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**SUBJECT I**  
**SUSTAINABLE AGRICULTURAL GROWTH, DIVERSIFICATION  
AND FARM INCOME**

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**Transitioning to a Green Economy: A Narrative Overview of  
the Challenges and Opportunities in Indian Agriculture**

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Kumar\***

**ABSTRACT**

The green economy refers to promoting economic activities that improve social equity and well-being, generate employment and income opportunities, and reduce environmental risks while restoring and effectively managing the natural resources. Agriculture is one of the core industries in achieving the green economy goals, especially in developing nations like India. In order to meet future food and raw material demands, India must reform rather than maintain its agricultural industry. Therefore, the present review comprehends the sector's economic, social, and environmental attributes and identifies its significant challenges and opportunities for green economy of the country. Based on the literature from across a range of disciplines, the study observed that the future requires transformation rather than sustaining the agricultural sector with an emphasis towards efficiency rather than growth, employment generation, nutritional security and management of surplus food in consonance with the agro-ecological backdrop.

**Keywords :** Agricultural transformation, green economy, Indian context, sustainable agriculture

**JEL: O13, Q01, Q15, Q16**

I

**INTRODUCTION**

The notion of sustainable development gained considerable international recognition during the Stockholm Conference (1972), where the previously regarded independent challenges of environmental conservation and economic development were identified to be managed in a coherent manner (Mensah, 2019). Despite the worldwide efforts to implement sustainable strategies, with increasing population and rising present and future demands for food, power and energy, has forced the global society on the verge of transgressing the ecological boundaries (Voumik and Shah, 2014; Weick, 2016). As a result, the green economy has been identified as a promising inclusive concept and a catalyst to sustainable development (Söderholm, 2020; Weick, 2016) that integrates the economic, social (Cook and Smith, 2012) and environmental growth pillars to harness the expanding economic opportunities while addressing environmental pressures (Allen, 2012; Barbier, 2012). It was also entailed as one of the themes for the UN Conference on Sustainable Development in 2012

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(Rio+20). The green economy refers to promoting those economic activities that enhances equity and wellbeing of the society, generating employment and income opportunities, while significantly restoring and efficiently managing the natural resources with lesser carbon emissions and ecological risks (OECD, 2010; UNEP, 2011, 2014).

The agricultural sector is bound to be considered necessary in the global green economy action plan because it has both direct and indirect implications not only for the economy but for society and the environment as well (FAO, 2012). This sector employs around 26 per cent of the worldwide population, with 44.2 per cent living in rural regions (World Bank, 2020a, 2020b), and accounts for 70 per cent of the world's extremely poor (IFPRI, 2019). Many researchers have reported that a preponderance of the poor reside in rural areas with agriculture providing a significant source of income for its large proportion (Castañeda *et al.*, 2018; Christiaensen and Lionel, 2007; Dercon, 2009; Ravallion *et al.*, 2008). Therefore, growth in this sector can increase rural economies' viability, reduce rural poverty, enhance the social welfare of farm families and reduce the rural-urban income gap, all of which serve as a foundation for green growth.

The Agriculture, Forestry, and Other Land Use (AFOLU) activities contributed for 23 per cent of the worldwide net anthropogenic GHG emissions between 2007 and 2016, accounting for 44 per cent of methane, 13 per cent of carbon dioxide, and 81 per cent of N<sub>2</sub>O. (IPCC, 2019). However, depending on improved soil management and cultivation techniques, the sector can also act as one of the major CO<sub>2</sub> sinks through carbon sequestration in soil (Lal, 2004; Six *et al.*, 2002) and vegetation (Kell, 2011), causing a net sink of around 29 per cent of the global CO<sub>2</sub> emissions (IPCC, 2019). The sector covers 4.8 billion ha area constituting about 36 per cent of the global terrestrial land (13.5 billion hectares), out of which 24 per cent is under permanent meadows and pastures, and presently 12 per cent of the total agricultural land is being used as cropland. Croplands, pastures, and forests constitute about 66 per cent of the global terrestrial land, and the sector consumes 70 per cent of all freshwater withdrawn globally (FAO, 2020, 2021). As a result, the sector uses the majority of the world's natural resources and is critical to the preservation of the ecosystem.

