit in September 2019 has stated that “India's renewable energy capacity would be increased to much beyond 175 GW and later till 450 GW”. India has also taken up a voluntary target for restoration of 26 million of degraded land by 2030 during the 14th COP of UNCCD in Delhi. This is one of the largest programmes in the world to ensure carbon sink in land resources. Internationally, CDRI which is a partnership to support countries through knowledge exchange and provide technical support on developing disaster and climate resilient infrastructure was launched.

CONCLUSION

India houses 30 per cent of the global poor, 24 per cent of global population without access to electricity, and 92 million people without access to safe drinking water. Enamored with its vulnerability in terms of the impact of climate change, this pinpoints to the fact that India faces formidable challenges in terms of targeting SDGs. Given the challenges it faces, our analysis shows that it has prepared and launched some ambitious plans already, that will never go in vain, which has looked at in terms of clean energy, energy efficiency and lower emission intensity while altogether addressing the critical issue of poverty and food security.

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Sustainable Development Goals with Information and Communication Technology in the Context of India: A Brief

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ABSTRACT

The spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies, as does scientific and technological innovation across areas as diverse as medicine and energy Economic development is a continuous process of change in macro variables of any economy in desirable direction. Economic development includes both quantitative and qualitative aspects. Economic growth is a subset of economic development where we consider only the quantitative measures. Now-a-days the term sustainable development is much more widely circulated. By sustainable development we mean the use of natural resources in a manner such that the future generation cannot be affected from the use of these natural resources. Different aspect of development in the context of Millennium Development Goals (MDGs) which include eight goals were framed to address the world's major development challenges with health and its related areas as the prime focus. In India, considerable progress has been made in the field of basic universal education, gender equality in education, and global economic growth. However, there is slow progress in the improvement of health indicators related to mortality, morbidity, and various environmental factors contributing to poor health conditions. Now-a-days there occurs a transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDG). In this scenario the current paper will be highlighting on Transition from MDGs to SDGs in the context of Indian Economy with special reference to Information and communication Technology.

Keywords: Communication, Information Technology, Sustainable Development Goalsreen Finance

INTRODUCTION

The 2030 Agenda for Sustainable Development fundamentally recognizes that “the spread of information and communication technology (ICT) and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies”. While none of the SDGs is specifically about ICT, several targets refer to ICT and technology, and ICT will play a crucial role for the achievement of every goal. All three pillars of sustainable development-economic development, social inclusion, and environmental protection-need ICT as a key catalyst; and ICT, particularly broadband, will be crucial for achieving all 17 SDGs (NITI Aayog, 2016a). On the other hand, Economic development is a continuous process of change in macro variables of any economy in desirable direction. Economic development includes both quantitative and qualitative aspects. Economic growth is a subset of economic development where we consider only the quantitative measures. Now-a-days the term sustainable development is much more widely circulated. By sustainable development we mean the use of natural resources in a manner such that the future generation cannot be affected from the use of these natural resources.

The Millennium Development Goals influenced Development policy formulation and planning globally. Along with bringing critical development challenges to the forefront, they also provided countries with a strong target-oriented agenda. While India has been moving in the right direction in some areas, there is still work remaining in the others. This is therefore an opportune moment to incorporate the lessons learned from the MDGs, into the sustainable development goals and build upon the unfinished MDG agenda (MOSPI, 2017a).

In this backdrop our study is concentrated on transforming millennium development goals to sustainable development goals with Information and Communication Technology in the context of Indian Economy. This paper has five sections. Section I deals with the MDGs 2015 and Post 2015 development agenda in India (MOSPI, 2017b). Review on MDGs and SDGs in India in Section II, Section III deals with Implementation of SDGs in India, Information and Communication Technology how to relates with SDGs is discussed in section IV. Concluding remarks will be included in section V.

LITERATURE REVIEW

Section I: Millennium Development Goals 2015 and Post 2015

A) Millennium Development Goals 2015

In the year 2000, 189 nations made a promise to free people from extreme poverty and multiple deprivations. This pledge became the eight Millennium Development Goals to be achieved by 2015. In September 2010, the world recommitted itself to accelerate progress towards these goals.

Eight Goals for 2015

1. Eradicate Extreme Hunger and Poverty
2. Achieve Universal Primary Education
3. Promote Gender Equality and Empower Women
4. Reduce Child Mortality

1. Improve Maternal Health
2. Combat HIV/AIDS, Malaria and Other Diseases
3. Ensure Environmental Sustainability
4. Develop a Global Partnership for Development

B) Post 2015 Development Agenda in India

The year 2015 is a landmark year for global development - the Millennium Development Goals (MDGs) are reaching their December 2015 deadline, and the world is set to adopt a new set of transformative and universal sustainable development goals (SDGs). The Millennium Development Goals influenced Development policy formulation and planning globally. Along with bringing critical development challenges to the forefront, they also provided countries with a strong target-oriented agenda. While India has been moving in the right direction in some areas, there is still work remaining in the others. It follows an opportune moment to incorporate the lessons learned from the MDGs, into the sustainable development goals and build upon the unfinished MDG agenda (United Nations, 2015).

Post 2015, India pledged to transform the world by adopting the 2030 Agenda for sustainable development. The year 2016 marks the end of the MDGs era that has driven the global development agenda for the past 15 years and now way to SDGs to achieve over the next 15 years. In this point of view this is a vital moment to reflect on the successes and the lessons learnt from the MDG era, the challenges and opportunities faced by the India and the possible way forward for achieving the agenda for SDGs during the period 2016-30 (NITI Aayog, 2016b).

The SDGs are much expanded compared to the MDGs and covers all three dimensions – social sector development, economy, and sustainability across 17 goals. The 2030 Agenda for Sustainable Development promises to connect 5 Ps – People, Planet, Prosperity, Peace and Partnership. The SDGs are universal, integrated and interlinked, and pledges to leave no one behind. While, the first set of the SDGs (1-7) may be an extension of the MDGs with a more comprehensive mandate of mitigating developmental challenges in key sectors in all their forms, the later goals could be referred to an extension of the agenda itself. Those immediately following the first 7 goals (8, 9 and 10) are referred to as enablers of development covering areas like inclusiveness and jobs, infrastructure and industrialization, and distribution. The final set of goals under the SDGs (11-17) lays down the framework for sustainability covering areas like urbanization; consumption and production; climate change; resources and environment; peace and justice; and means of implementation and global partnership (UNDP India, 2016).

Section II: Review on MDGs & SDGs in India (refer to table 1).

Table 1: MDGs and Targets – Summary of Progress achieved by India

MDGs	Target	Status
MDG 1: ERADICATE EXTREME POVERTY AND HUNGER	TARGET 1: Halve between 1990 and 2015, the proportion of people below national poverty line.	Achieved
	TARGET 2: Halve between 1990 and 2015, the proportion of people who suffer from hunger.	In Progress
MDG 2: ACHIEVE UNIVERSAL PRIMARY EDUCATION	TARGET 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	In Progress
MDG 3: PROMOTE GENDER EQUALITY AND EMPOWER WOMEN	TARGET 4 : Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015.	Achieved
MDG 4: REDUCE CHILD MORTALITY	TARGET 5 : Reduce by two -thirds, be tween 1990 and 2015, the Under- Five Morality Rate.	Nearly Achieved
MDG 5: IMPROVE MATERNAL HEALTH	TARGET 6: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio.	In Progress
MDG 6: COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES	TARGET 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS.	Achieved
	TARGET 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.	Achieved
MDG 7: ENSURE ENVIRONMENTAL SUSTAINABILITY	TARGET 9: Integrate the principle of sustainable development into country policies and programmes and reverse the loss of environmental resources.	In Progress
	TARGET 10: by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation.	Achieved for the indicator of drinking water. In progress for the indicator of Sanitation
	TARGET 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.	The pattern not statistically discernible
MDG 8: DEVELOP A GLOBAL PARTNERSHIP FOR DEVELOPMENT	In cooperation with the private sector, make available the benefits of new technologies, especially information and communications.	Achieved

A) SDGs in Brief (refer to figure 1):

Figure 1: SDGs in Brief

The total seventeen (17) SDGs can be categorised into four major parts which are as follows:

Social ➢ SDG 1 - No Poverty ➢ SDG 2 - Zero Hunger ➢ SDG 3 - Good Health and Well-Being ➢ SDG 4 - Quality Education ➢ SDG 5 - Gender Equality ➢ SDG 6 - Clean Water and Sanitation	**Environmental** ➢ SDG 12- Sustainable Consumption and Production ➢ SDG 13- Climate Action ➢ SDG 14- Life Below Water ➢ SDG 15- Life on Land
Economic ➢ SDG 7- Affordable and Clean Energy ➢ SDG 8 - Decent Work and Economic Growth ➢ SDG 9 - Industry, Innovation , and Infrastructure ➢ SDG 10 - Reduced Inequalities ➢ SDG 11- Sustainable Cities and Communities	**Fostering Peace and Partnership** ➢ SDG16- Peace, J ustice and Strong Institutions ➢ SDG 17- Partnerships for the Goals

Strategic Shifts from MDGs to SDGs are as follows:

Conclusiveness – Focus on the Finish line: Zero Poverty, Hunger, preventable Child Deaths, Gender Discrimination & Violence, etc. • **Comprehensiveness -** The SDGs are more comprehensive with fuller array of targets, better focus on causality and strategic issues. • **Universality** – Applicable to all countries,with greater emphasis on the responsibility of the developed countries, • **Inclusiveness –** Clear focus on 'leaving no one behind and reaching the furthest behind first. **Hunger distinct from Poverty –** deeper analysis of structural and social factors separat es poverty from food and nutrition security. • **Peace Building –** Addressing conflict r esolution and peace bu ilding as enablers of growth and development • **Resourcing –** – Focus on sustainable economic development in a country to meet financial resource requi rement for achieving SDGs; – Holistic approach to international fin ancing of SDGs – Stronger focus on ODA, international resource flows, technology transfer and trade • **Measurability –** Clear emphasis on monitoring, evaluation, and accountability, and the metrics - high-quality, up-to-date, and reliable data

Section III: Implementation of SDGs in India.

Priority wise some of indicators has been framed based on 17 SDGs:

SDGs	**Focus Areas of Indicators**
Goal 1: No Poverty	• population below poverty line & poverty gap ratio, • employment under MGNREGA, • Access to safe drinking water & Sanitation
Goal 2: Zero Hunger	• Access to food grains at subsidized prices • Stunting & wasting in under-5 children • Agricultural productivity & Gross Value Added per worker
Goal 3: Good Health and Well-Being	• Maternal Mortality Ratio; Neo-natal & Under-5 Mortality Rates • Immunization of under-2 children • Incidence of HIV/AIDS, malaria & TB • Medical personnel per 10,000 people
Goal 4: Quality Education	• Net Enrolment Ratio & Out of School Ratio • Enrolment Ratio of Children with disabilities • Pupil Teacher Ratio
Goal 5: Gender Equality	• Crime against women • Women's representation in Parliament, State Assembly & local bodies • Use of family planning methods
Goal 6: Clean Water and Sanitation	• Access to potable water & sanitary toilet (Urban/Rural)
Goal 7: Affordable and Clean Energy	• Access to electricity & clean cooking fuel • Share of renewable energy in total energy
Goal 8: Decent Work and Economic Growth	• Annual Growth Rate of GDP (PPP Per Capita) • Annual Growth Rate of Manufacturing, Agriculture & MSME sector • Unemployment & Work Force Participation Rate (M/F) • Access to bank accounts & banking outlets

Goal 9: Industry, Innovation, and Infrastructure	• % of rural population living within 2 km of an all-season road • Share of manufacturing sector employment in total employment • CO_2 emiss ion per unit of value added • R&D expenditure as % of GDP & No. of patents/IPRs filed • Access to mobile phones.
Goal 10: Reduced Inequalities	• Income growth among the bottom 40% of People • Representation of vulnerable groups in elected bodies
Goal 11: Sustainable Cities and Communities	• Slums/EWS settlements covered by formal housing • Proportion of cities with efficient public transport & mobility • Annual Mean levels of PM 2.5 & PM 10 in cities
Goal 12: Sustainable Consumption and Production	• Post harvest storage & distribution losses • Adoption of Waste Management measures
Goal 13: Climate Action	• Number of states taking climate adaptive measures • Achievement of Nationally Determined Contribution (NDC) Goals
Goal 14: Life Below Water	• No of sewage treatment plants and toilets constructed • % Change in area under mangroves
Goal 15: Life on Land	• Proportion of forest area to total land area • Total tree cover outside forest area • Increase in Tree/ Forest cover in degraded areas • % Increase in Net Sown Area
Goal 16: Peace, Justice and Strong Institutions	• % of people subjected to violence • No. of human trafficking victims per 1,00,000 people • No. of government online services provided • Population covered under Aadhaar

Section IV: Information and Communication Technology & SDGs

Information Communication Technology (ICT) offers an incredible platform for achieving the SDGs. Every goal—from ending poverty and halting climate change to fighting injustice and inequality—can be positively impacted by ICT (The Earth Institute Columbia University, 2017).

Goal wise impact on ICT can be explain as below:

Goal 1: No Poverty

ICT is key to helping end poverty by providing possibilities to improve productivity among millions of people so that they can better provide for themselves and their families and move out of poverty. This can occur in many ways, for example, by providing timely and accurate information services to help ensure equal rights to economic resources, as well as enabling services such as mobile banking and micro-credit, and in helping small producers to find the best markets for their products. ICTs can be used for ending poverty and promoting inclusive & sustainable economic growth. Promoting sustainable resource management system by using ICT to secure last-mile delivery food, medicine, and disaster relief.

Goal 2: End hunger & achieve food security

ICT can help to reduce hunger and increase food security by giving farmers direct access to market information, weather forecasts, as well as planting, harvesting and targeted irrigation advice, logistics and storage, thereby helping to increase yield, restore soil, reduce waste and improve both productivity and effectiveness. ICTs can be used for improving food security and promoting agricultural sustainability.

Goal 3: Healthy lives & promote wellbeing

ICT can deliver substantial and significant benefits across the whole of the global healthcare ecosystem. Connectivity enables health workers to be connected to information and diagnostic services, while analytics can help make projections about disease outbreaks, health service usage, patient knowledge, attitudes, personal continuous management of diseases and health practices. Connecting remote health centres and expertise - Improving diagnosis and patient support (ICT for integrated care), Empowering patients with better information & responsibility (Self management of health based on predictive computer modelling), Improving data management for reporting and monitoring.

Goal 4: Ensure inclusive and equitable quality Education for all

ICT is helping to improve education globally, allowing students to access learning assets and teachers to prepare for classes anytime, anywhere. It also can deliver online certification and student advisory services, in turn leading to improved economic opportunities for all.

Goal 5: Achieve gender equality and empower all women and girls

ICT can enhance gender equality and gender empowerment, allowing women and girls to access information of importance to their productive, reproductive and community roles as well as involving women in urban planning. Women's sustainable livelihoods can be enhanced through expanded access to markets, education, training, and employment.

Goal 6: Water & sanitation for all

ICT will be crucial in ensuring the availability and sustainable management of water and sanitation for all. ICT is particularly important in terms of smart water management, infrastructure location, better and lower-cost maintenance, optimized operations, and improved quality of service to customers.

Goal 7: Ensure access to energy for all

ICT is already demonstrating its strong potential to improve energy efficiency and reduce emissions, both by making ICT itself more environmentally sound and less carbon-intensive, and through ICT-enabled solutions such as smart grids, smart buildings, homes and smart logistics that allow other sectors of the economy to improve their energy efficiency and lower energy consumption.

Goal 8: Economic growth, employment, and decent work for all

ICT skills have become a prerequisite for many forms of employment in the 21st century. Digital technology is transforming the way that business is being done everywhere, from traditional employment sectors including farming, manufacturing, and the health sector to new sectors such as offshore services. Moreover, ICT is important for economic and productivity growth.

Goal 9: Infrastructure, industrialization, innovation

ICT will continue to play an essential role in building and maintaining resilient infrastructure, in promoting inclusive and sustainable industrialization, and in fostering innovation in the emerging information and knowledge societies which depend on open access to academic research, transparency to make informed decisions and the power of online collaboration to support cross-sector and in-house co-creation, learning and work.

Goal 10: Reduce inequality

ICT can help reduce inequality within and between countries, especially when used to help bring information and knowledge, and therefore social and economic progress, to disadvantaged segments of society—including those living with disabilities, as well as women and girls.

Goal 11: Sustainable cities and communities

ICT is essential in offering innovative approaches to managing cities more effectively and holistically, with ICT basic infrastructure and applications such as smart buildings, smart water management, intelligent transport systems, and new efficiencies in energy consumption, resource waste management.

Goal 12: Sustainable consumption & production patterns

ICT can foster sustainable consumption and production through product-specific improvements, increased dematerialization and virtualization, and the implementation of smart technologies in sectors including agriculture, transportation, energy, supply chain management, and smart buildings.

Goal 13: Urgent action to combat climate change and its impacts

Smart ICT applications, particularly in the areas of, energy, transport and buildings, manufacturing (Industry 4.0), smart services and agriculture and urbanization in general, climate change and mitigate its impacts. ICT can optimize value chains, reduce resource usage and waste, and plays a crucial role in sharing climate and real-time weather information, forecasting early warning systems as well as supporting resilience and climate adaptation.

Goal 14: Oceans, seas, and marine resources

ICT can assist in oceanic conservation and sustainability. Satellite monitoring delivers timely and accurate global data, improving accountability, while big data can be used to analyze biodiversity, pollution, weather patterns and ecosystem evolution, and to help plan mitigation and adaptation strategies.

Goal 15: Halt and reverse land degradation

ICT can play a significant role in the conservation and sustainable use of terrestrial ecosystems and preventing biodiversity loss through improved and reporting, which leads to increased accountability, as well as through use of big data to analyze short- and long-term trends and plan mitigation activities. ICT also improves efficiencies in land restoration via sensors, data collection and analysis.

Goal 16: Peace, justice & strong institutions

ICT has proven to be a powerful tool in areas such as electoral monitoring, using crowd sourcing. Government use of open data increases transparency, empowers citizens, and helps to drive economic growth.

Goal 17: Strengthen the means of implementation & partnerships for development

ICT is unique in its capability to specifically strengthen the means of implementation for the SDGs, through enhancing international cooperation and coordination; promoting technology transfer; capacity-building; forging multi-stakeholder partnerships; and enabling and improving data monitoring and accountability.

DISCUSSION

The 'Millennium Development Goals' had the target year as 2015' and the 'Sustainable Development Goals' have come up in 2015 to accelerate the progress achieved under the MDGs and to address other important development issues. The Millennium Development Goals (MDG), emerged from the UN Millennium Declaration in 2000, addressed the priority areas of development and had set targets for year 2015. The MDG framework had created large momentum in development in various sectors and was instrumental for significant progress in India. By adopting the Sustainable Development Goals (SDGs) in 2015, India has framed the commitment towards continuing the momentum created by the MDGs to address the unfinished task as well as other development issues (UN ESCAP, 2015).

CONCLUSION

There is now a remarkable convergence of vision underlying the priorities for the proposed SDGs and those of the new Government in India. Building on the MDGs, the SDGs propose to end poverty and deprivation in all forms, leaving no one behind, while making development economically, socially, and environmentally sustainable. All three pillars of sustainable development—economic development, social inclusion, and environmental protection—need ICT as a key catalyst; and ICT, particularly broadband, will be crucial for achieving all 17 SDGs.

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Information Technology and its Application in Sustainable Development

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ABSTRACT

Humans have a direct relationship with nature and its resources. With industrialization, the natural resources have been overused and overconsumed to such a greater extent that it did worsen the natural ecosystems and their stability. In new milieu, sustainable development has emerged as a challenge as well as a necessity for development further. With the over-consumption of resources and development being followed chronically, there arose the problems of natural resource deficit, degradation of the resources and its depletion due to overuse, widescale pollution and a large gap between the developed and the developing countries. With recent trends of sustainable development, information and communication technology and its applications found a huge acceptance as it is much dependable a system that can shape sustainable development better. With proper implementation of the same, we can definitely bring about sustainable development in terms of waste minimization, energy conservation, education, energy intensification, reducing greenhouse gas emission, all of which accounts for social benefits and a better sustainable future for all living entities.

Keywords: Information and Communication Technology, Sustainable Development, Waste Minimization, Consumption

INTRODUCTION

Digitalization and technological advancement play an important role with building of infrastructure to strengthen and transform society and its connectivity to resources. With introduction of information and communication technology (ICT), there has been a drastic change how people work, communicate, and sustain their lives. All parts of human experiences have been revolutionized with the information technology and its applications. There has been monumental importance of information technology to economic development and business growth in developed countries. The benefits on the revolutionary aspect has been much more enjoyed by richer countries with more access and greater ability to seize on the opportunities of its applications. Several policies and programmes have been advocated by numerous government authorities and non-governmental bodies to bridge the gap of digital division with greater access to information technology.

LITERATURE REVIEW

It has always been challenging to utilize technological innovations to achieve the goals of sustainable development. The United Nations considered one of its sustainable development goals (SDG) to increase the access to information and communications technology and to strive to provide universal and affordable access to the internet in least developed countries by 2020. There has been a radical shift in mobilization of science and technology to promote sustainability in our living and in support of social causes. As per World Commission on Environment and Sustainable Development (1987), sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their needs. Owing to the different dimensions of development, the needs of present and future generations keep on changing and the focus area should be therefore, to ensure continued economic development with societal responsibilities and environmental conservation. Promotion of movements have taken place largely with development of technology to harness different aspects of society and environment such as use of solar energy to increase agricultural productivity, reduction of pollution, reduction of greenhouse gas emission and global warming, conservation of energy etc with the help of Information and Communication Technology (Cash *et al.*, 2003). The review paper includes the study on application of information and communication technology for different societal and conservational aspects that shall lead to sustainable development.

Impact of Information Technology on Sustainability

Years ago, impact of IT on development in industrialized countries were the prime area of focus. Organization for Economic Cooperation and Development (OECD) has several hundreds of reports and documentations on importance of IT in advanced countries. But with research, it has been found further that developing countries are the most vulnerable in recent times and should bring about the changes required to follow sustainable development. Information technology is a potential, affordable means that may facilitate the transition required to attain sustainability. Several International initiatives could be undertaken to empower the developing countries to pursue sustainability. But the linkages between IT and development has to be understood well for determination of effectiveness of the same.

There are several direct and indirect effects of IT on environmental sustainability (Nair & Prasad, 2002; Mills, 1999). International reports on influence of information and technology in attaining sustainability in developing countries have also been produced by World Bank and United Nations with the objective to promote the use and application of IT for socio-economic development. Several grants and incentive programs do encourage the influence of IT in developing nations. To take the new societal conditions to better situations, the European Union has been actively developing policies that are related to the information technology and its applications. The European Commission has been found to develop a website on 'Information Society', with the aim to increase awareness among public for their better understanding and to bring about study on the impact of 'Information technology' and its applications throughout Europe (Koomey *et al.*, 1999). This has helped to optimize the socio-economic benefits of information technology in Europe. The website offers policies and statements on strategies that have been recommended for Europe. Like the programme of World Bank is the United Nations Sustainable Development Networking Programme (SDNP) that assists developing nations to establish connection to national network with increase in their online content (OECD, 2002).

Positive Attributes of Information Technology

Information technology has significantly contributed to sustainable development goals. Use of IT equipment has resulted in saving of cost significantly in different areas. A few such areas include the minimization of wastes, conservation of energy, education, intensification of energy, greenhouse gas emission reduction, etc that has immensely benefitted the society and can further bring radical changes. The different aspects of such societal changes have been discussed further.

Waste Minimization

Municipal solid waste management is an important part of sustainable development. To manage waste, focussing upon waste minimization is an integral part of management. Waste minimization is defined as reduction of material per unit of product produced. The application of information technology with waste management system has led to innovative technologies including underground collection system with GIS (geographic information system) technology, waste monitoring system with GSM (global system of mobile), etc. With large scale popularity of GIS technology in different fields, coupling of GIS with waste management gained impetus over past few years in developed countries such as Italy. Entire waste management cycle can be handled and optimized with automation system with use of information technology. Information and Communication technology (ICTs) has created efficient integrated systems that could meet waste cycling requirements. Coupling the waste collection with GIS oriented systems has been popular in Italy over few years (Rada, Ragazzi & Fedrizzi, 2013). This integrated application is structured in such a way that individual Municipalities can easily manage their entire waste cycling (from point of generation to landfill) with its application. Application of GIS can also be beneficial to know and determine the number of residents in the applied area and the routes of waste collection. This could further help to segregate wastes very easily at the source, which further helps to recycle the wastes (Rada, Ragazzi & Fedrizzi, 2013).

Another latest trend includes the application of global systems for mobile communications (GSM) in waste collection with installation of sensors that can detect an optimum waste collection in public garbage bins. With the collection of garbage in the garbage bin at threshold level, controller is indicated, and the indication is further transferred to collector of garbage to empty the bin on an urgent basis. Short messaging service (SMS) using GSM is used for delivering information to the driver (Arebey *et al.*, 2010). Also, physical machines replaced by voice mail is another way by which consumption of power is decreased with decrease in greenhouse gas emissions (USDC, 1998). There is also application of information technology for sorting and segregating municipal wastes and the processes include optical sorting, optical sensor-based sorting technologies (Metcalfe *et al.*, 2012; Wangyao *et al.*, 2009). With collaboration of information and waste disposal management system, collection system shall be more particular, and assessment of the work done would be easier. Web based waste management system shall help in tracking data management and would also enhance tracking information services with provision of addressing a query, report generation amongst others (Idowu *et al.*,2012). Selective wastes collection and optimization has been reported to have been done efficiently with 80 percent waste separation at the source for recycling (Rada, Ragazzi & Fedrizzi, 2013).