Although agriculture, forestry and fishing contribute only 3.27 per cent to the world's gross domestic product (GDP) (World Bank, 2018), yet the green economy vision will be at risk if the sector fails to provide sufficient food, feed and fibre to the growing population (Kanza and Vitale, 2015; Meijerink and Roza, 2007). In many developing countries, the sector's contribution in total GDP is 25 per cent and above, especially in Africa and South Asia (World Bank, 2018). According to (FAO, 2017), the worldwide demand for food and other agricultural products will rise by 50 per cent between 2012 and 2050. Therefore, producing more with less while preserving the environment and enhancing farmers' livelihoods is a crucial challenge globally

and it can be managed by adopting the notion of the green economy (Allen, 2012; Godfray *et al.*, 2010; Musvoto *et al.*, 2015).

India is among the fastest emerging market economies globally (IMF, 2018), with 1.366 billion people, accounting for 17.80 per cent of the global population (7.674 billion) (World Bank, 2018). According to (United Nations, 2019), India will be the world's most populous country by the year 2027, surpassing China. Therefore, the government holds the responsibility to meet its increasing population's development needs without exceeding the environmental boundaries and simultaneously supporting economic growth, enhancing social equity and job creation. Sustainable and equitable growth in the agricultural sector may lead to efficient use of the country's resources and reduce poverty, malnutrition, and inclusive green growth. Since every nation has its unique circumstances, the structure of a green economy and accompanying policies will differ. Therefore, the study's primary focus is to address the major challenges and opportunities in the agricultural sector in the perspective of India's green economy and identify the areas of intervention in the sector that could further achieve green growth.

## II

### METHODOLOGY

The study is the narrative overview (Green *et al.*, 2006) of the secondary data comprising relevant literature from various published research articles, books, reports, documents, official websites and databases of reputable sources like World Bank and FAO. In order to avoid bias and ensure the quality and transparency of research (Ferrari, 2015; Snyder, 2019), the literature was synthesised based on the four phases (identification, screening, eligibility, and inclusion) advocated by (Mensah, 2019; Moher *et al.*, 2009) (Figure 1).

#### *Identification*

Since the study was specifically focused on identifying the major challenges of agricultural sector in relevance to India's green economy, various keywords and terms such as agricultural households, climate depletion, food insecurity, green economy, income inequality, land degradation, poverty, sustainable development and water scarcity were examined in the global and Indian context. In order to ensure the quality of the study, the database was explored from the official reports, journals and other publications specified under Scopus and UGC care list of India. Further, the references specified in the relevant publications were also probed for a more inclusive research. In order to ensure the relevance in the present context, the study has focused majorly on the current literature. However, based on the substantial contribution, some articles of previous publications but significant importance have also been included in the research. The potential publications identified during this phase were included/excluded based on their relevance to the research objectives, credible publication sources, duplicity and influence (citations) in the field of

research (Browning and Rigolon, 2019). Out of 532 identified references, 276 were identified to be included in the screening process.