Energy Conservation

It is always vital to enhance energy efficiency and to invest in renewable energy to fulfil the sustainable development goal 7, i.e. affordable and clean energy. Madanian, Tansaz & Changizi (2011) reported that with provisions for energy efficiency and conservation, energy use can be minimised with strengthening of economy and sustainability. In information technological applications, the role of IT in energy conservation is undeniable with development of Building Management System (BMS). BMS is one of the most important and effective technology that controls building devices and provides services like heating, ventilation, air conditioning systems, with control also on lighting, security, fire safety, etc. With use of BMS and electronic controller linked to a computer network, systems in the buildings such as chillers, light, pumps etc can be controlled and monitored, with an energy saving of up to 20 percent. BMS, a technological system has been found to be installed in most new commercial and institutional buildings with widescale use in residential buildings too. It has automated control system that monitors the electrical equipments in buildings with the use of sensors, controls, and activators on an electronic digital processor to have capability of communication and control. BMS is known to cover elements including software, controllers, linking network and central controllers. University of Ulster (Belfast Campus) with implementation of BMS for cost reduction in their energy consumption gained annual cost saving of 8 percent. A 32 percent reduction in energy consumption for heating was obtained by a school campus Erikslund in Sweden (Hjerpe, 2007).

Education

Education has been one of the most powerful way towards sustainable development. As a policy intervention, sustainable development goal 4 targets on quality education to ensure that all girls and boys obtain complete free primary and secondary schooling by 2030, with guarantee of equal access to different opportunities with quality technical and vocational education for all including Universities, together with lifelong learning opportunities for all. Information and communication technology and its use as tools to enrich the learning process overall in case of various subjects can promote learning through large-scale teaching-learning interaction and collaboration.

Digital literacy and culture have changed the way people learn immensely and hold a positive impact on distribution of knowledge around the globe and therefore helps to incorporate skills for searching and learning, producing effective information and more. Research suggests that with digital literacy, information and communication technology can provide specific professional development opportunities with attainment of formative learning assessments, assessment of online resources, and shall foster student-teacher collaboration. With the target that schools and colleges should prepare educated students with effective knowledge in the use of information and communication technology, there already has been a great reform in education with improved learning. Schools today, use a diverse kind of ICT tools that help to communicate, create, and disseminate knowledge as well as store and manage the information (Blurton, 1999). This shall help to develop higher order thinking capacity and skill, provide creativity to students to express better and develop preparedness to deal with technologies ongoing and upcoming in the society and in workplaces. Use of multi-media devices and customized learning, virtual classes online, accessibility to digital library, access to learning resources in digital platform, online courses, interactive exercises etc are some other resources that provide a vastness in the field of education (Sharma, 2014). A systematic training in information and communication technology is also an essential platform for education managers, supervisors, and decision makers. In future, in schools, there shall be more requirement for development of infrastructure for ICT (Goodwin, 2012) with stable internet connectivity and technical support as well as security measures. Digital content development in local languages with reflection of local cultures shall ensure effective use of ICT. Schools shall also focus on ensuring all students with equitable access to information and communication devices for learning. Policies must be developed further to bring media and internet to all students.

Energy Intensity

Impacts of information and communication technology on economic activity and productivity has been huge over recent times. In USA, internet-related activities in 2011 added considerable value to all industries (Tindell, 2014), with reduction in transaction costs. Economic efficiency also found to increase with reduction in input costs in relation to output with increase in technological efficiency and with enabling greater allocative efficiency to be achieved. Thus, information technology is labour saving.

Growth in information technology and other less-energy intensive industries caused decline in economy use in the energy-intensive sectors. The surge in productivity in these sectors has large contribution from IT. Intensity of energy indicates efficiency rather than consumption of energy. Consumption of energy at different sectors include residential, commercial, industrial and transportation. Residential and commercial consumption of energy occurs mainly in buildings. In United States, residential consumption is slightly higher than commercial use (World Bank, 2002). In the commercial sector, particularly e-commerce, it has a positive impact on conservation of energy with the replacement of physical stores with internet related virtual stores. This contributes to energy efficiency with the advancement of IT. This not only enables energy efficient supply chain management but also reduces physical stores and their need, reduces inventory, and substantially saves material handling and administrative costs. Also, IT contributes to controlling electricity consumption used for lighting and other appliances. Telecommuting which enables flexibility among employees allowing them to work remotely, often from home, is another way to reduce use. Also known as teleworking, it may provide alternative workplaces facility for employees with cost saving from the undertaken measures with the reduction of commercial office space in square foot. The industrial sector that consists of major source of energy consumption, becomes more energy efficient with reduction of inventories, better space utilization and effective supply chains.

Greenhouse gas emissions

Information and Communication Technologies (ICTs) in general is a radio-based remote sensor and is used as a main tool for environmental observations, monitoring of climate, and climate-change predictions on a global scale. ICT essentially saves the lives with modern disaster predictions, detection, and early warning systems. Some of the ICT systems that are involved in climate monitoring includes weather satellites to track the progress of hurricanes; weather radars that track forest fires; radio-based meteorological aid systems that collect weather data, earth observation-satellite systems that obtain information on atmospheric composition; etc. ICT can be used in several ways to meet the requirements of reduction of greenhouse gas emissions with strong actions on mitigation of climate change. ICT can address problems that different countries face with respect to climate change and can also be used to mitigate the impact of emission of greenhouse gases on different other sectors so that the countries can adapt to climate change. With enhancement of action on adaptation, the developing countries can tackle climate change with ICT industry being a key part of national commitments to reduce greenhouse gas emissions. ICT based systems can also help both developed and developing countries to adapt to the negative effects of climate change with monitoring of weather and the environment worldwide; can help to reduce emissions and enable energy efficiency in different sectors through substitution and replacement of objects by electronic means; can drive down emission in the ICT sector with introduction of more efficient equipments and networks. Different adaptive measures may be taken like taking action to tolerate the effects of climate change on a local or country level, such as remote sensing to monitor the natural disasters like earthquakes and tidal waves with improved communications to deal with natural disasters even more effectively.

With target in 2015 to set intended nationally determined contributions (NDC) to reduce carbon emissions and contribute to global target to reduce and limit global warming, use of information and communication technology is potent to play a significant role in driving carbon reductions with substantial socio-economic benefits. Scientists obtained ICT has potential role to reduce carbon emission in European Union and UK, and can generate economic and socio-economic value for stakeholders, can enhance energy efficiency across European Union. Information and communication technology enable new business models and helps to transit from linear to circular value chains with cutting and eliminating waste with identification of new streams. With large-scale energy use in sectors of industry, housing and transport, there is emission of greenhouse gases. With ICT-supported monitoring and reporting schemes, the energy consumption can be adjusted upto a sustainable level.

Social Benefits

With the change in preferences and consumption pattern, information and communication technology has enough potential to influence sustainable development. Government at both National and State levels found to make use of information technology and reach out to people over a shortest possible time. Telecommunication is one such example, with the use of which benefits have been achieved in many a sector such as transport load reduction. Online store system is another way by which need to visit to a physical store has been checked. Thus, several new services have helped to shape the needs and preferences of a consumer. With information technology being the new mantra of the society today, it is an inseparable part of our lives and has enriched the fields of education, health, and governance. For the improvement of social conditions, the revolution of information and communication technology provides numerous opportunities. Significant growth of education has been achieved with internet-based study that provides long distance training and education. Distance learning is IT's greatest contribution to sustainable development. Also, the technology has brought the world closer to each other. With speed, there is improvement in every section of the society. Social initiatives for sanitation and health on a local level has been handled with information technology with much innovation. For example, there are websites being developed by government to help the rural villagers with vital information about water, sanitation, education, women-related issues, and farming. Several e-commerce initiatives through portals with selling of articles and expanding of business to urban areas has been possible as well. Communication of medical reports, x-rays and other test results is another way of technological advancement across the world with the assurance that a patient can get the best of treatments and that too, early and on time.

DISCUSSION

Comparative benefits of information and communication technology to rural residents compared to city-dwellers has been reported by Tindell (2014). Also, information and communication technology have some negative impacts as far social interactions are concerned. The extra time spent overuse of internet has affected the direct social contact among people. This has been noticed to adversely affect the family cohesiveness as well as the well-being of children. The risk of injury and accidents has increased due to continued use of electronic devices even on roads and public places. Cyber-bullying is another negative aspect of the use of information technology and needs to be managed. Reduction in privacy in one's life has also been a major negative side of the internet use.

CONCLUSION

To ensure balance among the three pillars of economy, society and environment, nations must target to build a holistic energy-efficient strategy for all businesses with robust deployment of efficiency-enhancing information and communication technology. Developing nations like India must concentrate upon use and development of information and communication technology (ICT) to make its economy more energy–efficient, environmentally-friendly, and competitive globally to become sustainable in many a way. Even, corporate energy strategies should be set with higher goals of energy conservation and efficiency. Investing more energy in information and communication technology and its applications shall help to save energy and attain sustainability in all spheres. The role of Information Communication and Technology can further be targeted with some empirical study on sustainable development. Socio-political, economic, environmental, and cultural aspects that are part of sustainable environment may also be targeted as the areas of research.

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Potential Impacts and Associated Risks of Climate Change With Recommended Sustainable Climate Solutions

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ABSTRACT

With every passing year the weather pattern is changing. Increasing population and income generation invoked human for land conversion, concretization and infinitely unsustainable activities which are the primary drivers of climate change. Rapid climate change has creaked the environment and ecology. GHG emission, deforestation, land degradation, food insecurity are the global challenges contributing to climate change. The catastrophic results of climate change are faced every year in the form of droughts and floods which in turn affects human life unfavorably. The Intergovernmental Panel on Climate Change has mentioned the possible causes responsible for driving climate change and adaptation and mitigation techniques to overcome this alarming situation. Climate change is the result of unsustainable practices and activities and can be controlled through sustainable measures. Adapting renewable technologies, waste management, sustainable farming, afforestation are few steps toward sustainability and combating climate change. Also, it is the sole responsibility of every human to adapt and perform sustainable practices to maintain the environment and land worth of healthy living.

Keywords: Climate Change, Environment and Ecology, Sustainable Farming, Afforestation

INTRODUCTION

Extreme weather fueled by climate change has touched every single corner of the world. These extremities are breaking threshold in the form of floods, storms and fires bringing chaos and destruction everywhere. This statement seems to be hypothetical but is obvious and justifiable by looking around the climatic scenario and their impacts starting from South Africa to North America and from Australia to Asia. These events not only damage the resident's life and their living but also crack the financial stability of the nation. This is a loss-loss situation and requires enough time for its recovery. But no one can assure the re-occurrence of the event. Eventually, people have to compromise the scenario and the cycle goes on and on. The worst part is that the poor and vulnerable suffer the most despite being least responsible for the cause. As per the recent report of Christian Aid 2019, UK based organization estimated the number of people killed in thevents and the overwhelming majority of the deaths was caused by just two events in India and South Africa- a reflection of how the world's poorest people pay the heaviest price for the consequences of climate change (Ware & Kramer, 2019). All disasters are linked with climate change activities and the biggest cause of climate change is the Greenhouse gas emission.

Scientists have identified the physical mechanism by which climate change influenced the event or calculated the extent of its relationship with human-caused warming. “In some cases, scientific studies have shown that climate change made the particular event more likely or stronger, for example with warmer oceans supercharging tropical storms” (Ware & Kramer, 2019). Also, higher temperatures and reduced rainfall has shifted the weather pattern. The disastrous consequences of climate change have intensified the rainfall, raised sea-level rise, and increased the flood intensity.

The extremes, occurred on the planet, that is hotter than anything humans have ever experienced, and it is going to get worse, due to committed warming from existing emissions. 2019 was around 1°C hotter than the pre-industrial average and is likely to have been the second-hottest year on record. But unless urgent action is taken to reduce emissions, global temperatures will rise at least another 0.5°C over the next 20 years, and another 2-3°C by the end of the century.

A climate breakdown- Few disastrous events occurred in 2019

Christian aid, a UK based Christian organization which strives to work for healthy human life and poverty eradication, has listed few anthropogenic events which has succumbed the nature and human life. The sole primary cause for such events is Climate Change. The adverse impact of climate change has affected all over the planet which we are facing every year in the form of catastrophic events. For most of the events, scientists deduced that human-caused warming and activities are responsible for GHG emissions which in turn lead to extreme temperatures and extreme rainfalls and cause drought and flood like events.

- **Floods in Argentina and Uruguay:** A widespread flooding in the Pampas region of Argentina and Uruguay was the result of extremely heavy rain. The disastrous consequences were very expensive. Five people killed, up to 2.4 million hectares of soya beans were flooded (Argentina is the third-largest soya bean producer in the world) and more than 11000 people were forced from their homes. It was identified by the climate scientists that human-caused warming has exacerbated extreme rainfall in the region. Extreme rainfall has increased since 1960 and heavy rain and flood risk will continue to grow unless carbon emissions fall rapidly.
- **Floods in Queensland, Australia:** A heavy and prolonged rainfall hit Queensland, Australia killing three people and around 6, 00,000 cows. This event caused structural damage and 3300 homes were damaged which were particularly badly hit in the region. By the end of the year 2019, it was fire, rather than floods,

that caused devastation in the parts of Australia and sparked a debate about climate change in the country. Australia has increasingly been experiencing heavy rainfall. Scientists linked the cause with climate change which will become worse with further warming.

- **Storm Eberhard in Europe:** A powerful windstorm moved across Europe causing widespread damage. Wind speed exceeded 140km/h. The consequences were four people killed by falling of trees and debris, delay, and disruption of transport and one million homes lost electricity across Europe. Scientists studied that damaging windstorms would become more frequent because of human-caused warming, and the level of damage caused by each storm will increase.
- **Cyclone Idai in Southern Africa:** Cyclone Idai brought powerful winds, heavy rain, and storm surge across the region, causing particular damage in Beira, Mozambique's second-largest city of the country. It was one of the deadliest Southern Hemisphere cyclones on record killing 1300 people and caused damages worth over $2 billion. Cyclone Idai came a month later just after Cyclone Kenneth and destroyed buildings, crops, roads, and power infrastructure leaving a despicable situation. The two cyclones affected an estimated 2.2 million people and Southern Africa's grain production fell 7% below its 2018 output.
- **Floods in Midwest and South US:** Heavy rains over extended periods with rapidly melting snowpack due to high temperatures led to extensive flooding across much of the country. The consequences were loss of harvests, three people killed and economic loss of the country. Climate scientists linked the floods with climate change.
- **Floods in Iran:** Heavy rains led to significant flooding and landslides caused widespread destruction. The consequences were 78 people killed with two million people in need of humanitarian assistance, 314 bridges destroyed, 1, 79,000 houses damaged and destroyed, and one million hectares farmlands flooded. Scientists claim that such events are likely to occur with the climate change and may affect the future weather patterns in Iran if warming continues.
- **Cyclone Fani in India and Bangladesh:** Cyclone Fani was the strongest storm to make landfall in India with wind speeds up to 200km/h and led to storm surges of 1.5 meter. The consequence of heavy rainfall and flooding killed at least 89 people, displaced 3.4 million people, uprooted 10 million trees and damaged 1,40,000 hectares of cropland in Odisha alone. The damage has been estimated at $8.1 billion. In November, both countries were also hit by Cyclone Matmo (also known as Bulbul), which killed at least 39 people and did damage worth at least $3.4 billion in India alone. This event is also linked with climate change particularly due to warmer ocean water and rising sea water level.
- **Floods in North India:** Extreme monsoon rain caused widespread flooding in parts of Northern India, as well as Bangladesh and Nepal, from June to October 2019. The prolonged heavy rain caused widespread flooding and destruction

across parts of India. Government figures suggested nearly 1900 people were killed in India alone and more than 3 million people forced from their homes. The causing trend remains the same i.e. climate change. A study found that monsoon rainfall will become more unpredictable, with variability increasing up to 50% this century if emissions continue to rise.

- **Typhoon Lekima in China:** China was hit by Typhoon Lekima in August, resulting landfall in Zhejiang with winds of 185 km/h. It was the fifth-most intense storm to hit China since 1949. Rainfall reached 40cm in some areas, leading to widespread flooding, while daily rainfall records fell in 19 locations. The storm caused major damage in China. It triggered floods and landslides, with transport systems, shut down, two million people evacuated, 13,000 homes destroyed, and an estimated 2.7 million homes left without power. It killed 101 people and is estimated to have cost at least $10 billion, making it the second-most costly typhoon in Chinese history. These events occurred due to warming oceans that thrives the storm system.
- **Typhoon Faxai and Typhoon Hagibis in Japan:** In September and October, Japan was hit by two unusually strong typhoons, Faxai, followed by Hagibis. Faxai with wind speed up to 216km/h and Higibis with wind speeds up to 225 km/h hit Tokyo miserably. The damages were Faxai killed at least three people, left 900,000 homes without power and disrupted transport. Typhoon Hagibis was even more destructive than Faxai and killed 98 people. Scientists have connected these typhoons and climate change. Piers Forster, a leading climate scientist, said "Super Typhoon Hagibis bears the hallmarks of climate change.
- **Hurricane Dorian in North America:** Hurricane Dorian was the second-strongest storm on record in the Atlantic, making landfall in the Bahamas as a Category 5 hurricane with wind speeds up to 297 km/h and a storm surge of 5.5 to 7 metres. Bahamas had faced devastating impact of the storm with 673 people died. An economic damage of more than a quarter of the country's GDP was calculated in Bahamas. Initial estimates suggested 13,000 homes were destroyed or damaged in the Bahamas, with nearly 70% of homes flooded. The reason being the same-climate change.
- **Floods in Spain:** Heavy rain flooded the southeast region of the country killing seven people. Floodwaters caused the closure of schools and airports with state of emergency declared in several regions. The cause of the event was the temperature rise.
- **Tropical Storm in Imelda in Texas, US:** Tropical Storm Imelda caused flooding leaving cities and roads underwater, damaging homes, businesses, and farmland. Five people were killed by the storm. Climate change made the extreme rainfall in Storm Imelda 2.6 times more likely to happen, according to a rapid analysis by World Weather Attribution. 18% increase of rainfall in the storm was found because of climate change. A warmer atmosphere can hold more moisture and results in heavy rainfall. Hence, climate change is highly responsible for heavy rainfall and flood.

- **U.S Fires in California:** The Kincade fire was the largest fire in Sonoma County's history which burnt over 30,000 hectares. At least three people were killed by the fires136 and the economic costs have been estimated at over $25 billion, meaning they may have been the most expensive disasters of 2019. As well as direct damage from the fires, millions of people were left without power as California's electricity utility, PG&E, shut down its network to avoid sparking fires. California burning was the consequence of high temperatures drying out forests and so creating more fuel for wildfires.

Anthropogenic causes and impacts of climate change

I. Greenhouse Gases and Environment: GHGs play a very important role to keep the planet warm enough to inhabit. But, in recent decades the amount of these gases has increased significantly. The production of electricity, heat, and transportation from the burning of fossil fuels like coal, oil, and gas, is the primary source of human-generated emissions. Another source is deforestation which releases sequestered carbon into the air. Logging, clear-cutting, fires, and other forms of forest degradation contribute up to 20 per cent of global carbon emissions (Denchak, 2017). Other human activities that generate air pollution include fertilizer use (a primary source of nitrous oxide emissions), livestock production (cattle, buffalo, sheep, and goats are major methane emitters), and certain industrial processes that release hazardous gases. Agriculture and road construction activities can change the reflectivity of the earth's surface, leading to local warming or cooling. This is hanging the naturally safe and existing weather patterns into disastrous events. It not only affects the livelihood of the residents of the world but also creating several challenges in terms of decreasing growth rate and economy of the country, food security and land availability of the residents (February 23 and Denchak, no date).

II. Increased Land Use: Land ecosystems play a key role in the climate system, due to their large carbon pools and carbon exchange fluxes with the atmosphere.

Human exploitation has affected about 60–85% of forests and 70–90% of other natural ecosystems e.g., savannahs, natural grasslands (Veldman, 2016)…..“Land use caused global biodiversity to decrease by around 11–14%” (IPCC, 2020). Land temperature has occurred at a faster rate than the global mean with adverse observable impacts on the land system…“The average temperature over land for the period 2006–2015 was 1.53°C higher than for the period 1850–1900, and 0.66°C larger than the equivalent global mean temperature change” (Cowtan & Way, 2013). These warmer temperatures (with changing precipitation patterns) have altered the beginning and end of growing seasons. Additionally, regional crop yield reductions, lack of freshwater availability, stressed biodiversity and increased tree mortality tends toward unsustainable usage of land. Increasing levels of atmospheric CO_2, have contributed to the observed increase in plant growth as well as an increase in woody plant cover in grasslands and savannahs.

Climate change is expected to increase variability in food production and prices globally, but trade-in food commodities can buffer these effects. Climate change will exacerbate diminishing land and freshwater resources, increase biodiversity loss, and will intensify societal vulnerabilities, especially in regions where economies are highly dependent on natural resources.

Adaptation and mitigation of climate change impacts without compromising the non-material benefits of land may lead to Enhanced food security, reduced malnutrition, reversing desertification and land degradation (Kongsager, Locatelli & Chazarin, 2016).

Conversion of natural land, and land management, contributes significantly to GHG emissions and global climate change, but land ecosystems are also a GHG sink. It is not surprising; therefore, that land plays a prominent role in many of the Nationally Determined Contributions (NDCs) of the parties to the Paris Agreement (IPCC, 2014).

The advancement of technology development, population growth and increasing per capita demand for ecosystem services will continue land-exploitation and land degradation. These socio-economic drivers will continue to amplify the existing societal challenges through conversion of natural ecosystems into concretized land, rapid urbanization, and pollution from the intensification of land management and equitable access to land resources. Climate change negatively affects the ecosystem and its services which further intensifies these challenges.

III. Desertification: The increasing population has over exploited the land, food, and water. This over exploitation is now resulting in drylands. These drylands are nothing but the result of desertification. Desertification has already affected agricultural productivity and loss of biodiversity pathetically. Excess use of land for a crop production decreases its nutritional value and the land may soon become infertile making it unsuitable for ecological activities. Also, the spread of invasive plants is destroying the ecosystem services and over-extraction is leading to groundwater depletion. Climate change increase in land temperature and evapotranspiration, reduction in precipitation in interaction with human activities, is converting dryland areas into deserts. Expansion of croplands, unsustainable land management practices and increased pressure on land from population and income growth are human practices responsible for desertification adding up its part in climate change. “Desertification exacerbates climate change through several mechanisms such as changes in vegetation cover, sand and dust aerosols and greenhouse gas fluxes” (IPCC, 2014). Desertification reflects most of the solar rays, reducing the energy available at the surface and associated surface temperatures, producing negative feedback on climate change. Desertification changes the absorption and release of associated greenhouse gases (GHGs) through its effect on vegetation and soils. Dust storms are very frequent in the absence of vegetation and dried surface cover like desert. Integrated farming, integrated crop, soil, and water management measures can help farmers to reduce soil degradation and increase the resilience of agricultural production systems along with climate change mitigation. These measures cover crop diversification, adoption of drought-resilient plants, reduced tillage, drip irrigation and rainwater harvesting and maintaining vegetation and mulch cover.

Cleaner energy sources and renewable technologies can reduce desertification and mitigate climate change through eliminating the use of wood as fuel and burning crop residues for energy generation.

IV. Land Degradation: Coastal ecosystems such as mangrove forests, marshes and seagrasses are at typical deposition locations, and their degradation or replacement with other vegetation is resulting in a substantial carbon release (Pendleton *et al.*, 2012) which highlights the need for a spatially integrated assessment of land degradation impacts on climate that considers in-situ but also ex-situ emissions.

Fire regime shifts in wild and semi-natural ecosystems can become a degradation process in itself, with high impact on net carbon emission and with underlying interactive human and natural drivers such as burning policies (Wilgen *et al.*, 2004), biological invasions (Brooks *et al.*, 2004), and plant pest/disease spread (Kulakowski, Veblen & Bebi, 2003). Some of these interactive processes affecting unmanaged forests have resulted in massive carbon release, highlighting how degradation feedbacks on climate are not restricted to intensively used land but can affect wild ecosystems as well (Kurz *et al.*, 2008).

Agricultural land and wetlands represent the dominant source of non-CO_2 greenhouse gases (GHGs) (Chen *et al.*, 2018). In agricultural land, the expansion of rice cultivation (increasing CH_4 sources), ruminant stocks and manure disposal (increasing CH_4, N_2O and NH_3 fluxes) and nitrogen over-fertilization combined with soil acidification (increasing N_2O fluxes) are introducing the major impacts and their associated emissions appear to be exacerbated by global warming.). Current budgets of anthropogenically fixed nitrogen on the Earth System (Tian *et al.*, 2015; Schaefer *et al.*, 2016; Chen *et al.*, 2018) suggest that N_2O release from terrestrial soils and wetlands accounts for 10–15% of the emissions, yet many further release fluxes along the hydrological pathway remain uncertain, with emissions from oceanic 'dead-zones' being a major aspect of concern (Schlesinger, 2009; Olsson *et al.*, 2019). In the case of flooding of non-wetland soils, a suppression of CO_2 release is typically overcompensated in terms of net greenhouse impact by enhanced CH4 fluxes that stem from the lack of aeration but are aided by the direct effect of extreme wetting on the solubilization and transport of organic substrates (McNicol & Silver, 2014). Both wetlands rewetting/restoration and artificial wetland creation can increase CH_4 release (Altor & Mitsch, 2006; Fenner *et al.*, 2011).

Degradation processes affecting wild and semi-natural ecosystems, such as fire regime changes, woody encroachment, logging, and overgrazing can trigger strong albedo changes before significant biogeochemical shifts take place. Physical impacts of land degradation on the atmosphere can also contribute to global and regional climate change. Source of physical effects on climate are surface roughness changes which, by affecting atmospheric drag, can alter cloud formation and precipitation, as suggested by modelling studies showing how the massive deployment of solar panels in the Sahara could increase rainfall in the Sahel (Li *et al.,* 2018), or how woody encroachment in the Arctic tundra could reduce cloudiness and raise the temperature (Cho *et al.*, 2018).

Climate change is considered to exacerbate land degradation and potentially accelerate it due to heat stress, drought, changes to evapotranspiration rates and biodiversity, as well as a result of changes to environmental conditions that allow new pests and diseases to thrive (Reed & Stringer, 2016).

V. Food Security: There are many routes by which climate change can impact food security and thus human health (Watts *et al.*, 2018). Climate change has greatly affected the quantity and quality of food production, both directly and indirectly. Increasing temperature has degraded the water availability and quality, increased pests and diseases which has not only affected the food availability but also human health. Climate change changed CO_2 in the atmosphere, affected biomass and nutritional quality.

The extreme temperature due to increased GHG emissions has led to changing weather conditions and affected the human health of agricultural workforce. Through changing metabolic demands and physiological stress for people exposed to extreme temperatures, there is also the potential for interactions with food availability; people may require more food to cope, whilst at the same time being impaired from producing it (Watts *et al.*, 2018). All these factors have the potential to alter both physical health as well as cultural health, through changing the amount, safety, and quality of food available for individuals within their cultural context.

Climate drivers that affected the food security and food systems include temperature-related, precipitation-related, and integrated metrics that combine these and other variables (FAO, 2017). Climate drivers relevant to food production and availability may be categorized as modal climate changes (e.g., shifts in climate envelopes causing shifts in cropping varieties planted), seasonal changes (e.g., warming trends extending growing seasons), extreme events (e.g., high temperatures affecting critical growth periods, flooding/droughts), and atmospheric conditions, for example, CO_2 concentrations, short-lived climate pollutants (SLCPs), and dust. Water resources for food production will be affected through changing rates of precipitation and evaporation, groundwater levels, and dissolved oxygen content (Huntington *et al.*, 2017; Sepulcre-Canto *et al.*, 2014; Cruz-Blanco *et al.*, 2015; Schmidtko, Stramma & Visbeck, 2017).

Ozone causes damage to plants through damages to cellular metabolism that influence leaf-level physiology to whole-canopy and root-system processes and feedbacks; these impacts affect leaf-level photosynthesis senescence and carbon assimilation, as well as whole-canopy water and nutrient acquisition and ultimately crop growth and yield (Emberson *et al.*, 2018). The IPCC Special report on Climate Change mentions under Food Security that …"Without a large decrease in air pollutant emissions, high ozone concentration could lead to an increase in crop damage of up to 20% in agricultural regions in 2050 compared to projections in which changes in ozone are not accounted for". Higher temperatures are associated with higher ozone concentrations; C3 crops are sensitive to ozone (e.g., soybeans, wheat, rice, oats, green beans, peppers, and some types of cotton) (Backlund, Janetos & Schimel, 2008). The IPCC Special Report on global warming of 1.5°C found that climate-related risks to food security are projected to increase with global warming of 1.5°C and increase further with 2°C (IPCC, 2018).

The rising concentrations of carbon dioxide and increasing emissions of GHG's in the atmosphere has driven climate change very rapidly. As plants use CO_2 in photosynthesis to form sugar, rising CO_2 levels, all things being equal, enhances the process unless limited by water or nitrogen availability. This is known as 'CO_2 fertilization'. Furthermore, increasing CO_2 allows stomata to partially close during gas exchange, reducing water loss through transpiration. These two factors affect the metabolism of plants, and, as with changing temperatures, affect plant growth rates, yields and their nutritional quality (Tombesi *et al*., 2015).

Increasing concentrations of atmospheric CO_2 lower the content of zinc and other nutrients in important food crops. Dietary deficiencies of zinc and iron are a substantial global public health problem (Myers *et al.*, 2014). Currently, the world is burdened with zinc deficient diseases and the world population is at highest risk of zinc deficiency as they receive most of their dietary zinc from crops (Myers *et al.*, 2015). The total number of people estimated to be placed at a new risk of zinc deficiency by 2050 is 138 million. The people were likely to be most affected live in Africa and South Asia, with nearly 48 million residing in India alone.

Risk-management and Sustainable Development

I. Adapting Green Energy Solutions: The main cause for the highest percentage of the release of GHG is the production of electricity using fossil fuels. This challenge has already been taken up by almost all the countries across the globe and the most adaptive and sustainable alternative to the problem is renewable energy sources for energy generation and conservation. Renewable energy is sustainable, more environmentally friendly and increases the self-dependency of the nation in terms of energy supply and demand. The renewable energy is clean and green contributing negligibly in Green House Gas emissions. America, Europe, Asia, Africa and almost all the countries are working on the renewable energy sector to come up with more efficient technologies which can completely replace fossil fuels for electricity generation. Another source of Green House gas emission is the transportation sector which emits noxious gases and makes the environment difficult to even breathe. The rapid urbanization and increasing number of automobiles have made cities Heat Islands and the worst part is that the poor suffer the consequences of the hazardous events despite being least responsible for the cause. Green energy solution refers to the adaptation of sustainable and clean energy effecting least in an imbalance of nature. Solar energy which is advancing rapidly considered to be the most efficient alternative for electricity generation either-off-grid, on-grid or through hybrid system. Solar energy can be applied at smaller area either in homes, apartments, communities, or at large area power plants of MW capacity or more. Either solar water heating system, solar air conditioning, solar cold storage, solar dryers, or solar PV for lighting and running electrical and electronic appliances, solar has proved its significance. The EVs, E-Rickshaws, Solar based flights, solar running trains can replace the existing automobiles and transportation sector which currently run on fossil fuels. The good part is that the world is already working towards a collaborative platform through different programs either be UNFCCC, ISA etc. but eventually it will take a lot more years to completely replace the existing technologies with safer options.

II. Water Conservation [Optimal Use and Rainwater Harvesting]: Water gives life to human existence. The urbanization and concretization have restricted the natural groundwater flow for its refinement and recycling process. Due to this, the groundwater level is decreasing day by day and the consumption is already very high due to extremely hot weather climate. The reason for extremely warm weather is increasing Green House Gas emissions. In this scenario, the alternatives to make water available to every human being on this planet is calculated consumption of water use, no wastage of water and adopting renewable options for natural water filtration. Consuming water optimally by farmers in agriculture, labors at constructional sites, daily human use etc. will reduce the overall consumption and excessive loss of groundwater, respectively. Another alternative is Rainwater Harvesting in which rainwater is directed a few feet below the ground for natural filtration and conservation. This technique also limits the consumption of fresh underground water for drinking and bathing. The rainwater can be filtered and collected for gardening, car washing, flushing etc. The solar water purification system is another trend which can be used for water purification.

III. Waste Management: Another source of GHG is big heaps of dumped waste. Waste is non-environment friendly subject because it is degrading the air quality, emitting Green House Gases and lowers the drinking quality of groundwater by mixing of leachate produced under the waste heaps. The best solution is to stop the building of big mountains out of waste by adopting the basic formula of waste management i.e., Segregation at the source. Segregation at source is the first step towards this initiative and it is recommended by almost all waste management communities. Another technology to treat non-degradable waste is a thermal process such as pyrolysis converting plastic to fuel. Different ideas and innovations are adopted by different communities and startups who are utilizing the waste in very innovative and aesthetically either it is the development of parks using scrap tyres or building bus stand with discarded water bottles.

IV. Reducing deforestation and forest degradation and increasing afforestation: Forests are the biggest GHG sinks. But the increasing earth temperature has brought this heat to an extent where forest fires are becoming a common event to occur. Australian forest fire is one of the most recent events. There are more cases in the past few years. The reason for deforestation and forest degradation is the increasing population, their living and food requirements. As the population is increasing, people are looking for land for their living. Hence, they migrate towards jungles and cut trees. This practice not only degrades the forests but also affects the natural habitat in forests. Animals are running away from forests in search of food and water. Some are either killed or died unbalancing the natural habitation. Afforestation is another mitigation measure which increases Carbon Sequestration. Increasing forest area contributes to the maintenance of global carbon sinks (IPCC, 2020).

V. Sustainable forest management (SFM) and CO_2 removal (CDR) technologies: IPCC Special Report on Land Degradation says that …"Sustainable land management including SFM contributes to mitigation and adaptation and can prevent and reduce land degradation, maintain land productivity and sometimes reverse the adverse impact of climate change on land degradation". SFM aimed at providing timber, fiber, biomass and non-timber resources which can provide a long-term livelihood for communities, reduce the risk of forest conversion to non-forest uses for settlement, crops, etc., and maintain land productivity, thus reducing the risks of land degradation. Other biophysical and human activities can also control CDR. Through harvest and forest regeneration along with sustainable forest management measures can provide active carbon sinks which can help us in combating climate change. In 2007, the IPCC concluded that in the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, will generate the largest sustained mitigation benefit' (IPCC, 2020).

VI. Carbon Trading and Carbon Credit: Carbon market aims at lowering the economic cost of reducing GHG emission by allowing the trading of instruments responsible for it. United Nations Framework Convention on Climate Change (UNFCCC) developed global carbon markets either through the CDM or under the Kyoto Protocol and recently under the Paris Agreement (2015) a market-based mechanism has been established. CDM (Clean Development Mechanism) aims to reduce Green House Gas emissions and halt climate change delivering positive social/ environmental impact in measurable terms. It put a price on carbon and materializes environmental and social impacts of carbon pollution and permits trading which lowers the economic value of reduced emissions. If the country has reduced emission levels, then that country can buy Certified Emission Reductions (CERs) - tradable offsets (also called carbon credits) which can be further sold. The developing countries can earn Certified Emission Reductions (CERs) by avoiding, reducing, and sequestering carbon emissions and increase their project's financial viability.

Eventually, risk management and sustainable development account for a greater number of practices and approaches including what is mentioned above. These practices help in reducing emissions and provide a more sustainable platform to survive on this planet. The mitigation and adaptation measures maintain a balance of the ecosystem and avoid the hazardous impacts faced by different corners of the world.

DISCUSSION

The ecological imbalance has created a risky and fearful scenario especially among the economically weaker section which faces the throwbacks of nature in response to the unsustainable activities and pollution caused by humans. Therefore, to live a healthy and sustainable life people need to come together for adapting green energy practices to give nature the best from their side so that nature can give the best on them. (UNFCCC, 2007).

With increasing industrialization, the emission of GHG has increased drastically which is a concern to the world. However, the world is diverting itself towards sustainable alternatives through adaptation and mitigation measures. Sustainable development can reduce vulnerability to climate change and the current climate change scenario may accelerate the nation's ability to achieve sustainable development pathways. To promote sustainability, it is necessary to either adapt climate change impacts or promote adaptive capacity. But climate change can slow the pace of sustainable development because of adverse impacts with eroded adaptive capacity.

CONCLUSION

The long-term impacts of climate change have damaged the environment so badly that even the most stringent mitigation efforts cannot avoid some impacts of climate change in the next few decades. Therefore, it is essential to practice adaptation and mitigation, particularly for addressing near term impacts. Today, we need to develop mixed strategies that cover mitigation, adaptation and technological research and development to enhance the strategies. Moreover, we should also divert ourselves toward a renewable world along with renewable practices.

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Influence of GIS in Sustainable Agriculture

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ABSTRACT

Sustainable agricultural goal is to meet the present societal demand without compromising the future generation's needs. However, providing indefinite food security due to rising food demand for the current and future generations is an environmental, social, and economic concern. GIS technology helps economists, planners, agronomists, and farmers to study and formulate strategies that will encourage sustainable food production to ensure the survival of the human race. Using GIS in sustainable agriculture can bring great benefits, especially land resource management, mapping, crop modeling, crop forecast, utilization of fertilizer, human resource management. In this paper, we study the influence and applications of GIS on agricultural sustainability to overcome the problems and strengthen the capacity for sustainable agricultural development.

Keywords: Sustainable Agriculture, GIS Technology, National Economic Growth

INTRODUCTION

GIS is no longer a revolutionary concept in agriculture. The agricultural sector is the primary backbone of the maximum countries in the world. In the case of the rural economy, agriculture assists in socio-economic development. No economic reform strategy will succeed without sustainable and broad-based agricultural production, which is important to increase living standards, alleviating hunger, ensuring food security, developing industry, and service sector to make a significant contribution to national economic growth.

GIS plays a vital role in agriculture at different scales, from local to global. GIS enables farmers in smart farming with the assistance of spatiotemporal knowledge (Rehman, 2015). The emergence of many major national and larger-scale digital databases, the introduction of modern active data collection and remote sensing technologies on the farm level, and the continuing transfer of GIS tools have influences in the agricultural applications over the last decades. Principally GIS developed on the field of agriculture to determine crop acreage estimation, crop modeling, and forecast, crop and orchard monitoring, crop and physiochemical mapping (Kingra, Majumder & Singh, 2016). Perhaps the most significant applications are those linked to precision or site-suitable farming, which helps to guide crop, fertilizer, pesticide, and water distribution inside fields in ways that optimize agricultural yields and reduce chemical inputs and maintain environmental sustainability (Oshunsanya & Aliku, 2016).

LITERATURE REVIEW

Sustainable agricultural development relies on the sensible utilization of natural resources (water, soil, livestock, climate, plant genetic, forest, topography, and fisheries) with appropriate management of technology under the existing socio-economic infrastructures (Coleman & Galbraith, 2000). In developing countries, technology plays a significant role in the fast economic growth and social transformation. Geospatial technology and technological advances assist in establishing a diverse and efficient agriculture that is environmentally friendly and able to provide citizens with outstanding nutrition. Although natural resource inputs cannot be regulated in agriculture, they can be better understood and handled using GIS applications. GIS may lead significantly to accurate estimation of crop yield, analysis of soil type and structure, detection, and remediation of soil erosion. Highly precise and consistent, reliable forecasts of the crops tend to reduce uncertainty. In agricultural development, the main issue is the need to improve the production, jobs, and income of poor segments of the agricultural population, and this condition can be resolved by implementing GIS in agriculture. GIS tools and web services allow farmers to predict crops and monitor their agricultural production using satellite-collected multi-spectral imagery. The facility of GIS to evaluate and visualize agricultural landscapes and workflows has proved to be a great benefit for farmers. GIS provides the potential to analyze and interpret soil data to decide which crops should be planted when and how to preserve the soil nutrients to support the plants better. In agriculture, GIS helps farmers achieve higher productivity and lower costs by enabling better use of land resources. GIS also helps to reduce the vulnerability and risk of small and marginal farmers. Agricultural Geographic Information Systems (AGIS) utilizing geometrics technology, farmers can map, monitor, and forecast the present and future fluctuations in rainfall, temperature, crop yield, etc.

In future, the growth in agriculture will come from innovative technology that is not only cost-effective but often compatible with the country's natural environment regime; innovations directly applicable to rain-fed areas; continued genetic advances for better yields; enhanced data for sustainable planning; bridging the difference between theory and practices.

Land Resource Management

Geographic Information System (GIS) is a technology that offers geographic database analysis and visualization facilities. This unique tool helps the farmers, scientists in land resource assessment, prioritization, mitigation, and planning for sustainable management of the land resources (Kingra, Majumder & Singh, 2016; Rehman, 2015). Agricultural mapping helps the farmers to understand the situation easily. The importance of agricultural mapping is becoming crucial day by day for monitoring and management of soil and irrigating farmland. It favours the development of agriculture and rural development. Precise mapping and analysis of agricultural geographic and geologic features help scientists and farmers to establish more productive and effective farming techniques. These techniques help the farmers to take further remedial action in the form of proper usage of fertilizers, controlling infestations of weeds and pests, preserving the natural resources, etc., which ultimately assist in more and higher quality food production. Soil quality, soil structure, soil loss estimation analysis is also crucial for higher agricultural productivity with site specific crop analysis (Bullock, Lowenberg-DeBoer & Swinton, 2002; Erdogan, Erpul, & Bayramin, 2007). Geographical features mapping information helps us in estimating important data such as the most economical laying of canals considering the cost of excavation and levelling, etc. Meteorological mapping (like rainfall patterns, climatic conditions, seasonal changes, and predictions) is important information required by farmers and agriculturists to plan the type of farming most suitable and economical. Water distribution map (like the length of systems, efficiency details, areas served, and the volume of water carried) helps in estimating how efficiently the systems work and, on its basis, determine the extension projects and maintenance programs. Land utilization pattern mapping provides precise information that helps in analyzing the resources efficiently and effectively.

Crop Modeling and Forecasting

The most important utilization of GIS in the agricultural field is crop modeling and forecast to help the farmers in protecting crops, solve crop issues, and damage crops (Hartkamp, White & Hoogenboom, 1999). According to the weather pattern, geographic location, and irrigation agricultural decision making is an essential part of agriculture to get more productivity (Sarmah *et al.*, 2018). Availability of crop statistics data for planning and decision making helps the farmers to minimize risk (Longley *et al.*, 2005). Using GIS in crop growth monitoring, soil status monitoring, regular reports regarding total area under cultivation assist the farmers to make more reliable production. Monitoring of crops at frequent intervals during the crop growth time in order to take necessary steps and determine the possible output. Crop coverage mapping (like sustainable season/ climatic conditions, water requirements, manure/ fertilizer requirements, the total time for sowing reaping and harvesting) are crucial for estimating the yield productivity (Rosenzweig, 1990). GIS also helps to keep record of historical data which leads to study the existing trends. A reliable crop yield estimate is one of the most important components of profitability analysis. Where, Crop growth models assist to understand the association between physiological process and environmental factors such as water distribution, solar irradiation, temperature, and nutrient availability under changing climatic scenarios.

Human Resource Management

Shortage of manual and experienced labour, developed countries utilize more advanced machinery and chemical fertilizer to minimize the labour cost (Nishiguchi & Yamagata, 2009). GIS and GPS is an advanced tool which helps the farmers in minimizing the labour intensively using precise mapping and decision-making system. Prediction of crop showing dates helps the farmers to manage labour availability. Conventional crop and meteorological data acquisition and analysis are more reliable than Remote Sensing and GIS data, but it is experienced labour intensive, costly, and time-consuming. To overcome these kinds of problems, GIS maybe become an alternative way to acquire day to day information (Kingra, Majumder & Singh, 2016). In the case of precision farming, GIS helps in labour management (Usery, Pocknee, & Boydell, 1995).

Agribusiness Management

Agricultural management using GIS may lead to sustainability in the future with the help of advanced farm management and decision support systems (Saiz-Rubio & Rovira-Más, 2020). Historical crop data analysis and predictions of crop yield using GIS data help to financial analysis of the farmers. GIS also provides a strong database related to stock assessment, market location, market analysis, and transportation, which benefitted farmers to best practice. Meteorological disturbances mapping and monitoring using GIS provide sophisticated information to reduce vulnerability.

DISCUSSION

Increasing competition with declining crop prices, farmers need to maintain a profit from the agricultural field to maintain their standard of living. Decision-making system using GIS technology helps the farmers to choose the best agricultural practices to gain profit with maintaining sustainability. GIS becomes the most powerful tools which may help the farmer to meet future food concern (Usery, Pocknee & Boydell, 1995). GIS helps in integrating different types of data for meeting sustainable agricultural goals as economic profitability, health environment, and social and economic equity.

CONCLUSION

Utilization of GIS technology in data gathering and decision making may be a challenge to the different types of farmers. In that case, researchers, scientists, and agribusiness professionals have a great opportunity to build a system that is easier to use for maximum farmers. GIS with proper technology assists the farmers not only data gathering and visualization but also as a powerful decision support system, which may lead to reduce seasonal vulnerability and maintain agricultural sustainability.

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Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) A Way of Sustainable Development in Rural India

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ABSTRACT

In the process of transforming the Indian economy, we should transform the agriculture to reduce the vulnerability in rural area. In this respect to improve efficiency, sustainability, and agricultural resilience, we have to provide subsidy in terms of indirect or direct cash transfer. Several eminent economists have long been arguing for abolishing agricultural subsidies and their substitute by direct income support (DIS) to farmers. The DIS is considered less distorting, more supportive of sustainability and less prone to corruption and leakages. The DIS scheme like Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme, seeking to provide income support to all small and marginal landholder's and farmer's families with cultivable land up 2 hectares across the country, related to agriculture and allied activities as well as domestic needs by way of payment of Rs. 6000 per year, subject to certain exclusions, has been launched on the 24th of February 2019. This study has discussed about the way of rural sustainable development in India using PM-KISAN scheme. A point of departure of the present study is to shed a light on the merit and demerit of the direct effects of targeted interventions. As a case study, the impact of the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme is evaluated.

Keywords: Direct Income Support Program, PM-KISAN, Social Security Scheme, Poverty Alleviation Scheme, Sustainable Development

INTRODUCTION

The problems of extreme vulnerability together with an increased incidence of natural and man-made disasters are the important phenomenon which crippled the rural economy in India and any other developing economy. The development researchers have focused understanding the vulnerability of livelihood sources and intensification of poverty among rural people. So, the concept of social safety nets either in the form of targeting or Universalism has become more and more significant and main issues of poverty reduction, environmental management, and human development. Targeting policy or targeted intervention is defined as the short-run intervention which concentrates limited resources to the poor to alleviate poverty. It is generally thought that targeting is not only more cost-effective but also more equitable than is the universalism which transfers resources equally to all members of society. However, it is not easy to empirically decide whether targeting is more efficient than universalism because targeting the poor involves substantial costs. Most studies on targeted intervention have focused mainly on indirect transfer benefits and few evaluated their direct transfer effects.

Several eminent economists have long been arguing for abolishing agricultural subsidies and their substitute by direct income support (DIS) to farmers. The DIS is considered less distorting, more supportive of sustainability and less prone to corruption and leakages. The DIS scheme like Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme, seeking to provide income support to all small and marginal landholder's and farmer's families with cultivable land up 2 hectares across the country, related to agriculture and allied activities as well as domestic needs by way of payment of Rs. 6000 per year, subject to certain exclusions, has been launched on the 24th of February 2019. The amount is being credited into the accounts of the beneficiaries held in destination banks. Against the wishes of reformists, DIS schemes have not replaced any input subsidies so far. These include subsidy on fertilizers, irrigation, electricity, agricultural credit, and crop insurance. The JAM trinity of Jandhan, Aadhaar and Mobile connectivity was not insisted upon in PM-Kisan's first (December to March) and second installments (April to July). These were paid without Aadhaar authentication. Even for the third installment (August to November), Aadhaar is not being insisted upon. Under the Scheme, the entire financial liability towards the transfer of benefit to targeted beneficiaries will be borne by the Government of India.

The similar programme can also be found in different parts of the world.

Table 1: Direct Income Support over the World

Conditional Income Support (Target group meeting certain conditions)		
Country	**Programme**	**Benefit**
Mexico	Oportunidades	Cash payments to families in exchange for regular school attendance, health clinic visits, and nutrition support
Brazil	Bolsa Familia	Cash transfer based on conditions like vaccinated child, attending school, preferentially to female
Unconditional Income Support (Whole target group)		
Country	Programme	Benefit
Bolivia	Bonosol	A universal, age based, non-contributory, central government social security program
Bangladesh	Chars Livelihoods Programme	Un-conditional transfer of productive assets worth 8,000 to 13,000 Taka, including temporary stipend to the poorest households living on riverine islands

Author's compilation on the basis of different reports

From the above table, we can see that DIS is classified between conditional and unconditional income support. The PM-KISAN is an unconditional and specific target group-based program. This study has discussed about the way of rural sustainable development in India using the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme. A point of departure of the present study is also to shed a light on the merit and demerit of the direct effects of targeted interventions. As a case study, the impact of the PM-KISAN scheme is evaluated.

I. Different Aspects of Sustainable Development:

Sustainable development uses a number of old concepts in new ways to address new problems and marries them with the relatively new biological science of ecology to provide developmental solutions which aim to be sound both from the human and biosystem perspectives (Kelly, 1992). Sustainable development theory links models of long term biological and economic maximization. It extends cost benefit analysis and bio-economics and combines it with ideas of economic welfare first expressed by J.S. Mill in the nineteenth century. Sustainable development received its first major exposure in 1980 with publication of the world Conservation Strategy (IUCN, 1980). The sustainability concept has attracted wide attention since promoted by Brundtland Report, which argued for development which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). From an anthropocentric perspective, ecological sustainability is not necessarily a goal, unless degradation of ecosystems leads to reduced welfare of mankind. In this regard, it has been suggested that attention should be paid to protection of three systems, viz. ecological, economic, and social (Barbier, 1987).

Social sustainability might include freedom of individuals; community cohesion, availability of jobs, maintenance of services (housing, health, education, law, and order); and preservation of cultural diversity and heritage values. Economic sustainability can be frames in terms of variables such as levels of unemployment, personal incomes, affordability of services, viability of firms and financial performance of regional and national economies.

Based on above discussion, we can provide a useful framework for sustainable development in rural area through farming.