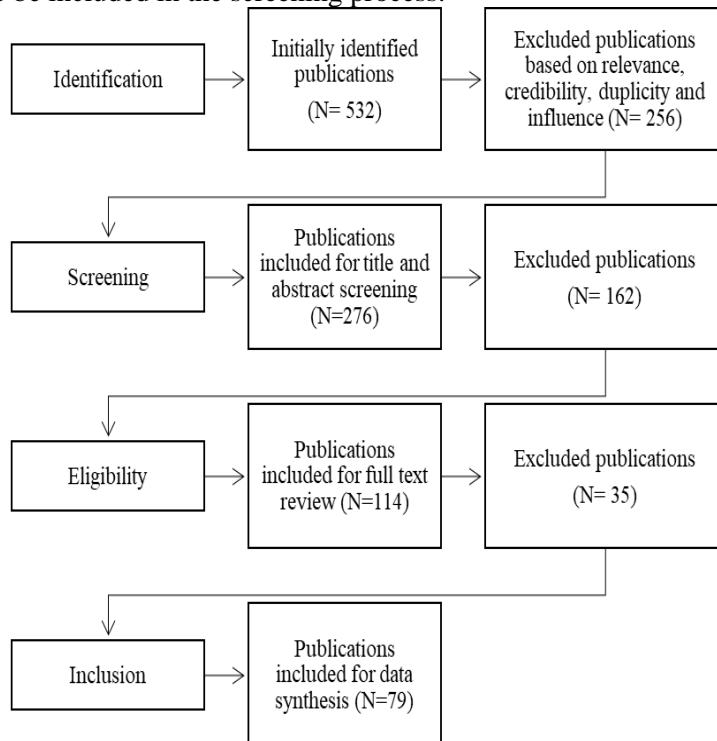


Figure 1: Structural Outline of the Literature Selection Process

### *Screening*

During the second stage, the identified publications were further screened (based on their title and abstracts) for their specificity and relevance to the research objectives, and a total of 114 publications were selected for a full-text review.

### *Eligibility*

The screened publications underwent the full-text review process where each article was thoroughly studied. Based on the recursive abstraction method (Polkinghorne and Taylor, 2022), the data gathered from selected sources were manually summarised and paraphrased under each sub-theme of the stated research. The data representing the interlinked sub-themes were also segregated and the irrelevant or duplicate references were further excluded from the research.

### *Inclusion*

In the final phase, based on the above stated inclusion/ exclusion process, 79 relevant research publications were considered for the final synthesis of data in the current research.

## III

## RESULT AND DISCUSSION

*Economic Challenges*

India has the largest proportion of global population living in rural areas (United Nations, 2019) and holds the second position among the most populated countries (World Bank, 2020b). About 65 per cent of its population is rural (World Bank, 2020b) and dependent on agriculture as the main source of livelihood. With the presence of second largest global arable land (159.7 million hectares) and 15 major climates, the country is the world's leading producer of many spices, pulses, fruits, vegetables, and other cash crops. Furthermore, when compared to Asia and other developed countries, the country has a cost advantage in terms of production. At 2011-12 prices, the agricultural sector constitutes about 14 per cent of India's GDP (MOSPI, 2021) which is significantly higher than the global average of three per cent (World Bank, 2018). This contribution of agriculture to the Indian economy refers to agricultural and allied activities. However, the share will be higher if we extend this to the food and other agro- processing value chains (Chengappa, 2013).

The agriculture sector's share to GVA (Table 1) has been steadily decreasing, from 17.8 per cent in 2012-13 to 14.6 per cent in 2018-19. This is due to the fact that, whereas the overall GVA has increased by 6.7 per cent, the agriculture sector's GVA expanded by only 3.23 per cent. Agriculture, on the other hand, continues to play a vital part in the economy, employing over 44 per cent of the workforce. Except for the year 2018-19, the inflation rates based on implicit price deflators (Table 1) show that the farm sector's price rise has remained higher than the general price levels. According to (Holt-Giménez and Patel, 2009), rising food prices have a detrimental impact on the poor. This highlights the major challenge of sustaining growth in the agricultural sector while keeping the food price inflation within limits.

TABLE 1: GVA GROWTH RATES AND IMPLICIT PRICE DEFLATORS FOR AGRICULTURE  
(AT 2011-12 PRICES)

Year	Total growth rate	GVA	Agriculture, forestry and fishing	Implicit price deflators (per cent)	
				Agricultural inflation rate	Total inflation rate
(1)	(2)	(3)	(4)	(5)	
2012-13	5.4	1.5 (17.8)	9.9	7.7	
2013-14	6.1	5.6 (17.8)	8.9	6.1	
2014-15	7.2	-0.2 (16.5)	8.9	3.7	
2015-16	8.1	0.6 (15.4)	5.7	1.1	
2016-17	7.1	6.8 (15.2)	5.9	2.9	
2017-18	6.4	5.9 (15.1)	4.9	4.2	
2018-19	6.6	2.4 (14.6)	2.0	4.2	
AAGR	6.7	3.23			

Source: Author's calculations derived from National Accounts Statistics 2020, MoSPI, GoI

Note: Figure in parentheses indicate share in GVA (per cent); AAGR = Average Annual Growth Rate (per cent)