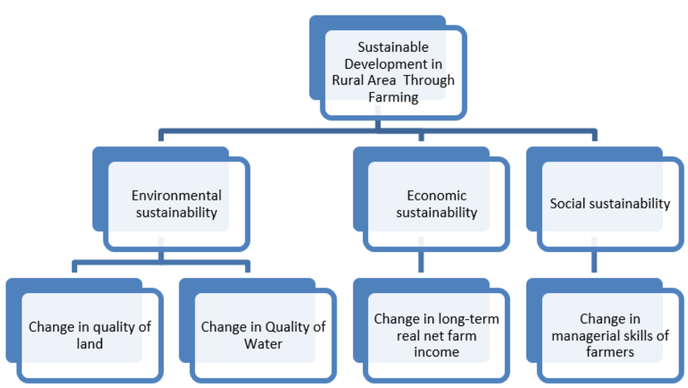

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Figure 1: Framework of Farming Induced Sustainable Rural Development

In underdeveloped countries agricultural work is performed by unskilled farmer and most of them are unable to use resources for farming activity efficiently. The over utilization of chemical and inefficient land utilization process induces the quality of environment and land in rural area. Vincent (1994) provides critical insights into farmers attitudes to monitoring land quality. Their study suggests that while involvement in monitoring would be of significant value to farmers, most farmers do not understand the relevance of monitoring, and associate it with research rather than farming practice. They may be unwilling to admit to a problem of land degradation because this could reduce property values, and because they perceive a social stigma associated with disclosure. Farmers are therefore interested in knowing what to observe, and the results of monitoring by others, but are unlikely to voluntarily participate in monitoring programme.

Vincent (1994) further indicate that many farmers have misconceptions about what are sustainable management practices. For example, many consider long weed-free fallows preferable to multiple cropping which maximizes soil cover, fail to recognize that long fallow depletes organic matter and accelerates soil erosion.

This study provides a useful framework for sustainable development in agriculture via the transmission of direct transfer benefit of PM-KISAN. The development in agriculture and the beneficiary of PM-KISAN associated to agriculture will make a sustainable development in rural India via the above pathways which we will discuss in the next section.

II. PM-KISAN and Sustainable Development:

If all future events were known with complete certainty, then a poor household would always be able to take appropriate action to avoid any potential sudden decline in the income stream received by this household. In fact, however, this information is not known. Instead poor households in developing countries are faced with considerable uncertainty. To mitigate the vulnerability arises from such kind of uncertainty, different type of Direct Income Support Schemes and Indirect Income Support Scheme are introduced by most of the welfare states. DIS schemes supply cash directly to poor households to correct the market failures linked with non-internalized positive externalities (Janvry & Sadoulet, 2004). They identify the vulnerability of those whom the scheme addresses and make a provision of a cash grant to enable individual/group coping mechanisms, often in response to guaranteed human rights. These constitute protective social security measures. These programs thus represent a paradigm shift in governmental approach that earlier focused on the supply-side delivery of basic services. Instead, they focus on the demand-side, by protecting the good consumption basket. These programs also represent a shift from targeted subsidies to more sharply general programs that aim to improve human capital formation and, thereby, increase efficiency in the long run.

PM-KISAN is an assistance to overcome the weakness with the income associated to uncertainty from natural disasters. The indirect benefit transfer like different employment generation programmes are also helpful in such situation of income failure. The indirect benefit transfer programme is self-selecting into those households with a comparatively high, and those with a much lower, risk of falling into the vulnerability set. The group faced with a relatively high risk of falling below the boundary income level will tend to apply for assistance. The opposite is the case for those with facing a comparatively small risk of falling below the boundary income level. But one high risk group, that will not be identified by this work requirement, is composed of those not capable of work even if they are willing to do so.

Direct income support boosts many sustainable development goals. PM-KISAN schemes can also be treated as an instrument that has a direct impact on income and indirect impact on consumption and human capital formation (De la Brie're, & Rawlings, 2006). Such transfers have policy relevance in India at present concerning the alleviation of various dimensions of human poverty. Most of the farming communities are suffering from a low-level equilibrium trap and they persistently belong to a low level of education, health, and nutritional attainments. The inequality among regions between rural and urban areas and within the social groups is widely seen as a hindrance to the achievement of Millennium Development Goals.

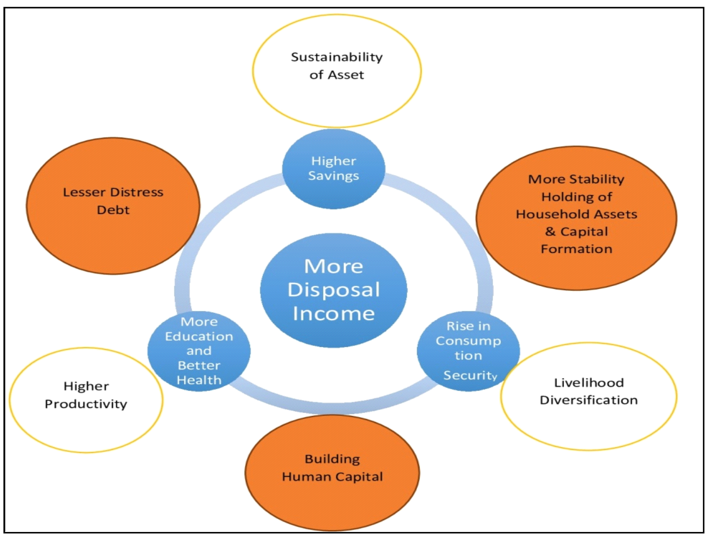

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Figure 2: Pathways of Sustainable Development

The rural areas' less-favored regions, still largely dependent on agriculture, are frequently source of negative growth, soaring unemployment and mounting rural poverty (Lerman, 2000). This is a decrease in agricultural production as it prevented development of individual farms by depriving them of significant investment. The negative social and economic consequences upon the rural population are detailed in Vranken, Noev & Swinnen (2004). Sustainable agriculture is a way of growing or raising food, including animals, in an ecologically and ethically responsible manner using practices that protect the environment, safeguard human health, are humane to farm animals, and provide fair treatment to workers (Mason, 2003).

In the current deceleration in economic growth in rural area as a result of the global economic crisis, the PM-KISAN scheme may also be seen as a way to ensure a little safeguard to the formation of human capital/capabilities of the poor and augmenting the rural productivity via enhancing the agricultural base. The above figure exemplifies the transition process from PM-KISAN to rural development. The direct transfer to marginal farming household raises the disposable income which leads to rise in consumption and food security in rural India. Consumption smoothening continues the demand in different sector of the economy which has a linkage effect. After the consumption, the remaining part of the direct transfer can be used to enhance the level of education and access the better health facilities. It also has a contribution to higher savings. The higher savings and the transfer PM-KISAN will reduce the distress debt in future. The savings can be used by the farming community in capital formation for increasing productivity in agriculture. On the other hand, good health from good quality food consumption and health facility along with education enhances productive skill of the famers.

The more diversified the local economy, the higher the multiplier (Leven, 2000). The capital formation and skill development through PM-KISAN will develop a capability of diversified agricultural activity and a linkage between farm and off farm activity. The off-farm activity creates value to agricultural product developing a class of farmer-entrepreneurs. This diversification is also an incentive for young people to stay in rural areas, and rural households increasingly seek to complement their income outside the agricultural sector. In many rural area's tourism and provision of services, especially environmental services, are growing and becoming an important source of job creation and diversification. The development of a local and regional economy depends on its capacity to sell its products outside its borders or to attract external revenues (Krikelas, 1992). The above sectoral linkage and eco-tourism through beatification as well as organic farming generates economic and environmental sustainability simultaneously. The positive impact on economic performance leads to stabilization of the rural economy and improve the quality of life in rural areas. This brings the economic freedom and free voice for society with respect to mass wellness which instigates them to involve them in participatory rural development and leads to social sustainability.

III. Political Economy of the Scheme PM-KISAN:

In rural India basically, two types of government support can be seen in the agricultural sector. The first one is price support and the second one income support. When the government is procuring the agricultural produce from farmers at a remunerative price is treated as price support. India's Minimum Support Price based procurement is a classic example. But in the case of MSP, the market price and production levels are influenced. Here, a high subsidy provider country can become a big producer by giving higher prices (read subsidies) to farmers. WTO has specified these subsidies as amber box subsidies that distort trade. Such subsidies should be reduced as they may make a high-cost producer big produce and the country may export its produce. Our Food Subsidy (Rs 184220 crores as per the 2019 budget) belongs to the amber box subsidies that the WTO requests us to reduce it. Here, remember according to the WTO, a subsidy by the government that influences production and price is trade-distorting and it should be reduced.

Now, the second type of support i.e., the income support; here, the government will provide direct payment to the farmers for their low income from farming. Under the WTO jargon, it is called Direct transfer to farmers or Decoupled Income Support. Decoupled means such an income payment to farmers will not influence (or minimum influence) production and price of the respective crops. The political economy of support to the farmer is that most of the developing countries are granting price support (like the MSP) because the developing countries have insufficient funds to provide money to the large size of their farming people. Direct income support to farmers is the type of support given by developed country governments. Few numbers of farmers and easy way to identify the deserving farmers make direct income support as the easiest and successful agricultural support in the developed countries. PM-KISAN has changed everything. It is quite clear to us that a direct income support scheme like PM-KISAN is a subsidy like the ones given in advanced countries. Or in other words, with PM-KISAN, India entered the Green Box era in the WTO parlance. Remarkably, India's agricultural support policy shows indications of migration from price support (MSP) to income support with the introduction of PM-KISAN.

IV. Features and Progress of the Scheme PM-KISAN:

Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) is India's first national-level direct benefit transfer for farmers. 24th February 2020 is the 1st anniversary PM-KISAN. The scheme was started with a view to augment the income of the farmers by providing income support to all landholding farmers' families across the country, to enable them to take care of expenses related to agriculture and allied activities as well as domestic needs. Under the scheme, Landholder Farmer families with total cultivable holding up to 2 hectares shall be provided a benefit of Rs.6000 per annum per family payable in three equal installments of Rs. 2000, every four months. The scheme takes effect from 01.12.2018. The first installment to eligible beneficiaries during this financial year 2018-19 shall be for the period from 01.12.2018 to 31.03.2019.

The entire responsibility of identification of beneficiary's rests with the State / UT Governments. An exclusive web-portal www.pmkisan.gov.in has been launched for the Scheme. The financial benefits are released to the beneficiaries based on the data of farmers prepared and uploaded by them on the PM-Kisan web-portal. All landholding farmer families having cultivable landholding up to 2 hectares, whose names appear in the land records of States/UT as on 01.02.2019, are eligible to get benefit under the scheme for the next 5 years except the transfer of land on succession in case of death of landholder. However, all institutional landholders and constitutional post holders of any member from a farming household at any time are excluded from the benefits of the program. Any individual or farmer family owning more than 2 hectares of cultivable land will not get any benefit under the scheme.

The States shall prepare database of eligible beneficiary landholder farmer families in the villages capturing the Name, Age, Gender, Category (SC/ST) , Aadhaar Number (in case of Aadhaar Number has not been issued then Aadhaar Enrollment Number together with any other prescribed documents for purposes of the identification such as

Driving Licence, Voters' ID Card, NREGA Job Card, or any other identification documents issued by Central/State/UT Governments or their authorities, etc.), Bank Account Number, IFSC Code. Though the mobile number is not mandatory it is advised that when available it may be captured so that the information related to sanction/transfer of benefit can be communicated. In cases of beneficiaries in States such as Assam, Meghalaya, J&K where Aadhaar number has not been issued to most of the citizens, Aadhaar is not mandatory. Aadhaar number shall be collected for those beneficiaries where it is available and for other alternate prescribed documents can be collected for identity verification purposes by the State/UT Governments. The beneficiary lists would be displayed at Panchayats to ensure greater transparency and information. Further, States/UTs would notify the sanction of benefit to the beneficiary through system generated SMS. All such farmer families whose names are not included in the list of beneficiaries can approach the District Level Grievance Redressal Monitoring Committee in their Districts for inclusion of their names in the beneficiary list.

Table 2: State-wise/Installment wise List of Beneficiaries

State	Beneficiaries of PM-KISAN as on 29-10-2019	Beneficiaries of PM-KISAN as on 20-02-2020	% Change in Beneficiaries
Andaman & Nicobar Islands	15763	16,521	4.81
Andhra Pradesh	4358096	5117791	17.43
Arunachal Pradesh	22648	50,823	124.40
Assam	3064090	2704200	-11.75
Bihar	4108421	5360396	30.47
Chandigarh	438	423	-3.42
Chhattisgarh	1508817	1880822	24.66
Dadra and Nagar Haveli	9634	10,462	8.59
Daman and Diu	3268	3,466	6.06
Delhi	11513	12,896	12.01
Goa	6629	7,248	9.34
Gujarat	4602935	4875048	5.91
Haryana	1381096	1455118	5.36
Himachal Pradesh	820608	872175	6.28
Jammu & Kashmir	880634	934299	6.09
Jharkhand	1549205	1436023	-7.31
Karnataka	4193175	4912445	17.15
Kerala	2215290	2773306	25.19
Lakshadweep	0	0	0.00
Madhya Pradesh	4198019	5519575	31.48
Maharashtra	7360854	8459187	14.92

Manipur	73804	173789	135.47
Meghalaya	58985	70,236	19.07
Mizoram	65030	67,540	3.86
Nagaland	142916	170334	19.18
Odisha	3093054	3628657	17.32
Puducherry	8944	9,736	8.86
Punjab	2123478	2240189	5.50
Rajasthan	5267877	5204520	-1.20
Sikkim	4470	1,372	-69.31
Tamil Nadu	3305552	3534527	6.93
Telangana	3406496	3481656	2.21
Tripura	188831	196767	4.20
Uttar Pradesh	17483089	18764926	7.33
Uttarakhand	637906	701855	10.02
West Bengal	0	0	0.00
Total	76171565	84648328	11.13

Source: www.pmkisan.gov.in

About 7.61 crore beneficiaries of PM-KISAN (as on October 29) have received money without Aadhaar authentication. On the other hand, 8.46 crore (as on 20.02.2020) beneficiaries benefited under the scheme. PM-KISAN provides Rs. 7.1 crore in the first installment. The scheme has disbursed Rs. 6.1 crore during the second installment. In the third installment, PM-KISAN has provided Rs. 3.6 crore. The Central Government has already released more than Rs 50,850 crore (US$ 7.28 billion) till now. Total number of beneficiaries to be covered under the scheme is about 14 crores, based on estimates of the Agriculture Census 2015-16. All the state government has taken initiative to take advantage of the program without West Bengal.

The percentage of beneficiary households have been increased in most of the states except Assam, Jharkhand, Rajasthan, and Sikkim. The top five states in terms of high percentage of increase in beneficiary were Arunachal Pradesh (124.4 percent), Manipur (135.47 percent), Bihar (30.47 percent), Madhya Pradesh (31.48 percent) and Kerala (25.19 percent).

V. Merits and Demerits of the Scheme PM-KISAN:

The merit of cash transfers over loan waivers and subsidies lies in their potential greater efficiency in enabling poor households to directly purchase the required goods and services as well as enhance their market choices. Therefore, the impact of a welfare measure such as PM-KISAN can only be realized through financial support that provides farmers with adequate purchasing power to meet their daily necessities. About 79 percent of the current beneficiaries have received the first installment, while 59 percent have received the second installment. According to the Agriculture department, 6.68 lakh payments failed while paying the first installment while 1.32 lakh failed during the second installment. At the initial stage of implementation, Stop Payment instructions were issued in respect of the release of the first installment to 2,69,605 beneficiaries in various States as there were discrepancies in their bank account details.PM-KISAN may induce farmers to produce agricultural production less. But at the same time, it has some positives:

1. There is no leakage – income is transferred through direct bank transfer.
2. There is a safety for farmers against income loss and unfavorable terms of trade impact on agriculture.
3. It is less distortionary and is WTO compatible; there is less influence on production and price.
4. Farm income support is better than price support as it is crop neutral. The farmer is receiving incentive for continuing with agriculture whatever may be the crop he is cultivating. On the other hand, India's MSP historically, privileged wheat and rice farmers as procurement were concentrated on these two crops.

DISCUSSION

Though rushing into a massive cash transfer programme may complicate the government's ability to rectify problems on the fly, both politically and administratively. Again, the policymakers should be wary of overambitious implementation targets, in the rush for implementation the government has ignored its current administrative constraints and gone for nationwide scale up which will likely result in failure.

PM-KISAN is an ambitious scheme that has the potential to deliver significant welfare outcomes. However, the current top-down, rushed approach of the government ignores governance constraints and is therefore likely to fail. While there are 13.32 crore beneficiaries in the country according to agricultural census data, only 8.50 crore beneficiaries have been registered for the PM KISAN scheme till September 2019. The scheme does not provide a clear design of transfers and a framework for effective grievance redress. About 60 percent of eligible farmers are deprived of the PM Kisan Samman Nidhi benefits as the States have not added them to the list of beneficiaries (Dailyhunt, 2019). As per the Agri-Census data, 13.79 crore farmers are eligible to join the scheme, but only 5.41 crore farmers have been registered so far. Madhya Pradesh and Rajasthan have just started enrolling farmers for the scheme, West Bengal is the only state that has not registered a single farmer for the scheme.

CONCLUSION

Given that India's poverty line is Rs. 32 per person per day in rural areas and Rs. 47 in urban areas, according to the Rangarajan Committee, the income support of Rs. 17 a day for a household, which is the amount offered by PM-KISAN, is largely insufficient for even bare minimum sustenance of vulnerable farmers. Therefore, to be effective, any cash transfer scheme should first ensure that there is enough cash provided to help bring an affected community out of poverty. Though an alternative bottom-up strategy and well-planned implementation mechanism would allow weaknesses to be identified and rectified at the local level. It is indicated that the public action like PM-KISAN will depend very much on the effective monitoring of the programme. The most effective modalities can then be scaled nationally and ensure success.

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Artificial Intelligence and Buying Behaviour of Indian Youths in Ecommerce: An Empirical Study

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ABSTRACT

Artificial Intelligence (AI) is a revolutionary technology for companies to all over the globe to personalize the information of consumers. AI technology is getting better and improved day by day, allowing more industries to apply the AI for various businesses. Some research institute and universities have been working on this technology since decade in India to male AI more efficient and affordable in every field. AI is now becoming most important for large enterprises and start-ups, which are looking at different opportunities. In today's competitive world where manufactures, retailers and start ups in a continuous competition for consumer market only AI play the role of game changer. In this paper we focus on an impact of artificial intelligence on buying behaviour of Indian youths in Ecommerce and examine how Artificial Intelligence will influence Ecommerce. The research based on secondary data collection. To deal with any real new innovative issue, it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate. As much as the implementation and investment into smart technologies like Artificial Intelligence is the need of the hour as Ecommerce and its future seems to be very much married to analytics & the growth of AI-based tech, the buying behaviour of Indian youths are also changing in the present era of Artificial Intelligence in Ecommerce.

This study is going to be a path-breaking research which is a pioneer attempt to study how the Indian youths are reacting to AI in Ecommerce through their buying behaviour in online shopping.

Keywords: AI, Artificial Intelligence Ecommerce, Consumption, Buying Behaviour, Indian Youths

INTRODUCTION

Artificial Intelligence (AI) is a revolutionary technology for companies to all over the globe to personalize the information of consumers. AI technology is getting better and improved day by day, allowing more industries to apply the AI for various businesses. Some research institute and universities have been working on this technology since decade in India to make AI more efficient and affordable in every field, particularly in the field of Ecommerce. In today's competitive world where manufactures, retailers and start ups in a continuous competition for consumer market only AI play the role of game changer.

As much as the implementation and investment into smart technologies like Artificial Intelligence is the need of the hour as Ecommerce and its future seems to be very much married to analytics & the growth of AI-based tech, the buying behaviour of Indian youths are also changing in the present era of Artificial Intelligence in Ecommerce.

Ecommerce is also one of the fastest growing fields in Indian market. This word/term is commonly used to buy and sell products online, but now it can be describing any kind of commercial transaction through internet. It begins in the year 1994 where a man sold his CD through his website in American Retail Market. Since than many consumers parch their products through World Wide Web, or we can say Electronic commerce or Ecommerce. Many corporate, freelancers, small business enterprises and retailers are benefited by Ecommerce, which enable all of them to sell or perches their goods and services at such a large scale which was not possible earlier on offline platform. Global ecommerce sell projected to reach up to $27 trillion in 2020. According to the report of Internet and Mobile Association of India (IAMAI) it is tipped to reach 1.4 billion populations in 2018 (Agrawal, 2018).

According to India Brand Equity Foundation (IBEF) (IBEF, 2020) Ecommerce will transform many business and services in India. This market is expected to grow to US$ 200 billion by 2026, as expected to increase in the number of smart phone and mobile users. One of the important transformations is the use of digitalization in all service areas. India's Economy is expected to double from US$125 to US$250 billion by 2020 majorly backed by Ecommerce. As well as India's revenue is concern it is expected to jump from US$39 billion in 2017 to US$120 billion in 2020 with annual growth rate of 51% which is highest in the world (Casley India, 2019). This rapid growth of Ecommerce sector is depending on many aspects, but it has two important contents first users of smart phone and another is use of new technological improvement to serve consumer more. We hardly know this new word of AI in last couple of years. AI is already embedded our daily life in many ways. From personalizing shopping list to preferred fashion clothes, from Banking services to Education, from Medicine to Tourism and from insurance to IT. It is everywhere, each corner of life.

Artificial Intelligence (AI) is a revolutionary technology for companies to all over the globe to personalize the information of consumers. AI technology is getting better and improved day by day, allowing more industries to apply the AI for various businesses. Some research institute and universities have been working on this technology since decade in India to male AI more efficient and affordable in every field. AI is now becoming most important for large enterprises and start-ups, which are looking at different opportunities.

AI is can be defined as the ability of computer or a robotic system to process information and produce in a manner similar to the human thought process not only in decision making and problem solving process but also in difficult situation and logical thinking. We can say AI makes machine intelligent.

LITERATURE REVIEW

Statement of the problem

In normal circumstances, a customer has gone to a shop, look at things to buy, maybe talk to a sales assistant and then make a purchase decision. That means it was relatively easy to study the psychology of that purchasing pattern. Now, even though the agenda is the same, customers do all these things. In addition, they look at product websites, go to comparison sites, engage in chat in forums, ask their friends on Facebook and Whatsapp and might check items out with a range of competitors. They could then read some blogs to see what the "experts" are saying and could also look at some videos on YouTube showing the products they want to buy. They might also listen to some relevant podcasts and could even take part in a webinar (web-based seminar) about the item they intend to buy.

For any online retailer, this is a real-time issue. Much of the pre-purchase research activity undertaken by the prospective buyers is now done outside the confines of their store. That means the usual kind of intelligence a shopkeeper could use to secure a purchase is not available. Furthermore, even if the shopper does everything online, they may well be influenced by seeing other products in the real world or visits they have made to any neighbourhood stores.

In reality, as much as the online retailers are equipped with modern technologies like Artificial Intelligence to analyse the buying behaviour of its customers, online consumers are also using the same very apps or technologies to make pre-purchase or after purchase decisions. Many of the tech-enabled youths are using different smart phones or computers to confuse the so-called AI-enabled Ecommerce sites before making actual purchases.

After all, there is always a human behind every technology to interpret its readings or analysis. Similarly, how far AI has influenced the buying behaviour of the Indians youths while making purchases in Ecommerce sites needs to be analysed and understand not only from the point of view of enhancing modern marketing but also from the point of view of analysing the relevance of AI in it.

Scope and objectives of the study

As the problem is well known which focuses on impact of artificial intelligence on buying behaviour of Indian youths in Ecommerce, and the responses of the selected youths will be used to analyze and evaluate the data, the proposed research would be descriptive as well as analytical in nature. To deal with any real-life problem, it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate.

As such, the proposed study has the following objectives:

- To analyse the awareness level of the scope and benefits of AI among the Indian Youths in Ecommerce.
- To understand scope and benefits of AI in Ecommerce.
- To. examine how Artificial Intelligence will impact Ecommerce
- To understand implications and effect on society of AI in Economy

Relevance of the proposed study for policymaking

AI is a new revolutionary technology in Ecommerce and whole Economy. Today it is in its initial phase. Soon all manual jobs are getting automated and business and society will need to think about new skills areas to technical one. Another challenge is for utilizing AI for national security could have been examined beyond cost and capacity to include associated ethical and legal challenges such as the need for legal backing. Governments and business leaders have to decide the priority areas of AI to explore its benefit in all span of life. Whether AI is used to enhance potential and productivity of workforce or reducing business cost or creating new business or built new models with mankind.

Relevance of the proposed study for society

In the recent decade, artificial intelligence, also known as AI, has gained popularity. However, most of us have only seen the movies about it. There have been movies, like AI in 2001, where robots have human intelligence and human-like features but lack emotion. Although we still have not reached the movie levels of artificial intelligence, there are so many breakthroughs from the research done in the field. Today, we have machinery to replace humans, so they do not have to work in hostile conditions. The automobile market is also starting to promote autonomous driving cars, which is in the scope of AI. If the same AI is applied to Ecommerce, it surely is going to make a paradigm shift. Young online shoppers are actively engaging in Ecommerce in the country. How it is affecting the buying behaviour of the youths is a concern for the business houses as well as the society. Is AI a boon or bane for the society? This question can only be answered by undergoing a thorough study on the impact and implications of AI on the buying behaviour of the Indian youths.

Various applications and impact of AI in Ecommerce in India:

In today's competitive world where manufactures, retailers and start ups in a continuous competition for consumer market only AI play the role of game changer. Amazon go, Google Voice and EBay's ShopBot like genius applications are offering endless opportunities to ease their customers. they are providing more personal assistance to their buyers in which all information is updated and displayed quickly on all communication way, these all complicated and complex information are very difficult and sometimes impossible to manage manually.