The sector-wise employment trend in India (Table 2) indicates that between 2011-12 and 2017-18, the agricultural sector lost about 27 million jobs. Agriculture and

allied industries employ about 44 per cent of the workforce (2017-18), down from about 60 per cent in 1990-2000. About nine million people have gone unemployed from 2011-12 to 2017-18. This decline in jobs in the farm sector is not being compensated by the non – farm sector, particularly in the industrial sector, which has shown a declining trend from 2011-12 to 2017-18. (Mehrotra and Parida, 2019) have also reported this declining trend in the employment share of the agricultural and manufacturing sectors and have highlighted that the services sector is the only sector sustaining jobs (3 million per annum). However, the quality of jobs in this sector is primarily poor. Therefore, agriculture acquires a renewed importance for gainful employment, especially in the food processing industry. The study of Rangarajan, 1982) estimated that a one per cent increase in agricultural output tends to increase both the industrial output and national income by 0.5 per cent 0.7 per cent, respectively. The importance of agricultural growth on the non- farm industries have also been emphasised by (Johnston and Mellor, 1961; Kuznets, 1968). This is of no exception to India where the food processing industry holds 32 per cent of the food market and ranks fifth in terms of consumption, production, expected growth and export (USDA, 2018). According to an ASSOCHAM study (2017) by 2024, the Indian food processing sector can employ about nine million people (Thornton, 2017).

Therefore, despite a declining share of agriculture to GDP growth and employment generation, the sector remains critical to the Indian economy. The economic impact of agriculture has direct implications on the green growth policies of the country as the sector has further linkages to the non-farm sector. At present, the primary challenge is to identify ways to enhance agricultural productivity and sustain growth without letting food price inflation rise beyond acceptable limits. Moreover, the forward and backward linkages of the sector to different economic activities must be potentially identified, and efforts must be made to further develop the food processing industries. It will help create quality jobs and increase the country's export potential and economic growth.

TABLE 2: SECTOR-WISE EMPLOYMENT TREND IN INDIA

Year	Agriculture and allied sectors	Industry	Services	Others	Total (million)
(1)	(2)	(3)	(4)	(5)	(6)
1990-2000	237.67 (59.90)	44.05 (11.10)	94.20 (23.74)	20.84 (5.25)	396.76
2004-05	258.93 (56.60)	55.77 (12.19)	112.81 (24.66)	29.96 (6.55)	457.47
2009-10	243.21 (52.85)	48.54 (10.55)	112.33 (24.41)	56.10 (12.19)	460.18
2011-12	231.90 (48.89)	59.80 (12.61)	127.30 (26.84)	55.30 (11.66)	474.30
2017-18	205.30 (44.15)	56.40 (12.13)	144.40 (31.05)	58.90 (12.67)	465.00

Source: Author's calculations derived from NSS quinquennial rounds (2004-05 and 2011-12) and PLFS (2017-18) unit-level data.

Note: Figures in parentheses indicate percentages to the total in each category.

### *Social Challenges*

The Sustainable Development Goals (SDGs) - Agenda 2030 aims at a world with zero poverty, zero hunger, healthy, well-nourished individuals and reduced inequality. Since India is expected to globally have the highest population (nearly 1.4 billion people) by the year 2027, it is imperative to consider the imminent population pressure (four times higher than China) on the country's natural resources. Despite being the world's second-substantial agrarian economy, 27.42 per cent of the global and 42.13 per cent of Asian malnourished individuals dwells in India (Table 3). This dilemma between the increasing production and persistent undernourishment has also been highlighted by (Grebmer *et al.*, 2020). Globally, India abodes 24.39 per cent of undernourished people, 30.90 per cent of stunted children and 28.64 per cent of the anaemic women. Worst, about half of the world's wasted children (50.50 per cent) are from India. The fact that 55.74 and 72.86 per cent of the stunted and wasted children, respectively in Asia are from India raises a serious question to the country's sustainable development.

TABLE 3: STATUS OF MALNOURISHED INDIVIDUALS

Sr. No	Geographic entity	Under-nourishment in total population	Stunted children (below 5 years)	Wasted children (below 5 years)	Anaemic women (reproductive age between 15 to 49 years)	Total (millions)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	World	803.1	150.8	50.5	613.2	1617.6
2.	Asia	514.5	83.6	35	419.9	1053
3.	India	195.9	46.6	25.5	175.6	443.6
(i)	Percent to total population of world	24.39	30.90	50.50	28.64	27.42
(ii)	Per cent to total population of Asia	38.08	55.74	72.86	41.82	42.13

Source: FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018.

The extent of malnutrition (Table 4) highlights that even though India has made significant progress over the past few years, it still requires some major policy interventions towards nutritional security, especially in the case of anaemic women. About half of the women in India are anaemic and the proportion has remained almost stagnant from the year 2012 (51.3 per cent) to 2016 (51.4 per cent). Another major alarming issue before the country is that 38.4 per cent and 21 per cent of its children below five years of age are stunted and wasted, respectively. This proportion of malnourished children and women in India is even higher than Asia and Africa. (Krishna *et al.*, 2018; Mosites *et al.*, 2017; Smith and Haddad, 2015) outlined poor

feeding to infants, low dietary diversity and nutrition among children and poverty as the pre-eminent reasons for stunting in South Asia. Singh, 2019 has also acknowledged this issue and has stressed that a tall, vibrant and sustainable India cannot exist on nutritionally less secured individuals particularly the women and children.(Chand, 2019) has highlighted that India needs to shift its policy interventions from food to nutritional security and from shortage management to surplus management.

TABLE 4: EXTENT OF MALNUTRITION

Sr. No.	Geographi c entity	Under-nourishment in total population		Stunted children (under 5 years age)		Wasted children (under 5 years age)		Anaemic women (reproductive age between 15 to 49 years)		<i>(per cent)</i>
		2004-06 (1)	2015-17 (2)	2012 (3)	2017 (4)	2012 (5)	2017 (6)	2012 (7)	2016 (8)	
1.	Asia	17.1	11.5	27.1	23.2	9.7	33.5	36.6		
2.	Africa	21.3	19.6	32.6	30.3	7.1	37.7	37.7		
3.	India	22.2	14.8	47.9	38.4	21.0	51.3	51.4		

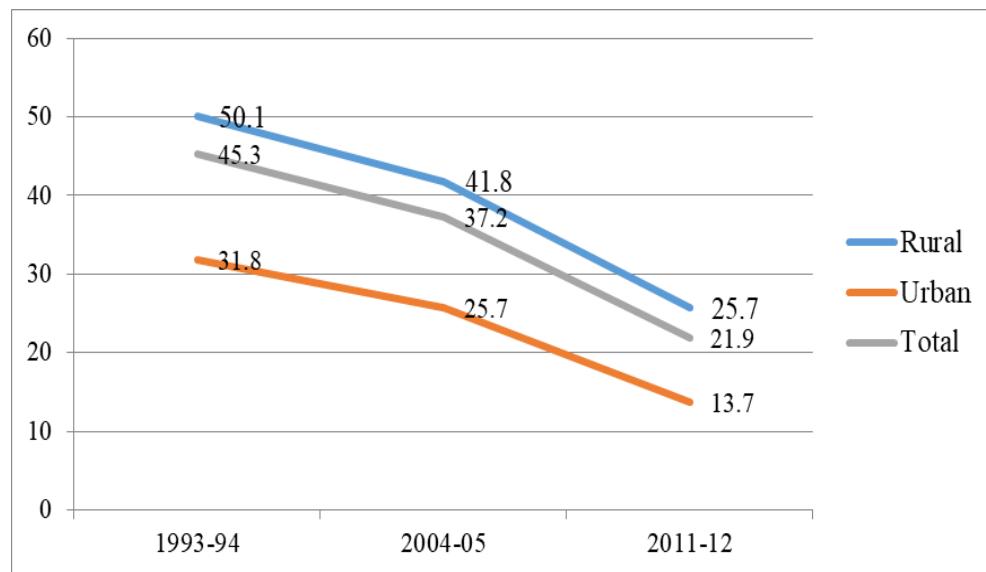
Source: FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018.

One of the most challenging factors that India has to overcome is the level of income inequality and poverty. Rural India accounts for about 72 percent of the country's workforce and 68.8 per cent of its overall population, respectively (Census of India, 2011). According to (UNDESA, 2012), India is expected to remain rural until 2050. While the trend of poverty in India (Figure 2) has declined over the years, 21.9 per cent of Indians are still poor, with 25.7 percent and 13.7 per cent of the impoverished residing in rural and urban areas, respectively. Therefore, the implications of rural development to eradicate poverty from the country are very crucial. (Chakravorty *et al.*, 2019) discovered very high income inequality in India's agricultural industry, with a Ginni Coefficient of 0.6, and stated that the country's small landholders are more prone to debt traps as their consumption spending is more than their incomes. Therefore, agriculture is imperative for the green growth of India, as its leverage effects on the entire economy can enable employment and income generation to the poor while confining the rural-urban income gap (Lopes, 2015; Musvoto *et al.*, 2018). (Djurfeldt, 2013; de Janvry and Sadoulet, 2009; Kumar *et al.*, 2011; Loayza and Raddatz, 2010; Roy and Pal, 2002) have also identified agriculture as the preeminent instrument in alleviating poverty, particularly from the developing countries.