AI is making waves like never in Ecommerce. It seems possible to expand business into new heights as it helps in many ways like:

i. **Prediction of sell and services:** AI enables to access the large amount of information about customers and data analysis without any error, as per the given objective and prepare patternsof individual's demand or likings like Limeroad and Netflix.AI is using to generate specific revenue forecast at macro level for sale management by providing clear trends and sales reps. A firm can optimize resource allocation and plan cost-effective outcomes.

ii. **Better services at affordable rate:** AI personalized marketing opportunities by providing quick, direct and error free customer's service. Price will be reduced due to absence of various agents and quick respond increase the level of satisfaction of consumers by using Chatbots. It is an overview that business spends $1.3 trillion on 65 billion customer's service calls each year. Chatbots will reduce that cost by answering up to 80% routine questions in a speedy responsible time by 24*7*365 (even in holidays). These services are offering by some business leaders like Zomato, Pizza Hut etc (Reddy Trips, 2017).

iii. Customer satisfaction: The real time conversation between customer and a Bots or messenger or on voice chat gave huge satisfaction to the consumers. These applications have all types of information about customer and by using this they can provide more efficient answers and intelligent service asked by customers. Unconditionally this will lead to higher level of customer satisfaction. As this is self learning system their answers are like human conversation more and more over the period.

iv. Analyze Recommendations and searches of consumer: If customers are looking for specific information, AI will provide you and numbers of specific, similar, and accurate information in a very natural way. Amazon Echo Look and Go find for example offer their users to use camera to take pictures to find their desired items within no time with similar results and price range. AI serves you as your personal assistance that recommended you what suits you and fit you best.

v. Financial assistance: AI can be used to make payments more safe and secure by fingerprint and image recognition. This will help in product search and recognition also like Pinterest and Amazon by providing facility to search product or item with the help of image. AI is also capable to analyze large number of reviews of any product or items generated by users and allow only Junín and original reviews to protect consumer from fake information. Near about 97 percent of consumers read online and 87 percent of them trust reviews to select products (Murphy, 2019).

vi. Demand forecasting: demand forecast is one of the biggest challenges in commerce. Being able to speculate about demand, stock inventories will be managed efficiently without unwanted cost. All types of goods and services can be included in this forecast. Now a day's AI is capable enough to gather all historic data of past perches based on time, festival, caste, income group or gender wise to help sales department to take decision accurately. AI can not only identify most and least popular product during specific period but also suggest it for promotion for focused group of customers.

vii. Voice search: Amazon Alexa obey your voice command. Even a small kid can use it as per need. Basically AI with voice command can make your order, check cart items, repeat your previous orders, check availability of items and suggest similar items, compare different sites to search best offers etc.it can also provide you best combinations of various products, suits you. Several opportunities have arisen in ecommerce after AI.

Major existing research works reviewed

a. International

With 100 billion connected devices expected by 2020, the future of retail and consumer behavior will move into a landscape of perpetual data collection, optimization, and aggregation (McDermott, 2017). At the same time, a research conducted by FlexMR

(2018), a world leading online market platform, shows that artificial intelligence is considered not as a threat but as an opportunity by the public.

Consumers still lack a firm understanding of what AI experiences can look and feel like today, which means that many AI-powered touch points go unrecognized as such (Zaczkiewicz, 2018). AT&T Foundry Report (2020) stated the following are the bold projections on the future of Artificial Intelligence in consumer experience:

a. Humans Have More Room to be Human
b. Be Everywhere as Data is Everywhere
c. Connectivity Instantly Powers Your Own Adventure
d. Consumers Go from One Click to Zero Clicks
e. Ethical AI Controls for Bias

b. National

Gupta (2016) found that the development of Ecommerce, in particular e-retailing, sets numerous challenges for both retailers and customers. The ease and availability of the e-retailing environment can result in impulsive online purchasing. On the other hand, the trend of online shopping in India is found to be most prevalent among youngsters, active participants being college going students and working professionals (MCPL, 2017).

As the online customers can get best possible professional advice and recommendation online, ecommerce majors are realizing that by extensive use of artificial intelligence and machine intelligence they can offer a better shopping experience (Sewta & Yadav, 2017)

Jadhav & Khanna (2016) found that main influencing factors for online shopping were identified as availability, low price, promotions, comparison, convenience, customer service, perceived ease of use, attitude, time consciousness, trust and variety seeking. In another study conducted by Avanade, a survey of 500 business and IT leaders from around the world revealed that they expect to see 33% increases in revenue because of smart technologies (Shyna & Vishal, 2017).

Many of the corporate houses are using the secondary data which was available on website to understand the insider view, various applications, scope and importance of AI and Ecommerce. PwC India (Ghosh & Rao, 2018) had conducted an online survey in which they involve participants from various industries and business functions from India as well as globally(either a full-time, part-time or a self-employed) in 2017 about the perspective on the perceived impact of AI on business and daily life of consumers. According to Darshan Shah, MD, South Asia, LenddoEFL, a Singapore-based fintech company explained that on the basis of various industry reports, more than 36% of large financial institutions were investing in such revolutionary technologies, and about 70% were planning to adopt it in the near future." (Kul Bhushan, 2018). Further, the scope of AI can be analysed through the following:

i. Complex problems of modern societies: one of the biggest benefits of AI is its speed of processing information. This helps researchers to pinpoint areas and focus on causes of complex problems. In health sector it can predict the outcomes of the drugs. The main findings show that 56% Indian respondents were believe that AI will help to solve complex problems of modern societies compared to 63% global respondent (Davenport & Kakakota, 2019).

ii. Cyber security: one of the biggest challenges of AI is to keep the system safe. 73% of the respondents from the survey were agreed on the importance of AI in cyber security as compared to 68% globally. Further 72% respondents were believed that AI can provide a better experience of one-to-one personalization as compared to 63% globally (Ghosh & Rao, 2018).

iii. Efficient customer service: Most important finding which was highlighted by Ghosh and Rao (2018) was that 49% participants were believe that they were prefer more adequate and efficient customer services provided by AI that can solve their problems more effectively and quickly for that they were ready to pay extra money. From our survey, 72% of the business decision makers believe that AI can offer a better experience of one-to-one personalization compared to 63% globally.

iv. Boost productivity: AI is very effective to boost the productivity of employees, 55 % of respondents from India as well as globe were believing that various applications of AI will enhance the productivity of employees by transforming the workplace. 83% respondent were believe that "AI advisor" will monitor performance rational and in impartial way. AI canassistants' employees by managing email, entering hours into timesheets, rescheduling and updating calendars, accounting for financials and routine paper work (Nandy *et al.*, 2018).

v. Financial assistance: AI is processed past data to generate information. This will reduce the risk in financial market. Data about each loan amount, repayment habit, number of existing credit cards etc can be used to manage risk of NPA and to customer more sense to the financial institutions that is offering loan or credit card. It is published in a report of Accenture's recent Accenture Banking Technology Vision 2018, that 83% of Indian bankers were believe that AI will work alongside humans in the next coming years as compare to the global average of 79%. In India 93% bankers were believe that they increased use of data to take complex and automated decision-making (Bhushan, 2018).

Challenges and limitations:

According to an estimate research by tech giant Accenture AI has potential to add $937 billion to India's economy by 2035 (Menon, Vajirani & Roy, 2017). This high-end technology AI in India is not going to be work without challenges. Lacking in reliable and accurate data in India's diverse cultural background, different geography, requirements, and adaptability, it is believed that number of challenges exist in Ecommerce using AI. However, AI has some limitation also.

There are four types of artificial intelligence, which are theory of mind, reactive machines, self-awareness, and limited memory. It depends on the area of utilization and intent of industry for what kind and purpose they are using AI. This system is based on algorithm. On the bases of this AI can predict process, explain, and describe certain decisions with remarkable accuracy. AI has not showed its full potential yet and so many ways it can be used. Moreover, it is already embedded in our lives but have some barriers. Some limitations of Indian market could slow the momentum; diversity of language, culture, traditions, and demographical differences can limit the ability of consumer to learn and go. Another major issue is under-invested by capital risk providers as compare to China and US. According to the (Ghosh & Rao, 2018), these following are the main barriers of AI:

Table 1: Main Barriers of AI

Main Barriers	Percentage
Unaffordable cost	20%
Technical viability	14%
Lack of quality data	12%
Privacy issues	12%
Faith	11%
Too many unknowns	10%
Lack of skilled team	9%

Source: Ghose and Rao (2018)

AI is a new revolutionary technology in Ecommerce and whole Economy. Today it is in its initial phase. Soon all manual jobs are getting automated and business and society will need to think about new skills areas to technical one.

Another challenge is for utilizing AI for national security could have been examined beyond cost and capacity to include associated ethical and legal challenges such as the need for legal backing.

The future of AI involves very advanced cognitive systems capable of doing that today machine learning systems cannot. It will intelligently interact with human experts and facilitating them with articulate explanations and analysis.

E-Commerce policy of India: There is no perfect and advance mechanism or policies around emerging technologies in India, which will have a pervasive and wide effect on society (Thakur, 2018). Government of India established a task force on AI, which released their report on March 21st, 2018, in which many combined expertise from different sectors examines how AI will benefit India under certain ethical considerations.

The National e-commerce policy will suppose to be introduced by the end of 2020. The government of India released a draft of consumer protection in e-commerce rules (Singh, 2020). Now it has been opened to the public so that everyone related with e-commerce industry can give their comments on it and after that it will be rationally perfect for the nation. Major concern areas of this draft are sustainable social measures for all including those who are now informal sector, faire sharing for cost between employers, workers, and government. Moderate and flexible legislation measures for labour and social security provisions. Apart from this Central Board of Direct Taxes (CBDT) have amendment rules of tax sharing by procedure for MAP agreement. MAP is an alternative dispute settlement process under the tax territories (Dhasmana, 2020). PDP personal data protection is also included in draft as PDP bill. This policy will look at cross border data flows with respect to protect individual's sensitive information of Indian citizens. This draft addressed mainly six issues of the e-commerce: regulatory issues, data, infrastructure development, stimulating domestic digital economy, e-commerce marketplaces and export promotion through e-commerce. Over 120 stakeholders from India and Foreign companies, associates, thinkers were contributed to enhance the quality of this draft. Unfortunately, due to COVID19 effect this draft has yet to finalize.

Digital platforms make life easier to the consumers as well as retailers. We can hope that after this E-Commerce policy E-Commerce websites will witness exponential heights in their market and Artificial Intelligence will provide them a better user platform.

DISCUSSION

Governments and business leaders have to decide the priority areas of AI to explore its benefitin all span of life. Whether AI is used to enhance potential and productivity of workforce or reducing business cost or creating new business or built new models with mankind.

To the other side we cannot forget that the term "artificial" means "dehumanised". AI is an innovative technique and has the potential to become more intelligent than any human; we have no certain way to predict how it will behave. E-Commerce is a business platform of making profit and expands its market in this competitive world. AI will facilitate them by aggressive planning of marketing and promotions. Today we are using narrow AI (or weak AI) which design to perform narrow task like recognition of facial expression and personalised buying pattern etc, but soon researcher create general AI (AGI or strong AI) which may perform human or very specific task like playing chess or solving equations. Many big players of E-Commerce industries were expressed their concern about the risk posed by AI (Menon, Vajirani & Roy, 2017).

CONCLUSION

It was concluded with various policy recommendations for the government to applicability of AI for the next five yearsconsidering the aim of addressing AI as a social and economic problem solver. AI has great impact on Indian youth and as secondary studies shows AI has huge scope in E-Commerce. Mantra, Amazon, Flipkart, Zomato, Swiggy, Ola, Uber, Snapdeal, Big basket, SIRI, Alexa, Netflix, Amazon prime and many big players are using AI for improving customer's experience and this will increase over the time. Rising middle class standard, changing various income-groups, changing consumption behaviour pattern, increasing technological adaptation, restructuring of business organisation and many more changes will arrived by using AI. This is likely to have an enormous and beneficial impact on E-Commerce industries. Scared or exited is only a choice.

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E-wallet in Rural India: An Analysis of Consumer Awareness & Future of E-wallet in Rural India

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ABSTRACT

Nowadays the world is transforming towards high technology and people have started using more and more ICT to fulfil their requirements and needs, such as communication, networking, shopping, and banking, instead of physically. For making small financial transactions, people use E-Wallet. E-Wallet or digital wallet refers to a platform through which electronic devices or online services allow individuals to make payments for transaction for buying online or at store. Nowadays it is very popular among teenagers and the youths, at organised as well as unorganised retail stores. Its popularity can be understood by this that all the big giants of telecommunications, electronics and e-commerce have their own wallets. According to the market share, the leaders are PAYTM, Amazon Pay, Freecharge, Bharat Pay & Phonepe. E-Wallet was supposed to be started in 1997. But the fully organised E-Wallet was introduced in 1998 with the name of Paypal by E-Bay whereas the first E-Wallet in India was started in 2006 with the name of wallet365.com by “Times of Money” Subsidiary company of Times of India Group. But the popularisation credit of E-Wallet goes to PAYTM in India because it was launched with multiple transaction options like Direct interface, wallet & banking. E-Wallet users in India are approximately 200 million & about 600 million register account. About 20 million merchants are accepting payment through E-Wallet in India & about 900+ million transactions are done every month done through E-Wallet. A report of NS banking shows that $28.7 Billion (2+ Trillion Rupee) transactions are made by E-Wallet. It has 85% of the users and 90% of merchants in urban India (Metros, State Capital & District Headquarter). Whereas we know that the India is a country of villages and 60% of total population lives in village. After knowing this, E-Wallet companies have started to focus on these areas. But they are in the initial stage in rural areas and getting good response by merchants and users. The objective of this study is to understand the potential and future prospects of E-Wallet market in rural areas through a survey of market by questionnaire. Data has been collected from both users, merchants, and payees.

Keywords: E-Wallets, Digital Wallets, Rural Marketing, Merchant, Retail

INTRODUCTION

India is one of the biggest growing Economy of the world with the highest rate of economy growth. it is also the youngest country of the world with the 60% of its total population is below the age of 45 It is also the one of the biggest exporter of IT products in the world through this we can understand that the how much the Indians are interested in the IT related Products & Services and to understand & support this we can understand it through the report of that India is world 3rd highest internet users and world 2nd highest users of Facebook user in the world. But the Indian economy has not been well structure due to the lack of infrastructure, very less digital transaction was made but from last one decade the rate of digital transaction has been be increased with the introduce of digital wallet (E-Wallet) in India it has been started in 2006 by Times of India Wallet365.com but started being popular in 2010 when the company named and Paytm started giving services with lots of offer on online mobile DTH recharge and making the bills payments but it was with limited growth rate and limited in to big cities. But in November 2016 when the Demonetisation was introduced in India and the government of India has motivated citizens to go for Digital payments instead of physical payments it became very much popular among all region cities in India in to all age groups and all kind of business even in the tier-3 tier-4 cities in India and this also happen because it was no cost digital transaction services for both merchant and the payee as compared to POS & Credit Card, Debit Card charges. There is almost 80% of house hold have a smartphone and the government of India has already opened the bank account for poor people with the name of Jan Dhan account through it they make payments using the E-Wallets and it became very popular successful at that period as compared to POS many IT Giants like Google Amazon launched their E-Wallet with more user benefits and due to of that it became more popular and also in the rural areas. We knows that the 60% of total population lives in the Villages and they depends on the small towns or the local market for their requirements but at that smalls shopkeepers have no issue in digital payments but they are not able to afford it. So, E-Wallet is very much popular among them.

What does the digital wallets mean E-Wallet which is also known as digital wallet means a platform through which electronic device or online service allow to make payments transaction for buying online or at store.

The objectives of the study are as follows: -

- To understand the consumer awareness about E-Wallet in rural areas.
- Analysis of the future of E-Wallet in rural India through the user perception

LITERATURE REVIEW

Chauhan (2013) elaborated how E-Wallets are going to make money transaction less cumbersome for the users. The people who use mobile applications just need to make payment at point of sale just after doing the purchasing. Autor also throw light on server-side E-Wallets and client-side E-Wallets. An encryption algorithm, known by the name RC4 is used for providing a secure transaction. Even after having some demerits like interoperability, advantages overweigh the disadvantages.

Kalyani (2016) presents usage, scope, advantages, and disadvantages of virtual wallets, specifically in India. He also gives recommendation for adopting the technology within the minimum possible time frame. He categorizes virtual wallets into four categories: Open wallets, semi-open wallets, closed wallets, and semi-closed wallets. He also focuses on the issues and challenges that wallet companies are struggling with. The major issues of concern are data security, phone battery, dispute resolution, market penetration and user acceptance etc. Technology has to walk a long way ahead to educate people to increase the customer base.

Author talks compares the transaction in ancient time and in modern world. Earlier people had barter system, then people started making use of cash now-a-days majority is drifting towards transaction through mobile devices. Today, people are using credit cards, debit cards and m-wallets for payments. Author also discusses about advantages and risks that are associated to e-currency and about types of E-Wallets. Modern transactions make use of ATM, Debit and Credit Cards, NEFTs and m-wallets etc. According to a survey done by author, customers are using E-Wallets mostly for the purpose of recharging and payment of bills. A lot of effort is required to make the mass aware about importance and ease of using E-Wallets to perform myriad operations.

Rathore (2016) states that smart phones have spread all over the markets and people have now started to make different kinds of payments through mobile phones. He also explores various challenges faced by digital wallet users. Customers, banks, and financial institutions are benefitted using Digital wallets. Tech-savvy customers are increasing at a tremendously faster speed.

Money Store The likely increase in the share of mobile phones and tablets will be increased by 30% by the end of 2020 which is quite huge. The mobile phones have risen from $86 million in 2011 to $1.15 billion in 2016 and this big number will be helpful to estimate the increasing engagement of people in digital means to spike it up even more. An emerging segment of payments contributes towards m-wallet and includes all services including mobile bill payments, utility payments, trip bookings, etc. Mobile phones were introduced a lot earlier but then this market was duly penetrated much later with the rising need for mobile phones in the market. Mobile money first tried to enter the market in 2011. The recent demonetization endeavour sorted the entire scene for digital money over the paper. According to a recent study, the Indian E-Wallet industry might spiral up to Rs 30,000 crore by the year of 2021-22. The mobile business along with the wallet business looks to be very favourable, specifically because of the technology that's working wonders With companies like Paytm, Freecharge, Mobikwik, etc, people are no more alien to the mobile wallet concepts and usage. Mobile wallets have a whole world within themselves with an array of functionalities, applications, and experiences.

Shankar (2017) In the long term, systems like UPI (Unified Payment Interface) stand a better chance as they enable direct transfer from bank accounts to make payments. Wallets Face a Wall. The winner for access to bank account will be the one that offers the least hurdles to complete a payment transaction. Mobile wallets are popular today. Paytm alone has more than 200 million users. But they have limitations. For one, they are not interoperable. Transferring money requires sender and receiver to have the same company's account – its Paytm to Paytm, Mobikwik to Mobikwik and Buddy to Buddy. So also, transferring money from wallet to bank account attracts service charge. Besides, the money transferred to a wallet does not earn interest. Even the founders of some mobile wallet companies are not so optimistic about their future if challenges like interoperability persist.

Ali, Akhtar & Safiuddin (2017), according to the study done by them in their research, Indian economy is emerging as the one of the strongest economies in the world which is growing at very fast rate. Certain factors like improved transparency, corporate Governance and restricting the parallel cash are very crucial for sustaining the development and growth of Indian economy. In their paper, they have discussed about the various challenges faced for the working of digital payment in rural areas and opportunity to overcome them.

Sardar (2016) summarized that M-wallets have emerged as the most significant contributor in pushing cashless and electronic payments. Over time when mobile payments will represent a significant part of retail sales, there should be inter-operability between different wallets. As most of respondents are concerned about the security of mobile payments, the security system should be strengthening.

Vidyashree, Yamuna & Nithya Shree (2015) concluded that People are more aware about the online payments through mobile applications and there is a wider increase in growth rate. Pay tm and Pay u Money is giving 2 level security authentications to safeguard our payment details. The digital payment system has to take necessary steps to overcome delay in processing of payments.

Brahmbhatt (2018) Majority of respondents (92%) agreed to prefer E-Wallet in place of conventional payment clearly illustrates that the adoption image of E- wallet among consumers in Ahmedabad has already crossed the beginning stage, to be successful in E-Wallet market now depends heavily on the marketing strategies of E- wallet companies as well as the financial policy makers.

Sharma, Aggarwal & Gupta (2019) The study indicated that convenience was the utmost useful factor in mWallet usage acceptance, followed by trust and then mobility. Trust was the factor that the survey respondents appreciated the most while using mWallets and at the same time it poses as a challenge for mWallet providers to provide appropriate security for payments through mWallets. Only then, the companies will be able to gain trust of the users and would be able to survive in the digital payments segment. The mWallet providers should work towards increasing the awareness of trust and privacy among the users and enhance the transaction security of digital payments. This will ultimately lead to improving the behavioural intention to use mWallets by the consumers.

Category of E-Wallet

Open Wallets: As the name suggests, open wallets are open to multiple services i.e. it allows a customer to buy goods and services, transfer funds and to withdraw cash from banks or ATMs.

Semi-open Wallets: This type of wallet is subject to a condition that it has to be associated with some specific company. The customer can load money in some application and spend it.

Closed Wallets: These are most popular specifically amongst e-commerce companies. Some minimum amount is reserved with the merchant in case of return or cancellation of product. Semi-Closed Wallets: These types of wallets are in high demand by merchants with the limitation that they do not provide redemption or withdrawals. This wallet allows you to buy goods and services from listed merchants thereby opening an account in your name.

RESEARCH METHODOLOGY

The data has been collected through primary and secondary sources for the research. The data has been collected from primary source questionnaire and the secondary data has been collected from Journals, News paper, Books, Government Report, website, and Magazines. Total of 100 respondents from the different villages, tier-3 & tier-4 cities of Bihar were selected by simple random sampling method of data collection. The response is recorded and processed by statistical technique of percentage analysis.

RESULTS AND DISCUSSION

The demographic profile of respondents is presented in table 1. 74% of the respondents were male and rest were female. Most of the respondents (69%) belonged to the 18-30 years age group. 50% of the respondents were employees and 37% were students. Less than half of the respondents had an annual income less than Rs. 2,50,000, 19% had no income, and remaining had income above Rs. 2,50,000.

Demographic profile

Table 1: Demographic Profile of Respondents

Characteristics	Dimensions	Frequency	Percent
Gender	Male	75	74
	Female	27	26
Age (in years)	below 18	3	3
	18-30	2	2
	18 – 30	71	69
	31 – 50	20	20
	above 51	6	6
Occupation	Student	38	37
	Employee	51	50
	Business	8	8
	Homemaker	5	5
Income (Rs. per _	less than 2,50,000	49	48
	2,50,000 - 5,00,000	18	18
	5,00,000-10,00,000	13	13
	above 10,00,000	2	2
	No Income	20	19

The first hypothesis of this study is:

H1: There is no significant difference between respondent's occupation and satisfaction level of using E-Wallet services.

The hypothesis has been tested using one-way ANOVA. The results are presented in table 2. The significance obtained value obtained is 0.029 which is smaller than 0.05, so we need to reject null hypothesis. So, it can be concluded that there is significant difference among satisfaction level of user using E-Wallet Service when classified by respondent occupation.

Table 2: One-way ANOVA

Wallet Services	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	2.864	3	0.955	3.126	0.029
Within Groups	29.930	98	0.305		
Total	32.794	101			

The second hypothesis of the study is:

H2: There is no significant difference among different age groups regarding their satisfaction on E-Wallet Services.

Table 3: One-way ANOVA

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	1.285	3	0.428	1.332	0.268
Within Groups	31.509	98	0.322		
Total	32.794	101			

This hypothesis has been tested using one-way ANOVA. As depicted in table 3, the significance value obtained is 0.268 that is not smaller than 0.05, so the researcher failed to reject null hypothesis. Thus, it can be concluded that there is no significant difference among the age groups regarding their satisfaction on E-Wallet Services.

The third hypothesis of the study is:

H3: There is no significant difference between gender of the respondents and awareness of respondents about E-Wallet services.

Table 4: Independent T-Test

Awareness of E-Wallet s and Gender	**Levine 's Test for Equality of Variances**		***t*-test for Equality of Means**		**RESULT**	**ANALYSIS**
	F	Sig	T	Sig		
Awareof E-Wallet s	0.302	0.584	0.430	0.665	0.665>0.05	H0 is not rejected

It is interpreted from table 4, that there is no significant level of difference in awareness of respondent about E-Wallet when classified through gender.

Table 5: Crosstabs Sources of awareness and gender

			Male	Female	
Info_ source	Social Media	Count	22	4	26
		Expected Count	19.1	6.9	26.0
	Friends	Count	24	11	35
		Expected Count	25.7	9.3	35.0
	Government Promotions	Count	11	8	19
		Expected Count	14.0	5.0	19.0
	Magazine/ Television	Count	18	4	22
		Expected Count	16.2	5.8	22.0
Total		Count	75	27	102
		Expected Count	75.0	27.0	102.0

The results presented in table 5 show that there is no association between the gender of respondents and source of awareness of government's initiative of promoting E-Wallet services.

Table 6: Chi-square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.247[a]	3	0.155
Likelihood Ratio	5.271	3	0.153
Linear-by-Linear Association	0.207	1	0.649
N of Valid Cases	102		

Table 6 provides us the information that the significant value is greater than 0.05 so the researcher is fails to reject null hypothesis that means there is no association between the gender of respondent & the sources of awareness about government promotional activity about E-Wallet services.

About 50 % of respondents, have high awareness level of E-Wallet among respondents shows that the E-Wallet service providers had successfully advertised the concept of E-Wallet among general people. Respondents got aware regarding E-Wallet's from Various sources. Word to Mouth publicity have higher impacts on information's spread compare to other methods like advertisement on social media, TV, and Government promotions.

Out of total respondents 72% are Paytm users. It shows the penetration of Paytm compare to other wallets. The second most popular wallet among respondents is Freecharge. It can be generally determined that Paytm and Freecharge wallet at highly adaptation level Compare to others.

Among Total respondent 55% of respondents use E-Wallet more than two times in a month. This shows that respondents are very inclined for the uses of E-Wallet for various payments and transactions.

Majority of respondents are aware about government push for Digital transactions. This shows that peoples at least have clarity on benefits of digital Payments over traditional payment systems.Approx. 87% of total respondent use it for mobile/DTH recharge purpose. The second most option preferred by users for Utility and bill payment. This shows that E-Wallets have successfully attracted the customers by different cashback offers and discount. Out of total respondents 66% respondents are satisfied with existing E-Wallet service, followed by 24% users which are Much satisfied with E-Wallet services. 10% of users have Average opinion about their satisfaction level.

Data analysis suggests that respondents Were very much concerned about all the five criteria which are mentioned above. Cashback offers are the most considered while doing transactions/payment from E-Wallet.

About 50% of respondent are agreed that they Surely consider the all security criteria such as-leak of confidential info, cybercrime, Phishing etc. This Means that E-Wallet companies have to work upon security features to attract and retain the users to exist on their platform for long time. More than 50% of users want to have best offers and faster process on E-Wallets.

Respondents agreed that E-Wallet is attractive choice for Transaction over traditionalmethod and it support as of now to conventional payment during the transition phase.

Limitations

The efforts were put sincerely while studying was put on consumer awareness and future of E-Wallet and the study was performed in the different regions of Bihar. Because the sample size is small, the findings and result may only be limited to the rural region of Bihar. The survey was done through the electronic platform which is time consuming and may be biased or the respondent may not be quite interested in giving their proper view. So, it would be better to reach the wider regions and conduct the survey through physical appearance and this is only possible with the availability of more time.

CONCLUSION

Majority of respondents (92%) agreed to use E-Wallet in place of conventional payment clearly that illustrates that the adoption image of E-Wallet of the consumers of rural area of Bihar has already crossed the initial stage. Further to become successful in E-Wallet market now depends totally on the marketing strategies of E-Wallet companies and the financial policy makers. India is a fastest growing economy and the youngest nation too so and the Government of India also promotes the digital payments in which E-Wallet evolves as one of the popular methods of digital payments. So there is lots of scope in this topic but from this research paper the author would like to suggest and promote the same topic for the wider region pan India level and that has to be Unified research and the differential research according to the region and what are the difference between them.

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Impact of CO_2 Emission and Environmental Temperature on the Tea Industry in India: A Critical Analysis

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ABSTRACT

Tea has become the second-most consumed liquid, after water and it is one of the most popular and lowest cost beverages in the world. India has been playing a dominant role in global tea trade since few decades. India is now the second largest tea producer in the world only next to China, leaving behind Kenya, Indonesia, and Sri Lanka. For Indian economy tea is one of the important cash crops. A large proportion of the Indian population is dependent on tea production for their livelihood. On the other hand, tea growth is vulnerable to climatic conditions as well as climate change. Under serious heat, the 'cup that cheers' literally quiet. Climate change such as erratic rainfall, high temperature, high carbon dioxide, etc. have serious impact on the tea production. On the other hand, industrialization, present lifestyle, and various economic activities are also responsible for global warming, pollution, and erratic climate change. In this study, we have analysed this newly emerging research field of climate change in combination with tea production. A deliberate attempt has been made, in this paper, to assess the extent of impact of CO_2 emission and temperature on tea production and tea yield in India. Keeping the irrelevant literature away, we have adapted a valid search query to cover the relevant literature as completely as possible, in this study.

Keywords: CO_2 Emission, Temperature, Production, Yield, Tea Industry, India

INTRODUCTION

Tea is considered as one of the most popular and refreshing beverages not only in India but also around the world. In the world, India is one of the largest and finest quality tea producers. The 200 years old Indian tea industry plays a pivotal role in the national economy. With 1692 registered tea producers, 2200 registered tea exporters, 5548 registered tea buyers and 9 tea auction centres across India, Indian tea industry spreads across Uttaranchal, Assam, Tamil Nadu, West Bengal, Sikkim, Kerala, Tripura Karnataka, Himachal Pradesh, Bihar, Arunachal Pradesh, Manipur, Nagaland, Mizoram and Meghalaya. Indian tea industry had a significant contribution to the national GDP in the year 2017-18 with record breaking production of 1325.05 million kilogram of made tea in that year.

Tea is vulnerable to climate change to a great extant. Agro-climatic conditions including suitable temperature, proper rainfall, suitable humidity, and solar radiation creates impact on crop yields and quality (Wijeratne, 1996). These agro-climatic conditions are encountering inconstancy in tea producing territories all around with environmental change, in this manner introducing biological pressure and imperatives for tea production. The previous six decades have encountered a pattern of steady changes in climatic conditions including warming and expanded annual fluctuation of temperatures and precipitation (IPCC, 2014) just as progressively outrageous climate conditions (Ewert *et al.*, 2005). The inconsistent climate patterns are also responsible for ozone depletion (IPCC, 2014) and this intern create negative impact on horticulture including tea production (Chang & Bratloff, 2015); tea yields and quality of tea leaves are also greatly affected by these.

Interrelated variables including temperature, precipitation, and rainfall make climate system and changing of one variable trigger changing in other variables. The previous decade has encountered vigorous multi-decadal warming with a combined increase of land and ocean surface temperature of 0.85°C during the period of 1880-2012 (IPCC, 2014). The predominant reason for the critical warming since the mid-twentieth century is no doubt an increase in greenhouse gas emission that have expanded since the pre-industrial time because of populace development and expanded economic activity combined with changes in technology, energy usage, lifestyle, climate policy (IPCC, 2014).

Variety of tea, stage of growth, plant age, maturity of the branches, maturity of leaves, and plucking is also greatly dependent on abiotic and biotic factors. Compared to older tea plants, young tea plants are generally more exposed to environmental factors as well as their changes. So, while immature, the young tea plants are nurtured in protected and controlled in nursery conditions, especially during the initial 2 to 4 years (Ahmed & Stepp, 2012). But during the mature stage tea plants are greatly affected by the abiotic and biotic factors as they are transplanted to the field. On the other hand, studies suggest that rising atmospheric CO_2 concentrations notably increases tea yield by stimulating photosynthesis by influencing biotic and abiotic component. However, in this present juncture, the study is intended to assess the impact of temperature and atmospheric CO_2 concentration on tea yield and tea production.

LITERATURE REVIEW

Several social researchers have conducted studies on tea industry, mostly centred around Sri Lanka, Indonesia, Malaysia, India, and South American plantations, those in the Caribbean islands. However, we have done extensive literature review that are related to climate change and production.

Chang & Bratloff (2015) in their paper "Socio-economic implications of climate change for tea producing countries" opined that there are numerous proof that GHGs are causing an earth-wide temperature rise and environmental change (Chang & Bratloff, 2015). While GHGs occur normally, immediate, or aberrant human exercises have inversed their outflow into the air. Fundamental appraisals demonstrated that environmental change will significantly affect future tea production, independent from the geographic dispersion of the tea crop. According to the authors, tea is cultivated on suitable land and as a cash crop is truly the favoured decision for most appropriate developing zones, for example, Assam and the high and low developing regions in Sri Lanka. Critically, there are a few vulnerabilities because of environmental change that are yet to be explored, which might influence future production levels. These incorporate the recurrence of catastrophic events, the multiplication of specific nuisances and sicknesses and higher foundation cost. However, several follow-up studies are required to fully understand the probable impacts at a regional level.

Ashardiono & Cassim (2015) in their article, “Adapting to Climate Change: Challenges for Uji Tea Cultivation” opined that current investigation in the circumstance of Uji Area demonstrated that usage of exactness agriculture framework as an environmental change countermeasure technique may additionally trouble the financial state of the tea farmers somewhat, which is under pressure (Ashardiono & Cassim, 2015). In any case by using agro-informatics framework, tea ranchers would have the option to get numerous advantages, for example, getting subtlety observing and estimation information of their tea estate conditions which is critical for choosing ideal planning and sorts of development intercession during the growth period. Gathered information will likewise turn out to be exceptionally valuable for creating detectability reports of their items. Through usage of recognizability system, Uji Area tea farmers would have the option to grow their items showcase locally as well as globally as it gives the entirety of the important data about the items starting point and its creation procedure which will end up being their items quality affirmation to the purchasers. The use of accuracy horticulture framework which is dependent on customary agribusiness information will additionally refine the current development framework, in this manner making new mediation strategies to guarantee the quality and amount of the tea reap.

Duncan *et al.* in their article titled, “Observing climate impacts on tea yield in Assam, India”, they have produced a tea garden level dataset of month to month tea yield in Assam, upper east India. This dataset gives a one-of-a-kind chance to understand the causal impact of climatic variations on tea yield (Duncan *et al.*, 2016). There are decreasing tea yield returns to monthly average temperature. They have shown that a similar pattern holds for monthly precipitation totals though the effect size is smaller, which implies that all else held equal, under warmer climates, tea plantations will be less productive. It has also been found from the study that on tea yield, precipitation variability, measured using metrics of rain free days and precipitation intensity, had a negative effect. So, it would be helpful to understand and identify effective and affordable strategies for the purpose of reducing the sensitivity of tea productivity to moisture variability and warmer temperatures, and it would have immediate pay-offs and afford environmental change **adaptation benefits.**

Research Gap

It is true that many social researchers have carried out study on plantation industry in

India, but the aspects- temperature, CO_2 emission, production, and yield, have been taken into consideration by few of them. Another thing, which has not been clearly explored that the impact of the above factors on both tea production, and tea yield. Above all, though at similar types of research were conducted at some regional levels, at national levels things are yet to be explored.

Objectives of the study

The study is undertaken to fulfil the following objective:

- To examine the impact of average temperature on total tea production in India.
- To determine the impact of total CO_2 emission on total tea production in India.
- To examine the impact of temperature on tea yields in India.
- To determine the impact of total CO_2 emission on tea yields in India.

METHODOLOGY

Area of the study: To fulfil the objectives of the study, the Indian tea industry was considered in case of total tea production and tea yield. Similarly, for total CO_2 emission and average temperature, national level data were considered.

Period undertaken in the study: To examine the relationship among the variable's average temperature, total tea production, total carbon emission, and tea yields, 54 years data have been undertaken ranging from the year 1960 to 2014.

Sources of data: The study is mainly based on secondary data. The data Secondary have been collected from various journals, articles, publications of Tea Board of India, Planters Associations, various reports published by the Department of Economics and Statistics, and newspapers, magazines, etc.

Standardization of parameters: The parameters which have been used to establish relational model are average temperature (X0), total tea production (Y0), total carbon emission (X1), and tea yields (Y1). The dependent variables, here, are total tea production which has been measured in thousand kilograms and tea yields which is measured in terms of kilogram per hectare. Simple linear regression has been conducted, in this study, using the EViews software.

RESULT & DISCUSSION

Average temperature and production: linear regression model

While conducting regression, considering the variables average temperature and production, we get the following regression model. This model has basically come out from the log estimation of the above-mentioned variables, where production (Y_0) is a dependent variable and average temperature (X_0) is explanatory variables.

Table 1: Result of linear regression model: average temperature and production

Dependent Variable: LOG(Y0)				
Method: Least Squares				
Date: 05/03/20 Time: 18:27				
Sample: 1960 2014				
Included observations: 55				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-46.14443	8.085512	-5.707050	0.0000
LOG(X0)	18.62430	2.530441	7.360102	0.0000
R-squared	0.505464	Mean dependent var		13.36520
Adjusted R-squared	0.496133	S.D. dependent var		0.369471
S.E. of regression	0.262264	Akaike info criterion		0.196752
Sum squared resid	3.645454	Schwarz criterion		0.269746
Log likelihood	-3.410683	Hannan-Quinn criter.		0.224979
F-statistic	54.17110	Durbin-Watson stat		0.818503
Prob(F-statistic)	0.000000			

Source: Computed by the authors

From table 1, the following regression equation can be formed.

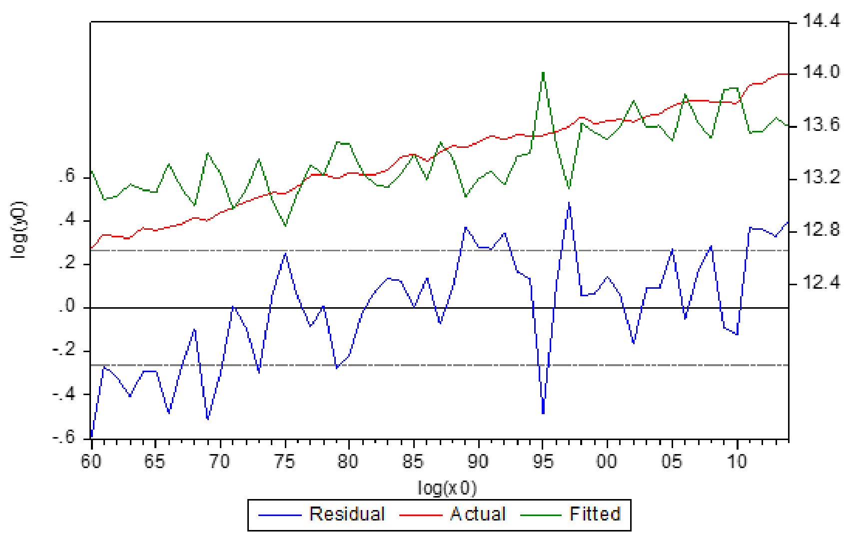
$$\text{Log}\,(Y_0) = -46.14443 + 18.62430 \log (X0) \qquad \text{----- (Equation- 1)}$$

Where, R^2= 0.505464, F= 54.17110*, DW= 0.818503, x0=average temperature, Y0=production *=significant at 5% level.

A quick glance at the results of the table 1 reveals that the coefficients, in equation- 1, are statistically significant and the fit is moderately tight

From equation 1, we can assert that 1% increase in temperature per year leads to 18.62% increase in tea production per year during the period of 1960 to 2014, which is significant at 5% level.

The relationship between the two variables can be represented from the following figure:



Source: Prepared by the authors

Figure 1: Variables: Average temperature and production

From figure 1 we can understand that though production increased over the period but several times it faced down fall where we observe inverse relationship. If we compare production and average temperature of that periods, we will get more clear idea.

Table 2: Increase or decrease in annual temperature and annual production over the years

year	Annual Average temp (Celsius)	Increase or decrease in annual temperature from previous year	Production (Th. Kg)	Increase or decrease in annual production (Th. Kg) from previous year
1962	24.04	0.04	346735	-7662
1963	24.15	0.11	346413	-322
1965	24.07	-0.03	366374	-6111
1969	24.46	0.52	393588	-8901
1975	23.74	-0.26	487137	-2338
1979	24.57	0.33	543776	-20070
1981	24.27	-0.28	560427	-8745
1986	24.2	-0.25	620803	-35359
1989	24.03	-0.39	688105	-11909
1992	24.15	-0.13	732322	-21870
1994	24.46	0.03	752895	-7931
1999	24.67	-0.09	825935	-48173
2002	25	0.27	838474	-15449
2008	24.61	-0.16	980818	-5609
2009	25.11	0.5	979000	-1818
2010	25.13	0.02	966400	-12600

Source: Collected from secondary sources

Table 2 clearly depicts the comparative data of total tea production and average temperature of that year when production faced downfall. Form the table in short run tea production and average temperature are inversely related.

Total CO_2 emission and production: linear regression model

While conducting regression, considering the variables CO_2 emission and production, we get the following regression model. This model has basically come out from the log estimation of the above-mentioned variables, where production (Y_0) is a dependent variable and total CO_2 emission (X_1) is explanatory variable.

Table 3: Result of linear regression model Total CO_2 emission and production

Dependent Variable: LOG(Y0)				
Method: Least Squares				
Date: 05/03/20 Time: 18:31				
Sample: 1960 2014				
Included observations: 55				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.799568	0.117605	66.32030	0.0000
LOG(X1)	0.424178	0.008944	47.42491	0.0000
R-squared	0.976978	Mean dependent var		13.36520
Adjusted R-squared	0.976543	S.D. dependent var		0.369471
S.E. of regression	0.056586	Akaike info criterion		-2.870408
Sum squared resid	0.169707	Schwarz criterion		-2.797414
Log likelihood	80.93622	Hannan-Quinn criter.		-2.842181
F-statistic	2249.122	Durbin-Watson stat		0.602737
Prob(F-statistic)	0.000000			

Source: Computed by the authors

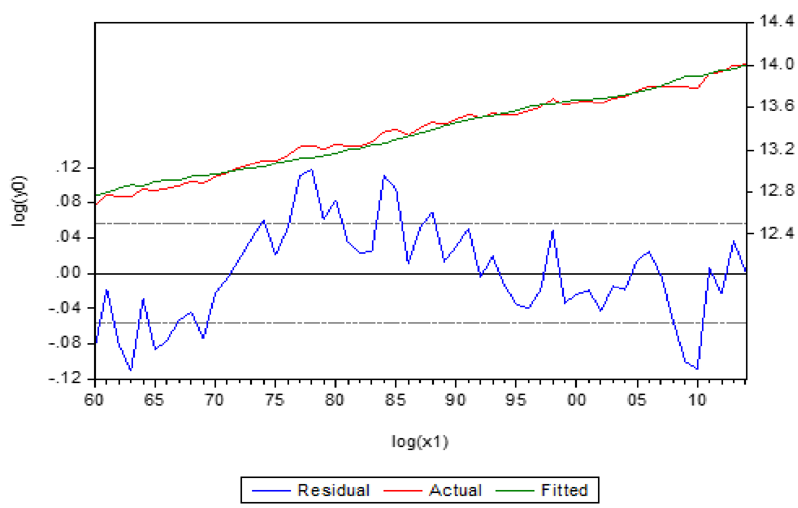
From table 3, the following regression equation can be formed,

Log (Y0) = 7.799568 + 0.424178 log (X1) ----- (Equation- 2)

Where, R^2= 0.976978, F= 2249.122*, DW= 0.602737, X1= Total CO_2 emission, Y0=production *=significant at 5% level.

A quick glance at the results of the table 3 reveals that the coefficients, in equation 2, are statistically significant and the fit is moderately tight From equation- 2 we can assert that 1% increase in total CO_2 emission per year leads to 0.424 % increase in tea production per year during the period of 1960 to 2014, which is significant at 5% level.

The relationship between the two variables can be represented from the following figure.



Source: Prepared by the authors

Figure 2: Variables: total CO_2 emission and production

From figure 2 we can understand that though production increased over the period but several times it faced down fall where we observe inverse relationship. If we compare production and total CO_2 emission of that periods, we will get more clear idea.

Table 4: Increase or decrease of CO_2 emission and annual production over the years

year	Total Kilo tons of CO_2 emission	increase / Decrease in Total Kilo tons of CO_2 emission from previous year	Production (Th. Kg)	Increase / Decrease in Production (Th. Kg) from previous year
1962	143467.7	13065.52	346735	-7662
1963	154083.7	10615.97	346413	-322
1965	165972.1	15324.39	366374	-6111
1969	190724.3	3388.308	393588	-8901
1975	252201.6	20208.84	487137	-2338
1979	296891.3	13795.25	543776	-20070
1981	338838.1	24821.92	560427	-8745
1986	457571.9	30898.14	620803	-35359
1989	579008.3	51444.34	688105	-11909
1992	699087.9	40898.05	732322	-21870
1994	764730.8	41033.73	752895	-7931
1999	995766.5	59544.75	825935	-48173
2002	1054259	13105.86	838474	-15449
2008	1568380	160772.3	980818	-5609
2009	1738646	170266.1	979000	-1818
2010	1719691	-18954.7	966400	-12600

Source: Collected from secondary sources

Table 4 clearly depicts the comparative data of total CO_2 emission and total production of that year when production faced downfall. Form the table in short run tea production and total CO_2 emission are inversely related.

Average temperature and yield (kg/hec): linear regression model

While conducting regression, considering the variables average temperature and yield (kg/hec), we get the following regression model. This model has basically come out from the log estimation of the above-mentioned variables, where yield (kg/hec.) (Y_1) is a dependent variable and average temperature (X_0) is explanatory variables.

Table 5: Result of linear regression model average temperature and yield (kg/hec.)

Dependent Variable: LOG(Y1)				
Method: Least Squares				
Date: 05/03/20 Time: 18:34				
Sample: 1960 2014				
Included observations: 55				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.97034	5.235239	-3.432574	0.0012
LOG(X0)	7.915440	1.638420	4.831143	0.0000
R-squared	0.305737	Mean dependent var		7.321602
Adjusted R-squared	0.292638	S.D. dependent var		0.201904
S.E. of regression	0.169811	Akaike info criterion		-0.672571
Sum squared resid	1.528303	Schwarz criterion		-0.599577
Log likelihood	20.49569	Hannan-Quinn criter.		-0.644343
F-statistic	23.33994	Durbin-Watson stat		0.515662
Prob(F-statistic)	0.000012			

Source: Computed by the authors

From table 5, the following regression equation can be formed

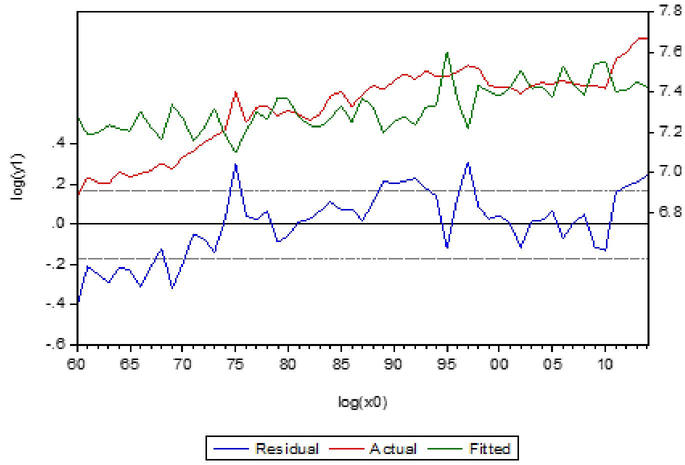
Log (Y_1) = -17.97034+ 7.915440 log (x0) ----- (Equation- 3)

Where, R^2= 0.305737, F= 23.33994*, DW= 0.515662, X_0= Average temperature, Y_1= yield (kg/hec.)*=significant at 5% level.

A quick glance at the results of the table- 5 reveals that the coefficients, in equation- 3, are statistically significant and the fit is moderately tight

From equation- 3 we can assert that 1% increase in Average temperature per year leads to 7.915440 % increase in yield (kg/hectare) per year during the period of 1960 to 2014, which is significant at 5% level.

The relationship between the two variables can be represented from the following figure.



Source: Prepared by the authors

Figure 3: Variables: yield (kg/hectare) and average temperature

From figure 3 we can understand that though yield (kg/hectare) increased over the period but several times it faced down fall where we observe inverse relationship. If we compare yield (kg/hectare) and average temperature of that periods, we will get more clear idea.

Table 6: Increase or decrease of average temperature and yield (kg/hec.) over the years

year	Annual Average temp (Celcius)	Increase or decrease in Annual Average temp (Celcius) from previous year	Yield (Kg/Hec)	Increase or decrease in Yield (Kg/Hec) from previous year
1962	24.04	0.04	1043	-27
1963	24.15	0.11	1037	-6
1965	24.07	-0.03	1072	-30
1969	24.46	0.52	1114	-32
1976	24.07	0.33	1405	-236
1979	24.57	0.33	1455	-72
1981	24.27	-0.28	1461	-33
1982	24.15	-0.12	1422	-39
1986	24.2	-0.25	1523	-118
1989	24.03	-0.39	1658	-31
1992	24.15	-0.13	1742	-52
1994	24.46	0.03	1768	-51
1998	24.76	0.66	1844	-21
1999	24.67	-0.09	1685	-159
2000	24.6	-0.07	1679	-6
2001	24.73	0.13	1675	-4
2002	25	0.27	1625	-50
2005	24.58	-0.16	1703	-10
2006	25.06	0.48	1732	29
2007	24.77	-0.29	1705	-27
2008	24.61	-0.16	1693	-12
2009	25.11	0.5	1689	-4
2010	25.13	0.02	1668	-21

Source: Computed by the authors

Table 6 clearly depicts the comparative data of Average temperature and yield (kg/hectare) of that year when yield faced downfall. Form the table in short run tea yield and average temperature are inversely related.

Total CO_2 emission and yield (kg/hec.): linear regression model

While conducting regression, considering the variables CO_2 emission and yield (kg/hec), we get the following regression model. This model has basically come out from the log estimation of the above-mentioned variables, where yield (kg/hec) (Y_1) is a dependent variable and total CO_2 emission (X_1) is explanatory variables.

Table 7: Result of Linear Regression Model

Total CO_2 emission and yield (kg/hec.)