#### *Environmental Challenges*

The three primary focus areas for a sustainable and green environment must be quality air and optimum use of its existing water and land resources. According to

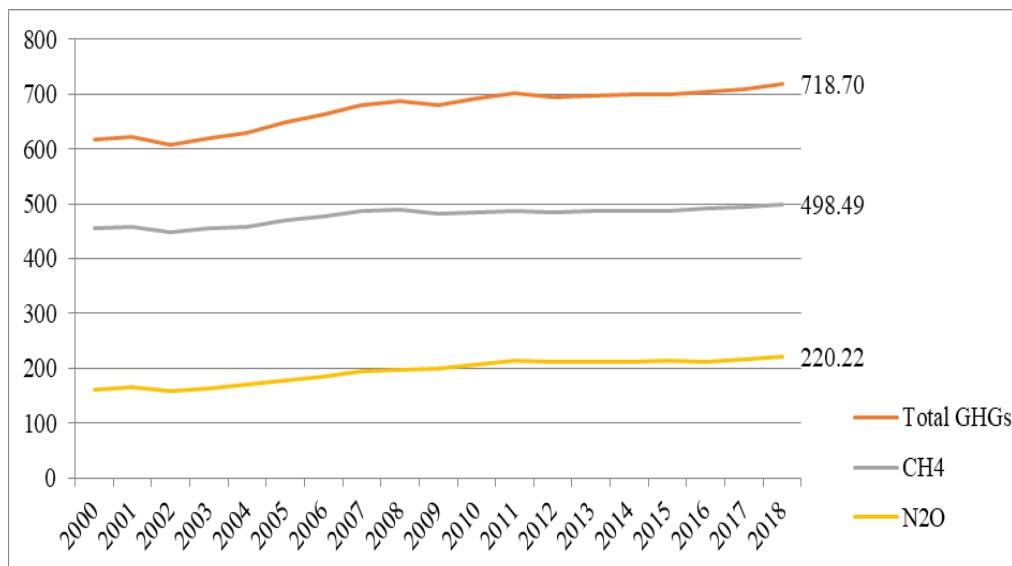
(WRI CAIT, 2017) the global GHGs emissions from the agricultural sector is highest in India (718.70 MtCO<sub>2</sub>e), followed by China (672.87 MtCO<sub>2</sub>e). Within the country,



Source: Expert Group Report, Planning Commission (2014) Planning; NSO, Ministry of Statistics and Programme Implementation.

Figure 2: Poverty Trend in India ( per cent of poor)

the energy sector makes up 2.42 GtCO<sub>2</sub>e (72.24 per cent) of the GHGs, followed by agriculture (21.45 per cent). Figure 3 represents that out of the total GHG emissions by the agricultural sector in the country, 69.36 per cent is due to CH<sub>4</sub> gas and the remaining 30.64 per cent comes from N<sub>2</sub>O. According to (FAO, 2018), the major reasons for methane (CH<sub>4</sub>) gas emissions are enteric fermentation (69.75 per cent), rice cultivation (23.56 per cent), manure management (5.99 per cent), burning of crop residues (0.66 per cent) and burning of savanna (0.04 per cent). Whereas N<sub>2</sub>O is emitted by the synthetic fertilizers (49.67 per cent), manure left on pasture (29.22 per cent), crop residues (11.57 per cent), manures applied to soil (6.84 per cent), manure management (1.79 per cent), burning of crop residues (0.46 per cent), cultivation of organic soils (0.33 per cent) and burning of savanna (0.12 per cent). However, the substantial periodic and yearly fluctuations make it nearly impossible to establish an exact judgement (FAO, 2001). (Preety *et al.*, 2001) found that the less obvious consequences of air pollution had larger economic costs than the evident effects.