Dependent Variable: LOG(Y1)				
Method: Least Squares				
Date: 05/03/20 Time: 18:36				
Sample: 1960 2014				
Included observations: 55				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.558543	0.186409	24.45455	0.0000
LOG(X1)	0.210583	0.014177	14.85387	0.0000
R-squared	0.806313	Mean dependent var		7.321602
Adjusted R-squared	0.802659	S.D. dependent var		0.201904
S.E. of regression	0.089692	Akaike info criterion		-1.949179
Sum squared resid	0.426369	Schwarz criterion		-1.876185
Log likelihood	55.60241	Hannan-Quinn criter.		-1.920951
F-statistic	220.6375	Durbin-Watson stat		0.362060
Prob(F-statistic)	0.000000			

Source: Computed by the authors

From table 7, the following regression equation can be formed

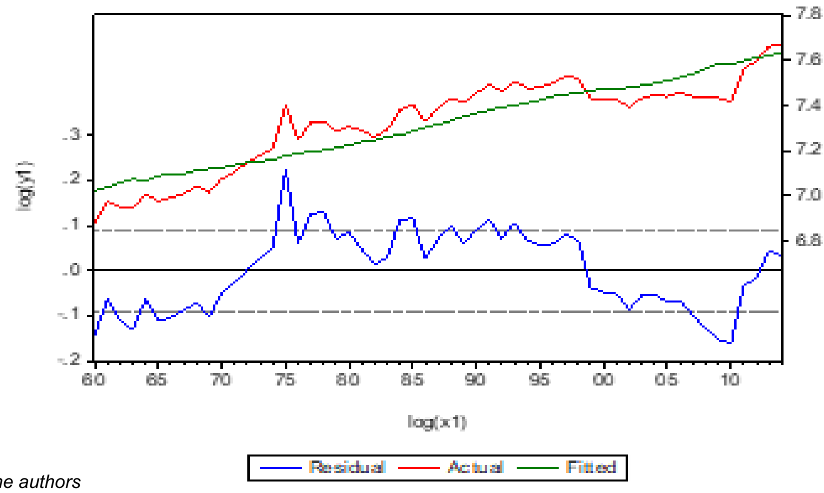
$\text{Log}(Y_1) = 4.558543 + 0.210583 \log(X1)$ ----- (Equation- 4)

Where, R^2= 0.806313, F= 220.6375*, DW= 0.362060, X_1= total CO_2 emission, Y_1= yield (kg/hec.) * =significant at 5% level.

A quick glance at the results of the table 7 reveals that the coefficients, in equation- 4, are statistically significant and the fit is moderately tight

From equation 4 we can assert that 1% increase in total CO_2 emission per year leads to 0.210583 % increase in yield (kg/hectare) per year during the period of 1960 to 2014, which is significant at 5% level.

The relationship between the two variables can be represented from the following figure:



Source: Prepared by the authors

Figure 4: Variables: yield (kg/hectare) and total CO_2 emission

From figure 4 we can understand that though yield (kg/hectare) increased over the period but several times it faced down fall where we observe inverse relationship. If we compare yield (kg/hectare) and total CO_2 emission of that periods, we will get more clear idea.

Table 8: Increase or decrease of yield (kg/hectare) and total CO_2 emission over the years

Year	Total Kilo tons of CO_2 emission	Increase / decrease in Total Kilo tons of CO_2 emission from previous year	Yield (Kg/Hec)	Increase / decrease in Yield (Kg/Hec) from previous year
1962	143467.7	13065.52	1043	-27
1963	154083.7	10615.97	1037	-6
1965	165972.1	15324.39	1072	-30
1969	190724.3	3388.308	1114	-32
1976	263785.6	11584.05	1405	-236
1979	296891.3	13795.25	1455	-72
1981	338838.1	24821.92	1461	-33
1982	349637.4	10799.32	1422	-39
1986	457571.9	30898.14	1523	-118
1989	579008.3	51444.34	1658	-31
1992	699087.9	40898.05	1742	-52
1994	764730.8	41033.73	1768	-51
1998	936221.8	18536.69	1844	-21
1999	995766.5	59544.75	1685	-159
2000	1031853	36086.95	1679	-6
2001	1041153	9299.512	1675	-4
2002	1054259	13105.86	1625	-50
2005	1222563	68242.87	1703	-10
2007	1407607	103889.8	1705	-27
2008	1568380	160772.3	1693	-12
2009	1738646	170266.1	1689	-4
2010	1719691	-18954.7	1668	-21

Source: Computed by the authors

Table 8 clearly depicts the comparative data of Average temperature and yield (kg/hectare) of that year when production faced downfall. Form the table in short run tea yield (kg/hectare) and total CO_2 emission are inversely related.

SUGGESTED POLICIES

The following measures are recommended, concerning tea cultivation, for the purpose of enhancing adaptations against environmental changes.

- Drought and stress tolerant tea cultivars should be planted to a greater extent.
- Low-yielding tea land can be used for other crops that can thrive in poor soil, which signifies diversification of production.
- The concept of intercropping should be considered. Tea plants can be intercropped with other tress like rubber, etc. which will give multiple benefit to the cultivators. Intercropping would be helpful in nitrogen-fixing, and the mature trees can be used for fuel. Ultimately, it would provide another means of income to the farmers.

LIMITATIONS OF THE STUDY AND SCOPE FOR FURTHER RESEARCH

The study is subjected to the following limitations:

- There are numerous factors, apart from greenhouse gases and temperature, which create impact on the tea production and tea yield. The future studies can be conducted considering other variables which are likely to affect tea production and tea yield.
- The average yearly temperature from the period of 1960 to 2014, has been considered in this study, but in tea growing regions, temperature keeps on fluctuating. The future studies can be conducted considering regional temperature.

CONCLUSION

The study concludes that tea production and tea yield get affected by CO_2 emission and environmental temperature if other factors remain unchanged. From linear regression model it has been found that during the period of 1960 to 2014, 1% increase in temperature per year leads to 18.62% increase in tea production per year, 1% increase in total CO_2 emission per year leads to 0.424 % increase in tea production per year, 1% increase in average temperature per year leads to 7.915440 % increase in yield (kg/hectare) per year, and 1% increase in total CO_2 emission per year leads to 0.210583% increase in yield (kg/hectare) per year. So, apparently it may seem that there is no negative impact of CO_2 emission and temperature on tea production and tea yield, but many a times Indian tea industry has faced downfall in terms of tea production and tea yield. In India, tea production went down in the years of 1962, 1963, 1965, 1969, 1975, 1979, 1981, 1986 1989, 1992, 1994, 1999, 2002, 2008, 2009, 2010; on the other hand, tea yield (kg/hectare) faced downfall in the years of 1962, 1963, 1965, 1969, 1976, 1979, 1981, 1982, 1986, 1989, 1992, 1994, 1998, 1999, 2000, 2001, 2002, 2005, 2007, 2008, 2009, 2010. So, deep observation to the data set suggests that both CO_2 emission and temperature do have impact on tea production and tea yield, but in the short run.

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Sustainable Development and The G-20 with Special Reference to India

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ABSTRACT

After the successful achievements of Millennium Development Goals, the member countries of the United Nations enthusiastically adopted 17 Sustainable Development Goals for all round development of people, animals and plants living both on earth and under water. This is the most comprehensive policy initiatives ever since the inception of the United Nations. In an unequal world where a sharp division is explicitly visible between the majority poor and the minority rich within and across the nations; where millions of shelter-less people to go to bed without square meals; where the ill-effects of unhealthy competitions among the industrialized and developed nations causing massive destruction of mother nature is commonplace; and diseases like cancer, HIV/AIDS and the latest COVID-19 that is taking thousands of life away daily incurring trillions of dollars losses globally, the SDGs are considered as too much ambitious and utopian. Despite the contemporary socio-economic crisis caused by the coronavirus the issue of Sustainable Development cannot be overlooked, and without concrete goals the world will only be reduced to a place of mere chaos, anarchy and unmatched competition among the powerful economies while poverty, hunger, ill-health and depletion of nature will have more devastating effect on nations. Since last few decades India, being a Medium Human Development country, has been trying to secure a permanent position in the Security Council, vying for global leadership in trade and commerce and showing its economic growth as well as success story of women's empowerment before the world community. But what is the actual socio-economic and political situation including gender empowerment prevailing in India are required to be gauzed, and the best way to measure a country's global position is making a comparative study with its counterparts. From this point of view, an independent research was conducted by this author with a view to examine India's global socio-economic position which was completed before COVID-19. Hence, through the present chapter, only initiatives taken by the Government of India for attaining Sustainable Development Goals, and the issues and constraints standing on the way of achieving SDGs have been examined followed by some concrete policy prescriptions.

Keywords: Sustainable Development, Economic Growth, Women Empowerment, United Nations

INTRODUCTION

William H. Draper III, the premier administrator of the United Nations Development Program, wrote in the Foreword of the UNDP Report that, “We live in stirring times.”

Almost three decades later a similar view was expressed by his present successor Achim Steiner. He pointed out that, “We are living in a complex world. People, nations and economies are more connected than ever, and so are the global development issues we are facing” (UNDP, 2018). What we need today is to search for a better world for the people, because the pivot of all development programs is people. Draper earlier pointed out the purpose of human development in a very lucid way. He considered that “The purpose of development is to offer people more options. One of their options is access to income – not as an end but to acquiring human wellbeing. But there are other options as well, including long life, knowledge, political freedom, personal security, community participation and guaranteed human rights” (Draper III, 1990).

When we look at India, we find that the largest democracy and the emerging superpower, is a country with over 1.37 billion people and the home to more than a sixth of the world’s population. This great nation has been projected to be the world’s most populous nation within a decade by surpassing China (BBC News, 2018). India’s economic success in recent years has helped to ensure South Asia as the fastest-growing region in the world: “India has been declared the sixth largest economy in the world with a GDP of 2.6 trillion in 2017” (India Today, 2018). India displaced France to stand firm on this position, while only five countries were ahead in the race. India is growing faster than any other large economy except for China, which is projected to be the world’s second largest by 2050. According to the Organization for Economic Co-operation and Development “Economic growth of around 7½% makes India the fastest-growing G-20 economy” (OECD, 2017). Recent economic reforms in India have widened business opportunities and increased collection in revenues. India has also made progress on structural reforms in the recent past, including through the implementation of the GST, which has helped reduce internal barriers to trade in every Indian state, increased efficiency, and improved tax compliance. “India has jumped from 6.7 percent in 2017 to 7.8 percent in 2018” (India Today, 2018).

India’s performance in last decade was overwhelming. In India, 271 million people moved out of poverty between 2005/6 and 2015/16, but the country still has the largest number of people living in multidimensional poverty in the world (364 million people). The 2018 global Multidimensional Poverty Index (MPI) released by the United Nations Development Program (UNDP) and the Oxford Poverty and Human Development Initiative (OPHI) estimated that about 1.3 billion people live in multidimensional poverty globally. The MPI (2018) further found out that, “India has cut its poverty rate from 55% to 28% in ten years” (OPHI, 2018).

Statement of Problem

Despite the astounding progress made by India in terms of reduction of poverty, the level has paralleled with the phenomenal level of poverty reduction achieved by China in a decade or so earlier. Further, with considerable progress in social and economic fields in the last few decades, India still encounters a multitude of challenges ranging from lower education rate to lesser per capita income. The International Monetary Fund World Economic Outlook pointed out that, “Among top ten world’s largest economies, India has very low per capita income having 142nd position in nominal and 126th position in PPP ranking" (News Today, 2018). With the acceleration of structural reforms, the move towards a rule-based policy framework and low commodity prices have provided a strong growth impetus, and recent deregulation measures and efforts to improve the ease of doing business have boosted foreign investment, still investment is held back by the relatively high corporate income tax rates, a slow land acquisition process, regulations which remain stringent in some areas, weak corporate balance sheets, high non-performing loans which weigh on banks' lending, and infrastructure bottlenecks. Quality job creation has been low, and the labour laws are complex in India (IMF, 2019).

As per National Sample Survey Report, total literacy rate in India is 77.7 percent comprising 73.5 percent rural and 87.7 percent urban population (NSS 75th Round, 2018). Interestingly, only 3 percent rural and another 3.1 percent urban population aged 15-59 years received vocational and technical education, while the rest of people did not receive any technical or vocational education. In terms of infrastructure, Indian schools are far behind its western counterparts. In a recent article it was stated that, "Despite high demand for schools, as is visible by the upward trends in enrolment data, supply-side factors related to teacher availability and infrastructure leave much room for improvement. For instance, the District Information System for Education (DISE) data shows only 53% of total government schools, which form majority of schools in rural India have electricity connection. Only 28% schools (18% government schools) have a computer and 9% (4% government schools) an internet connection. With the digital revolution beginning to be seen in urban schools, including urban government schools, it is likely that rural schools will miss riding the digital wave due to insufficient infrastructure (Singh, 2018). On the other hand, the National Sample Survey Report (NSSR, 71st Round) highlights that, more than 12% of rural households in India did not have any secondary schools within 5 kilometres whereas in urban areas such cases are less than 1%. Not only that, but Government also elementary schools have a shortfall of 9.08 lakh teachers against a sanctioned strength of 51.8 lakh posts (as of 31.03.2016). Drop out is still a major problem in secondary level. India's expenditure on education as percentage of GDP has gone up from 3.8% in 2013-14 to 4.4% in 2014-15, but it is not sufficient. Besides, total education rate in 2011 was only 74.04 per cent, which clearly indicates that in India about 31 crore people are deprived of education.

Health being an important indicator of Human Development is still neglected in India. It was highlighted in a recent report (Mohan, 2015) that India still suffers from malnutrition. Despite making several attempts in the last few years, India continues to struggle to tackle nutrition. Women's health is very important for a developing country like India, but it also caters the same unfortunate tale of poor health. Almost 55 per cent of Indian women between ages 15-49 have anaemia or low blood count. Early marriage is the result of low infant nutrition in India. About 30 percent of women, aged 20-24, had been married before the age of 18. Malnutrition is still prevalent in the country. India's situation of malnutrition among children may pose bigger threats in health care for the country in the future. It is estimated that 44.7% of girls between ages 15-18 have low Basal Metabolic Rate (BMR). This is the worst figure when compared to other fast-growing economies.

Importance of the Study

There is no denying of the fact that people are the real wealth of a nation. The basic objective of any plan and program of a nation is people's development. Further, the fundamental aim of development is to create such an enabling situation where people can enjoy the basic needs of life such as education, medicine, dwelling place, pure drinking water and comfortable environment for flourishing. Without increasing national income it would not be possible for the countries to provide better nutrition and health services, greater access to knowledge, more secure livelihoods, better working conditions, security against crime and physical violence, satisfying leisure hours, and a sense of participating in the economic, cultural and political activities of their communities. Of course, people also want higher incomes as one of their options.

A close investigation into the life of general Indian public exhibits people's suffering from deprivation. What is the use of development, if the citizens are not happy, and are exploited by elite group of society? What is the argument of calling India a great nation, if it fails to fulfil the minimum needs of the people? Can democracy survive if fifty per cent of its population remains out of the corridor of decision-making power? If violence against women through torture, rape, or threat is so rampant, how can women take equal part in all development activities? Still the third gender is excluded from all the development activities and, they fail to enjoy the fruits of development. Democracy is meaningless until and unless it overlooks the basic amenities of citizens like food, roof, cloths, pure water, and medicine. Human development is related with availability, accessibility, and affordability of all the minimum necessities of people such as bread, education, health, social security, and freedom of choice of the people. Without proper and scientific education and arrangement of health and sanitary facilities to millions of Indian people, human development of this great nation is next to impossible. If the government is unsuccessful to protect its people from foreign aggression, internal exploitation, corruption, and violence, how can India outshine its competitors like BRICS or G-20 countries?

Aims and Objectives of the Study

On this backdrop the present study was undertaken. The primary objective is to examine the present status and position of India. It was intended by the researcher to examine India's position in comparison with the G-20 countries. Further, it seeks to deal with (i) the present status of women in India, (ii) the policies and programs taken up by the Government of India for the achievement of Sustainable Development Goals, (iii) the issues and constraints standing on the way of Sustainable Development Goals, and finally to provide (iv) some policy prescriptions for attaining Sustainable Human Development and growth in India.

Universe of the Study

The present study was carried out in the G-20 countries. It was the intention of the author to cover these countries through online survey. The countries being historically, geographically, linguistically, culturally, and regionally varied, give a representative character of the world. Moreover, the countries possess different sorts of characteristics in relation to population, income, nature of government, size of the economy etc.

RESEARCH METHODOLOGY

The desk top research methodology has been adopted for the present study. However, the research is based on both secondary as well as primary data. Major sources of secondary data comprise books, journals, evaluative studies, periodicals, and newspapers. Besides, the related publications of international organizations like that of the United Nations Educational, Scientific and Cultural Organization (UNESCO), Reports of the United Nations Development Program (UNDP), International Monetary Fund, World Bank and relevant documents of Indian Government such as Census data, National Crime Record Bureau data, Health Survey report etc. were used for the research. The primary sources include the Government Acts, Manuals, and Statues. Along with these, formal and informal interactions with ordinary people have largely enriched the study.

Defining Democracy

A great many scholars have contributed to the rise and growth of democracy since the ancient Greek city-states. In ancient Greece, the concept of democracy or the rule of democracy was by no means considered as an ideal rule. Plato vehemently opposed democracy because; according to him people were not appropriately equipped with education 'to select the best rulers and the wisest courses' (Gauba, 2006). The word Democracy has come from Greek language, like aristocracy, oligarchy, monarchy, and other political terms. In Greek 'Demos' means 'the people' and Kratos means 'power'. Hence, democracy means "Power to the People."

However, democracy means a government by the common people especially a rule of the majority people. The most familiar definition of democracy has been provided by the former President of America, Abraham Lincoln. He envisaged that, "… democracy is the government of the people, by the people and for the people" (Garner, 1955). While the British Parliamentarian and philosopher John Stuart Mill describes democracy as a form of government in which, "…the whole people or some numerous portion of them, exercise the governing power through deputies periodically elected by themselves" (Mahajan, 1956). On the other hand, Robert Morrison MacIver considers that, "Democracy is not a way of governing whether by majority or otherwise but primarily a way determining who shall govern and broadly to what ends" (Kapur, 1979). Lord Bryce pointed out that, "The word Democracy has been used ever since the time of Herodotus to denote that form of government in which the ruling power of a State is legally vested, not in any particular class or classes, but in the members of the community as a whole (Bryce, 1921).

However, the concept of democracy is not a new rather it has a long Indian tradition. Gandhiji believed that true democracy is based on non-violence and for him establishment of peace and fulfilment of democracy are synonymous with cultivation of non-violence. Gandhiji pointed out, "True democracy or the Swaraj of the masses can never come through untruthful and violent means; for the simple reason that the natural corollary to their use would be to remove all opposition, through the suppression or extermination of the antagonists. That does not make for individual freedom. Individual freedom can have the fullest play only under a regime of unadulterated ahimsa" (Gandhi, 1939).

Perfect democracy, therefore, may be achieved only through perfect non-violence. If people follow true non-violence having self-control, master over methods of satyagraha and cooperate with the state; an ideal and genuine democracy can be emerged. Such a democratic state based on non-violence would facilitate full growth and progress of individuals and would be based on rational understanding, cooperation, and love for all which are the outcome of true non-violence. Gandhiji further pointed out, "My notion of democracy is that under it the weakest should have the same opportunity as the strongest. That can never happen except through non-violence" (Gummadi, 1999). On the other hand, Dr. Radhakrishnan considered that, "Democracy is not merely a political system but a way of life which affords equality to everyone irrespective of the difference of race, religion, sex, and economic status" (Sharma & Sharma, 2007). Therefore, it is evident that, democracy is both 'a form of government' and 'a way of social life.'

Democracy and Sustainable Development

Though democracy is an age-old concept since the time of Aristotle, the concept has emerged with new thrust as a cross-cutting issue in the outcomes of the major United Nations conferences and summits since the 1990s and in the internationally agreed development goals they produced. In the beginning of the 21^{st} century, the world leaders pledged in the Millennium Declaration Goals (MDGs) to spare no effort to promote democracy and strengthen the rule of law, as well as respect for human rights and fundamental freedoms. Further, the Outcome Document of the post-2015 negotiations, "Transforming Our World the 2030 Agenda for Sustainable Development," which was adopted by the members of the UNO also reaffirmed the commitment to a world in which "democracy, good governance and the rule of law as well as an enabling environment at national and international levels are essential for sustainable development."

Implications of Sustainable Development

The concept of Sustainable Development has two major components i.e. development and *sustainability*. It is interesting to note that, most of the classical economists and development theorists considered that development is only related with the economic growth and increasing the buying capacity of people. The classical theorists also emphasized on the transformation of agricultural production from tradition to modern, use of technology in factories in place of manual production, introduction of science and technology in everyday life, and last of all increasing the high consumption level of people. According to several neoliberal and modern development theories established over the past 60 years and the contemporary understanding, development is a process whose output aims to improve the quality of life and increase the self-sufficient capacity of economies that are technically more complex and depend on global integration (Remenyi, 2004). Fundamental purpose of this process is creation of stimulating environment in which people will enjoy and have long, healthy, and creative life (Tangi, 2005).

The term *sustainability* literally means "a capacity to maintain some entity, outcome, or process over time" (Jenkins, 2009). It was observed by the United Nations that after the

Stockholm Conference very little was accomplished to concretely integrate environmental concerns into development policies and plans. Hence, it was necessary to a more integrated perspective to incorporate both economic development and environmental sensitivities. As a result, in 1983, the UN General Assembly created the World Commission on Environment and Development which was later known as the Brundtland Commission. In 1987, the Commission published a Report titled Our Common Future. It built upon what had been achieved at Stockholm and provided the most politically significant among all definitions of sustainable development. The Brundtland Commission's brief definition of sustainable development is the "ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Now let us examine the status and position of India in global perspective.

India and the G – 20

There is a myth regarding the position of India. Millions of Indians have a misconception about the socio-economic status of contemporary India. Hence, it is necessary to examine the actual status and position of India in comparison with the G-20 countries.

Area and Population of G-20

Let us begin with the size of area and population of G-20 countries. It is observed from the available data from Worldometers in the year 2018 that Russia is the largest country while the second position is held by China, and the United States of America occupies the third position. Even entire European Union is lesser than half of Russia. India holds the seventh position in terms of area. On the other hand, Republic of Korea is a small country with only 97230 sq. km. area.

Country-wise data show that, China is the highest populated country with 18.54 per cent of the world population, while India is the second most populated (17.74%) country, and European Union is the third most populated with 7.00 per cent of global share. The USA and Indonesia holds the fourth and fifth position, respectively.

Gross Domestic Product of G-20

In terms of Gross Domestic Product China holds the second position, after the USA, followed by Japan (3rd), Germany (4th) and United Kingdom (5th). India is the world's sixth largest economy. According to the International Monetary Fund, India is projected to generate growth of 7.8 percent in 2019, boosted by household spending and a tax reform whereas the world's expected average growth of 3.9 percent. As per the estimate of the London-based Centre for Economics and Business Research that, India would overtake both Britain and France in terms of GDP, and had a good chance to become the world's third-biggest economy by 2032. At the end of 2017, Britain was still the world's fifth-biggest economy with a GDP of $2.622 trillion (Firstpost, 2018). Further, it comes to light that, France came down to seventh position and it was followed by Brazil (8^{th} position), Italy (9^{th} position) and Canada (10th position). Next comes Republic of Korea (11^{th} position), Russia (12^{th} position), Mexico (15^{th} position), Indonesia (16^{th}), and Turkey (17^{th}).

GDP per Capita Income at Current Prices

India has achieved spectacular growth in its economy in recent years. India's economic growth accelerated from a 4.25% annual pace in the 1961-1993 period, to 7.0% annually in the 1994-2017 period, as financial reforms and deregulation had a positive impact on the economy. Per capita GDP almost tripled, from 1.93% annually in the 1961-1993 period to 5.35% annually in the 1994-2017 period (Chappelow, 2020).

Despite holding the sixth position in economy, India's GDP per capita income is frustrating. Available data show that, India's GDP per capita income is the lowest (US$ 1,939.6) among the G-20 countries. The United States of America is the richest country in both Gross Domestic Product and per capita income GDP (US$ 59,531.7), while Australia holds the second position with US$ 53,799.9 GDP per capita income followed by Canada (US$ 45,032.1), Germany (US$44,469.9) and the United Kingdom (US$ 39,720.4) that hold 3rd, 4th and 5th position respectively. France (US$ 38,476.7) and Japan (us$ 38,428.1) are almost equally positioned while China (US$8,827.0) and Mexico (US$ 8,902.8) are having almost similar GDP per capita income. It is shocking that, individual citizens in South Africa (US$ 6,160.7) and Indonesia (US$3,846.9) are also richer than average Indian citizens.

FDI Outflow and Inflow

FDI inflows to the G-20 as a whole decreased by 27% from US$ 1208 billion to US$ 877 billion, but trends diverged across the G-20 sub-groups: FDI flows to OECD G-20 economies decreased by 39% but were partly offset by a 3% increase in FDI inflows to non-OECD G-20 economies. In 2017, the major FDI recipients worldwide were the United States (US$ 287 billion) followed by China (US$ 168 billion), Brazil (US$ 63 billion), the Netherlands (US$ 58 billion excluding resident SPEs), France (US$ 50 billion), Australia (US$ 49 billion), Switzerland (US$ 41 billion) and India (US$ 40 billion). A closer look of India and China's FDI outflow in 2017 shows that China's total FDI outflow was US$ 101914 billion, while India had only US$ 11256 billion outflow. On the other hand, FDI inflow of India during the same year was US$ 39978 billion; but China had succeeded in FDI inflow amounting to US$ 168224 billion. China's FDI inflow was the second highest after the United States of America. In terms of FDI outflows the first position is held by European Union and the second position is occupied by the USA. While Japan and China hold the third and fourth positions, respectively. However, India's outflow and inflow of FDI is better than many G-20 countries such as Argentina, Indonesia, Italy, Mexico, Russia, Saudi Arabia, and South Africa.

Human Development Index

The Human Development Report 2018 shows that Australia (0.939) tops in the Human Development Index, while Germany (0.936) comes in the second position followed by Canada (0.926). In the 800 and above index there are four countries such as Italy (0.880), Saudi Arabia (0.853), Argentina (0.825) and Russia (0.816). India fell in the lowest Human Development Index category among the G-20 countries with mere 0.640 points.

India's rank is the 130th, which gives it the status of a Medium Development country.

There is not a single country in the G-20 that has so poorly performed in Human Development Index. Out of 20 countries (including EU), eleven countries fall in with very high Human Development Index. These are: Australia (3rd position), Germany (5th position), Canada (12th position), United States (13th position), United Kingdom (14th position), Japan (19th position), France (24th position), Italy (28th position), Saudi Arabia (39th position), Argentina (47th position), and Russian Federation (49th position). Similarly, 4 countries fall in the High Human Development Index such as China (86th position), Brazil (79th position), Mexico (74th position), and Turkey (64th position). In the Medium Development Index only 3 countries are there - South Africa (113th position), Indonesia (116thposition) and India (130th position).

The position of a country in the Human Development Index depends on some indicators such as life expectancy at birth, maternal mortality rate and political participation of women. It is observed that, people in Europe and America live more years than average Indians. India is only ahead of South Africa, and people's life expectancy in all the other G-20 countries is better than the people of the largest democracy. People in Australia, Canada, France, Germany, Italy, Japan, Korea, and UK live more than 80 years whereas in India people's average life expectancy is only 68.8 years.

In terms of Maternal Mortality Rate, India is again the worst performer with 174 deaths per 100,000 live births. Countries like Italy (4), Japan (5), Australia (6), Germany (6), Canada (7) and UK have lesser than 10 Maternal Mortality Rate; but this rate for South Africa (138) and Indonesia (126) is higher, while some countries such as Republic of Korea (11), Saudi Arabia (12), the United States of America (14), Turkey (16) and Russia (25) are worse than Italy, Japan, Australia and Canada. Mexico (38), Brazil (44) and China (27) are in moderate position in the Maternal Mortality Rate.

But the most disappointing fact revealed in the UNDP Report (2018) was about the share of seats in Parliament by women. The G-20 countries have failed to provide equal opportunity to women at par with their male counterparts. It is observed that, Mexico (41.4%) has the highest percentage of women in the national Parliament, while South Africa is a bit lower with (40.0%) women in Parliament and it is followed by Argentina (38.9%). Further, it is found that France (35.4%), Australia (32.7%), Germany (31.5%) and Canada (30.1%) have more than 30% women in their Parliament, and countries like the UK (28.5%), China (24.2%), Saudi Arabia (19.9%), Indonesia (19.8%), the USA (19.7%), Russia (16.1%) and Korea (17.0%) have lower representation of women than their counterparts in France, Australia, Germany and Canada. But the position of India (11.6%) is the lowest in comparison with the other G-20 countries just mentioned above and even lower than Japan (13.7%), and Turkey (14.6%), while only Brazil (11.3%) is worse than India in empowering women through participation in the highest law making body.

It is revealed from the study that there is not a single country in the world where women are equally treated, and gender parity has been ensured. Gender disparity and disempowerment of women in India is worse than almost all other G-20 countries. Globally women earn less than men and are more likely to engage in poor-quality works, while a third suffers physical or sexual violence in their lifetime. In India women are deprived of their legitimate share of food, education, and income. Girl's sex ratio is comparatively lower than boys, crime and cruelty against women are more than men. Child marriage and sex trafficking in India is at an alarming stage. Education rate of girls is lower than their male counterparts. There is disparity between women and men electors; women's turn out in election is also lower than men; and finally, women are lowly represented in every political decision-making body - from Panchayat to Parliament. Women are lowly visible in administration, judiciary, and legislature. Women's labour force participation and per capita income are also much lower than their male counterparts.

Education and Labor Force Participation

Over the past several decades, global literacy rates have significantly increased. It is said that education is the mirror of society. When we compare India's literacy rate it comes to light that, it is the lowest (74.0%) among the G-20 countries. Russia achieved 100 percent literacy in 2010; many countries in the world and especially the G-20 countries have achieved full or nearly full literacy. The available data compiled from various sources indicate that Argentina (98.0%), Australia (99.0%), Canada (99.0%), France (99.0%), Germany (99.0%), Italy (99.0%), Republic of Korea (98.0%) and the United Kingdom (99.0%) have achieved almost 100 per cent literacy almost a decade ago. It is to be mentioned that literacy rate means "percentage of population aged 15 years and over who can both read and write with understanding a short simple statement on his/her everyday life." Only a few countries such as Brazil (90.0%), China (93.0%), Indonesia (91.0%), Saudi Arabia (91.0%), Mexico (92.0%), and South Africa (92.0%) could not complete full literacy.

In terms of labor force participation also there is wide gap between men and women. The Human Development Report indicates that, in the world where men's labor force participation rate is 75.3 per cent, this rate for women is 48.7 percent (UNDP, 2018). Thus, a clear gap of 26.6 per cent is visible. This gap is prevalent in almost all the countries in the world. Most difference is found in India where total labor participation of men is 78.8 per cent, while women's participation rate is only 27.2 per cent thereby making a difference of 51.6 per cent. Almost similar gap is observed in Turkey (39.5%), Mexico (34.9%), Indonesia (31.1%), Republic of Korea (21.0%), and Brazil (21.5%). On the other hand, there are some countries where the difference between men and women in labor force participation is a little lesser than the formerly mentioned countries, such as China (Male – 76.1%, Female – 61.5%), Japan (Male - 70.6%, Female - 50.5%) and Russia (Male -71.8%, Female – 56.6%). However, a few countries have been able to bring down the difference between male and female labor force participation. In Canada, this gap is only 9.1 percent, in France this gap is 9.5 percent, in the UK it is 11.3 percent, while in Australia and USA this gap is only 11.3 and 12.6 percent, respectively.

Hunger and Unemployment

The 2018 Global Hunger Index (GHI) indicates that the level of hunger and under-nutrition worldwide falls into the serious category, at a value of 20.9, down from 29.2 in 2000 (GHI, 2018). Underlying this improvement are reductions since 2000 in each of the four GHI indicators - the prevalence of undernourishment, child stunting, child wasting, and child mortality.

Out of 119 countries for which global hunger index is available, it comes to light that India's rank is 103. All other countries are better positioned than India. Argentina's rank is 18, Brazil stands at 31st position while China's rank in the global poverty index is only 25. Indonesia (73rd rank) is below the 30 points of India and Mexico's rank is 22 while Russia holds 21st position followed by Saudi Arabia (31) and South Africa (60).

On the other hand, when we look at the unemployment rate, it comes to light that all the countries in the world are having unemployment problem. In 2019, the global unemployment rate is expected to remain essentially unchanged, whereas the number of unemployed is projected to grow by 1.3 million (ILO, 2018). In terms of unemployment, India is a little better positioned than others. India's current unemployment rate is 3.5 per cent i.e. 18.6 million youths are unemployed in India, while this rate in South Africa is 28.5 per cent (6.4 million). China's unemployment rate is 4.7 per cent that means 37.6 million youths are jobless, and this rate in Brazil is 11.9 per cent comprising 12.5 million youths. Italy (11.0%) and Turkey (11.1%) are also facing much unemployment problem with 2.7 and 3.5 million unemployed people, respectively. The UK and USA are also not free from the burden of joblessness. UK's current unemployment rate is 4.2% (1.4 million people) and the USA's present rate of joblessness is 4.3 per cent where 7.0 million youths are unemployed.

Indian Initiatives for Achieving Sustainable Development Goals

From the above discussion it is revealed that India is lagging behind many G-20 countries in almost all respect. The Government of India is also concerned with the deplorable socio-economic attainments of India. Hence, like the previous ones the present government also has come up with several programs and schemes to ease the burden of poverty holding India back. It is not possible to highlight all the schemes and policies within this short article; still an endeavour has been taken to trace out a few important policies and schemes of the Modi government for human development, economic growth and upliftment of general citizens. The Pradhan Mantri Jan Dhan Yojana (PMJDY) is one such program. A couple of insurance programs were also launched by the Government of India recently for members of lower income groups and economically backward sections such as Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) and Pradhan Mantri Suraksha Bima Yojana (PMSBY). The Prime Minister launched the Saansad Adarsh Gram Yojana (SAANJHI) to develop the infrastructural facilities in India. Further, the Government of India initiated a few policies, programs, and schemes for reducing the gender gap and boosting women's empowerment. Some notable initiatives in this regard are the National Mission for Empowerment of Women (NMEW), Swadhar, Priyadrashani, Kishori Shakti Yojana (KSY), Swawalamban Program, Mahila Samriddhi Yojana (MSY), Balika Samriddhi Yojana (BSY), Sukanya, Ladli Laxmi Yojana, Apni Beti-Apna Dhan (ABAD) and many more. All the above schemes and programs are formulated for empowerment of people and especially for women for eradication of poverty.

With a view to ending hunger, the National Food Security Act (NFSA) 2013 was launched by the UPA-II government. The NFSA is being implemented across the country addressing the availability, accessibility, and affordability dimensions of food security. The Scheme covers around 800 million people, about 67% of the country's population. The National Health Policy, 2017 has been adopted to achieve specific targets for universalizing primary health care, achieving further reductions in infant and under-5 mortality, preventing premature deaths due to non-communicable diseases as well as increasing government expenditure on health.

India is focused on ensuring access to water and sanitation services to all. Since the launch of Government of India's flagship scheme, the Swachh Bharat Abhiyan (Clean India Mission), more than 12 million toilets have been constructed in rural areas (UNI, 2020a). The government of India's efforts to make India clean through toilet movements will ensure health and well-being of Indian people. Another flagship scheme, Sarva Shiksha Abhiyan, is aimed at achieving universal quality education for all Indians aged 6-14 years and is complemented in this effort by targeted schemes on nutritional support, higher education, and teacher training. Along with the general education, vocation training is also being imparted for making Skilled India mission successful. To address the employability issue of students, providing vocational education is of utmost importance. Through the schemes like Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP) and Skill Strengthening for Industrial Value Enhancement (STRIVE), the government is increasingly looking at revamping the educational framework and skill development of students, improving the quality of trainers, and standardizing the assessment and certification process so that students passing out meet the requirements of the future workforce.

Numerous measures have been put in place for promoting gender equality. For example, the Beti Bachao Beti Padao (Save the Girl Child, Educate the Girl Child) initiative focuses on a comprehensive package of interventions for the girl child including those pertaining to education and protection. Various Maternity Benefit Programs protect women from wage loss during the first six months after childbirth. Besides, Janani Suraksha Yojana is a great scheme for a woman that provides Rs. 6000 to pregnant women who undergo institutional delivery for hospital admission. Further, several programs are being implemented for enabling greater participation of women in the work force (Chandra, 2018).

Pradhan Mantri Ujjwala Yojana is another ambitious social welfare scheme of Narendra Modi Government. Under the Pradhan Mantri Ujjwala Yojana, the government aims to provide LPG connections to BPL households in the country. The scheme is aimed at replacing the unclean cooking fuels mostly used in rural India with the clean and more efficient LPG (Liquefied Petroleum Gas). Ujjwala Yojana is aimed at providing 5 Crore LPG connections in the name of women in BPL (Below Poverty Line) households across the country. Recently the government of India has taken some flagship programs to achieve Goal No. 8. These include National Skill Development Mission, Deendayal Upadhyaya Antodaya Yojana, Atal Innovation Mission, the National Service Scheme, and the Mahatma Gandhi National Rural Employment Guarantee Scheme. Further, the Deen Dayal Antyodaya Yojana (DAY) was launched basically with an aim to uplift the urban poor people by enhancing sustainable livelihood opportunities through skill development.

Keeping in view the objective of ‘Make in India,’ Skill Development is essential for socio-economic upliftment of people.

The Government of India’s emphasis on the three-pronged Jan Dhan-Aadhaar-Mobile programs are aimed at a comprehensive strategy of inclusion, financial empowerment, and social security. These priorities are in line with the Sustainable Development targets aimed at achieving greater equality and promoting the social, economic, and political inclusion of all by 2030 (UNI, 2020b). The Government of India’s Smart Cities Mission, the Jawaharlal Nehru National Urban Renewal Mission, and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are aimed to address the challenge of improving urban spaces. The Pradhan Mantri Awas Yojana aims to achieve housing for all by 2022 (UNI, 2020c).

In 2016 the Prime Minister of India launched another flagship program, Sagarmala for Holistic Development of Islands and Coastal Areas with a view to promoting port connectivity, development, and industrialization, in a phased manner during 2015 to 2025. Holistic and sustainable development of coastal communities, especially the population engaged in fishing, is one of the key pillars of the program. Coastal tourism is also being promoted under the program for enabling access to better livelihood opportunities (NITI Aayog, 2017).

The government of India launched the Green Highways Policy in 2015 to promote greening of National Highway Corridors across the country. The National Afforestation Program targets development of forest resources with the involvement of people. The integrated development of wildlife Habitats Program, which includes Project Tiger and Project Elephant, focuses on capacity building of staff, wildlife research and evaluation, anti-poaching activities, wildlife veterinary care, addressing man-animal conflicts and promoting eco-tourism. The Program of Conservation of Natural Resources and Eco Systems, through its different sub-programs, aims at conserving biosphere resources, natural resources, and eco-systems of the country (NITI Aayog, 2018).

Presently the Government of India is an important part of the new global partnership, and it has been strengthened by the country’s efforts to build networks within the region and with the world through the Shanghai Cooperation Organization, BRICS and its New Development Bank, and the South Asian Association for Regional Cooperation, as well as with UN agencies and programs around the world (UNI, 2020d). India left no stone unturned to vitalize global partnership for attainment of Sustainable Development Goals by 2030.

Challenges of Sustainable Development Goals

There are several challenges standing on the way of Sustainable Development Goals, human development, and economic growth in India. Within this small article, only a few such obstacles and challenges will be succinctly pointed out in the following part.

Let us start with the political challenges. Prior to every election - from local body to Parliament - threatening, intimidation, booth capturing, bombing, proxy votes, vote boycotting are some of the common incidents observed by any conscious citizen in India.

In health sector, despite the headway made in the last 15 years, several challenges remain. There are significant inequalities in access to quality and affordable health services, and a disproportionate burden of communicable and non-communicable diseases still exist. Low budgetary allocations for health are a key reason. The government's health expenditure has remained at around 1% of GDP over the past decade, which puts India significantly behind the global average. These funds are also not efficiently utilized due to fragmented planning and vertical disease programs.

In India, the quality of education from primary to university level remains at a very low ebb. In case of primary education, the basic deficiency is in terms of basic infrastructure, teacher absenteeism and poor quality. Similarly, in case of higher education the problem is largely in quality of teaching and near absence of proper research in most of the states and private sector universities (Misra & Ghadai, 2015). In a recent article (The Economic Times, 2018) in The Times of India it was revealed that, Indian universities are ceding ground to global competitors in preparing students for the modern workplace. International students not only bring in revenue, but they also help cultivate a university's reputation as collaborative, attractive and reputable. Currently, India's international student rate is much lower than many other countries, but that is something the nation is trying to change. The rapid growth and massification of India's higher education system has resulted in various quality problems, most notably in the fast-expanding private sector. Academic corruption and political intervention in educational institutions are major hindrances to achieve quality education in India. Women's safety and equality are great problems in India. Women are not free to flourish through participation in political, economic, and educational institutions. Gender discrimination and gender violence are still burning issues in India.

In regard to distribution of freebies it can be pointed out that, competitive populism among political parties, and offers of loan waivers and free power in the run-up to elections are just temporary solutions that do not address the need for structural changes to sustainably development incomes in the country. It is a fact that populist measures have short-term political gains but lead to long term economic problems as they are 'unproductive (The Hindu, 2019).

Moreover, corruption, tax evasion, extortion, hooliganism is rampant in India. Also it is a fact that, there is no dearth of sound policies and laws in India, but the inefficient governance and poor performances of the law enforcement and implementation agencies are mostly responsible for India's low performance in achieving Sustainable Development Goals.

Policy Recommendations

What is the use of robust economic growth if it does not make the qualitative change of average citizens? If there remains a wide gap between the haves and have not's how can India achieve Sustainable Development Goals? How can India be included in the category of very High Human Development countries with so much poverty, illiteracy, ill health, and low per capita income? Is it possible to achieve Sustainable Development Goals without women's equal participation in all development activities? Therefore, a few policies can be prescribed to the government for closing the gaps and achievement of Sustainable Development Goals for making India a superpower by 2030.

For ending poverty from India, it requires: 1. To promote growth in agricultural productivity and non-farm rural activities. 2. Public investment in rural infrastructure and agricultural research. Greater employment opportunities and growth is required in the rural non-farm economy. 3. Better and effective credit policies to promote farm investment and rural micro enterprises. Policies to be taken to promote human capital to expand the capabilities of the poor and development of rural financial markets. 4. Self-Help Group Approach to be strengthened as it is a proven method of empowerment of the poor, especially women. 5. Involvement of local communities and people's participation in NRLM and MGNREGS. Stringent measures for checking the rising corruption of MGNREGS is highly recommended. 6. Public Distribution System (PDS) needs to be reformed and better targeted. 7. Provision of safety nets like targeted food subsidies, nutrition programs and health (Kulkarni, 2013).

Regarding robust growth of economy and human development sound fiscal and monetary policies are required. Not the distribution of freebies, rather capacity building of Indian youths as well as employees is the highest need of the hour. Capacity building for governance is crucial if states are to smoothly perform their roles to minimize the risks. The role of the state should be enhanced to build capacity, set the rules, and undertake reforms to better enable citizens to participate in the global economy and attract capital into the country (Rondinelli & Cheema, 2003). Better governance capacity would also ensure better resource mobilization and distribution.

To reduce malnutrition, it is imperative to promote policies for increasing food productivity as well as for enhancing land use and desirable cropping patterns. Use of technology will improve food production and quality of production. Besides, food supplementation programs are essential for tackling hunger and food security issues, and for ensuring social equity (Consultation Report, 2010). Mid-Day-Meal program should be extended to class IX and X for better supporting the nutritional requirement of students.

The public health policy should focus on the prevention of diseases by providing clean water and sanitation rather than fighting diseases by administering antibiotics. There is also a dire shortage of healthcare staff. To meet the challenges, the government could forge partnerships with various stakeholders including foreign investors and Indian business community. It is necessary to invest in public health and finish MDG agenda through further improvements in maternal and child health, confronting neglected tropical diseases, eliminating malaria, strengthening the country's surveillance system to detect and respond to diseases and accelerating the fight against tuberculosis.

For educational sustainability, the key issue across all levels of education in our country is quality. Pay discrimination between central and state teachers should be closed immediately. A separate Indian education services cadre at different levels, within the civil services, should be created. Parents should be bound to send students to school, and district education officials should be responsible for the quality of both private and government schools (Rajagopalan, 2018). Local people's representatives like Gram

Pradhan of Panchayats, Councillors of Municipality should be responsible for quality education as well as equitable development of all schools under their jurisdiction.

Inequality is a great barrier to economic growth and development of Indian. Therefore, solutions to reducing income inequality lie in three aspects: (1) investing in women; (2) investing in agriculture; and (3) reforming workplace laws. Investing in women is most important and urgent today to reduce inequality and increase nations' gross domestic product (GDP). Helping women stay active in the workplace while raising a family is a key to achieving this growth. This means more family-friendly work policies, such as paid parental leave and creating an environment where kids are allowed in the workplace. Flexible timing would also help women to join and continue their works during pregnancy and child rearing.

Promote inclusive growth by ensuring that the income of the bottom 40% of the population grows faster than of the top 10% so that the gap between the two begins to close. Seal the leaking wealth bucket by taking stringent measures against tax evasion and avoidance; taxing the super-rich by re-introducing inheritance tax, increasing wealth tax, reducing and eventually do away with corporate tax breaks; creating a more equal opportunity by increasing public expenditure on health and education. Regularly monitor the measures the government takes to tackle the issue of rising inequality (Oxfam India, 2018).

Women's equality must be ensured for attainment of Sustainable Development Goals. Hence, it is proposed that 50 per cent seats should be reserved for women in all legislative assemblies and Parliament. For bringing about attitudinal change of public more and more seminars and sensitization programs should be initiated from school to university level. Women's safety can best be ensured by introducing self-defence training in all educational institutions and clubs in India. Crèche should be set up in all factories and offices where lactating mothers are working. More women should be recruited as drivers and security personnel for ensuring safe travelling of women to and from their home to workplace. The legal awareness campaigning should be more extensive and effective. Government should show more positive signs in recruiting equal number of teachers, nurses, administrators, lawyers, judges, medical officers, pilots, engineers, and research scholars to bring about equality between men and women. With equal participation in every sector, women's equality and empowerment will be ensured in true sense in India.

For controlling environmental pollution, it is necessary to popularize an eco-friendly lifestyle. It is also required to campaign against solid waste, especially plastic and non-recyclable plastic materials. The wastes such as plastic materials, glasses and other types of solid waste can be sorted into several categories, recycled, and used for different purposes. The people and especially the women and youths can be sensitized to the importance of responsible waste disposal.

To make India clean the Swachh Bharat Mission should be implemented in a more holistic way. A more sustained awareness campaign among the households, guesthouses, communities, restaurants and organizations in every village, city and town should be initiated. The schools, colleges, and universities, local clubs, civil societies should be more sensitized to curb the menace. Lastly, an introduction of both fine and legal action by government or local administration for creating nuisance and dirt on road, office, educational institutions, park, or any public place will produce effective results. National Green Tribunal should be more active, and the administration of local and state government should be more prompt where violation of the guidelines is taking place.

Regarding widespread manipulation in elections, it is recommended that either the voters should have a basic education for selecting their representatives, or the representatives should have certain educational as well as professional degrees. In addition to that, certain level of expertise in Indian Constitution, International covenants, and public administration should be the criteria of contesting a parliamentary election. Further, the electronic voting arrangement should be made for elderly, infirm and ill voters, and citizens living temporarily out of station. Full proof online voting arrangement and online nomination arrangements are the remedies for ongoing violence, alcoholism, proxy votes and vote purchasing by political stalwarts.

About national security it is proposed that Kashmir issues need to be resolved amicably and through dialogue. Major security threat is coming from Indian state Jammu & Kashmir and from our neighboring country. War can never be a permanent solution. Diplomacy is the best way to deter a belligerent country. At the same time, what Indian Army commandos carried out in the form of surgical strikes against terror launch pads in Pakistan-occupied Kashmir is also necessary because this kind of military operation conveys a very strong message to the terror groups. India must use force, following international military norms, for defending its border, people, and property.

Improving infrastructure is one way to increase GDP of India. Without investment in infrastructure there cannot be GDP growth. Electricity to be provided to all the households. Former Indian president APJ Abdul Kalam felt that, “No nation can aspire to be modern and developed without the availability of quality power for all. Vast biodiversity should be transformed into wealth of people and the nation through selective technological interventions; Indian marine resources are to be transformed into economic strength. Also, there is necessary for a resurgence of Indian engineering industry, machine tools, textiles, foundry, electrical machinery, and transport-equipment. India should be an exporter of electrical, engineering, electronic, and technological items in the world market. Along with production of rice and wheat, India should produce more aircrafts, computers, missiles, and fighter planes. More budgetary allocation is required in research and development in science & technology, commerce, medicine, marine, space, literature, and social science. Take all necessary steps to weed out corruption from India. Criminals, goons, corrupt officials, and corrupt politicians should be brought to book - whatever challenges may come from the Opposition parties or combined political forces.

CONCLUSION

From the above discussion it can be said that Indian democracy is still in nascent stage and it needs miles to go before matching with other High Human Development Countries in the world. But it is a matter of happiness that, the pace of India’s progress towards economic growth is commendable of which many of its European and Asian counterparts are now envious of. India’s robust economic growth has also attracted the global attention. Besides, strong military power, technological advancement, and vast majority of skilled human resources are added advantages for India. Despite all achievements still the questions relating to quality education, health, social security, tolerance, women's safety, and equality ask for government intervention. However, it is hoped that Indian government will make serious note of it and take all necessary measures to address the human development issues.

Finally, it can be said that India is growing. India is shining, and India is progressing under the present government. At the same time, India is facing many challenges too. However, from the overall trend of its achievements, it can be hoped that India will outshine many of the G-20 countries and become a Very High Human Development country in next two decades. Let us all put our brains and hands together to make India the most powerful, progressive, and developed country in the world.

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Subject Index

ABOUT THE BOOK

The edited volume contains 21 chapters which have exclusively studied on the various dimensions of the sustainable development and informatics. The contributions on sustainable development specially in agriculture, mechanization in agriculture, GIS in agriculture, climate change impact in tea industry, climate change and tribal livelihood, information technology in agriculture, impact of climate change and risks, and climate change impact on demand for cosmetics have been proved rigorous educative values.

The studies on information technology in India, energy efficient method to reduce CO_2, artificial intelligent, GIS and remote sensing in methane emission, digital BRICS economy, digital marketing in rural India demand special credit to explore greater attention on this theme. Even, the analysis of PM-KISAN programme in India, child labour in rural Odisha, vehicle emission in Kolkata and NPA in Indian banks have endeavoured to search nexus with sustainable development with sincere effort.

The book will satisfy the knowledge of the researchers who are interested in sustainable development and informatics. It will also help the policy makers too.

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