Source: World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), 2018

Figure 3: Trends in GHG Emissions by Agricultural Sector in India (MtCO<sub>2</sub>e)

Another key concern before India is ensuring optimal access to clean water for its growing population, livestock and agrarian needs. Agriculture is at the heart of the problem in this situation as well, and it will require significant transformations in the future. The groundwater depletion, salinization, waterlogging, and water pollution from pesticides, fertilisers, and livestock waste have all posed a growing concern to the country's water availability and quality. The country is accountable for sustaining water supply to over 18 per cent of the world's population from merely four per cent of the global freshwater sources (Central Water Commission, 2014). The agricultural sector utilizes about 80-90 per cent of total water in the country (Chand, 2019; Harsha, 2017) and groundwater irrigation covers more than half of its total irrigated area (Oza, 2007). However, more than 50 per cent area under cultivation is still without irrigation. About 90 per cent of the crops grown in the country (wheat, rice and sugarcane) are one of the most water consuming (Dhawan, 2017) and due to the prevalence of flood irrigation practices, the water use efficiency in the country is only around 30-35 per cent. (Amarasinghe *et al.*, 2007), have also reported very low efficiency (25-40 per cent) of the flood irrigation system.

Further India is projected to face a decline in the per capita availability of utilizable water resources by about 78 per cent by 2050, i.e., from 5247 m<sup>3</sup> in 1951 to 1170 m<sup>3</sup> by 2050 (Central Water Commission of India, 2015). Therefore, agriculture is of key importance in the efficient utilization of country's water resources with the efficient adoption of various supply side (watershed development, development of drainage system, etc.) and demand side (optimal crop plan, enhancement of water use efficiency, etc.) water management practices (Jain *et al.*, 2019). (Chand, 2019;

Chandrakanth *et al.*, 2013; Kumar and Palanisami, 2010) have further emphasised on the adoption of micro- irrigation on account of its more efficient water utilisation capacity, better yield and more net returns per unit volume of groundwater than the traditional irrigation practices. Increased plant water absorption capacity and availability, according to (Rockström and Barron, 2007), can maximise water usage particularly in rainfed conditions. However, policy interventions aimed at improving moisture retention and plant development must be in tandem with the soil management strategies (Bhattacharyya *et al.*, 2015; Rockström *et al.*, 2004).

Considering the fact that agriculture occupies almost half of the land in India, its implications on the preservation of biosphere and ecosystem, protection of habitat and landscapes, nutritional security, optimum use of land resources, quality of food, water and land and other socio- economic factors of farmers are of immense importance. Although the sector's contribution to India's GHG emission is increasing over the years, its potential to offset emissions from other sectors is of colossal importance. (Chand, 2019) has stated that the sector is having immense potential and is the best hope in the environmentally sustainable green growth

#### IV

#### CONCLUSION

The green economy aspires to promote economic growth while assuring social fairness, creating green employment, reducing poverty, improving resource usage efficiency, respecting ecological boundaries and scarcities, and safeguarding biodiversity and ecosystems. There is a need to re-think the growth strategies based on their impact on environmental sustainability and availability of resources, particularly to poor and vulnerable groups. The agricultural sector in India is critical for attaining the green economy's goals since it employs more than one-third of the world's small-scale farmers, who account for the great majority of the nation's famished, malnourished, and destitute. Agriculture is essential for securing the country's food security and nutrition in consonance with the agro-ecological backdrop. Considering the future demands of food and raw materials and the substantial contribution of agricultural sector in the country, the major challenge before us is to identify ways to enhance productivity while keeping the food price inflation within limits. Agricultural growth should not just focus on increasing output, but also on addressing associated economic, environmental and social concerns. The environmental pressures due to agricultural growth will tend to rise more in future and these should be addressed by technological change, policy reforms and suitable institutional responses. The future requires transformation rather than sustaining the agricultural sector with an emphasis towards achieving efficiency rather than growth, employment generation, nutritional security, management of surplus food and its equitable distribution. Furthermore, the use of climate-smart agricultural techniques such as precision agriculture and watershed management, as well as dynamic

agronomic practises such as diversification, integrated farming systems, and organic farming, will help the country transition to a green economy in tandem with sustainable agricultural growth.

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