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PROMOTING SUSTAINABILITY IN INDIAN AGRICULTURE

Focus Areas for Responsible Growth





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Message



It's a pivotal time for agriculture. A time to advance transformational change against the backdrop of global issues. The Global food demand continues to grow. The United Nations predicts the world's population will increase by 2 billion, up to 9.7 billion, by 2050. As our population increases, and industrial and economic development advance, the need for food will expand and change, driving pressures to convert more land and habitats to farmland to meet growing demand. Farmers have more threats to their crops. Changes in our climate have shifted weed, insect and disease pressures and increased extreme weather events. The society expects more from agriculture. The 2021 Global Food Security Index, by Economist Impact, reported that agricultural productivity in more than half of the world's countries has been negatively impacted by changing rainfall patterns and excessive temperature swings. The future of food production hinges on getting new, sustainable, and productive tools and technologies into the hands of farmers—technology that meets these needs while minimizing negative trade-offs. With the right focus, the right actions and people passionately committed to helping farmers and the planet, I am confident we can move towards a more sustainable form of agriculture.

I congratulate FICCI and YES BANK team for taking the lead and preparing this knowledge paper which will certainly help stakeholders transform their ideas into actions.

Vedika Kapoor
Head of Government & Industry Affairs – South Asia
Corteva Agriscience India Pvt. Ltd.

Message



Agriculture is rightly considered a pillar of Indian economy as more than 50% of its population is dependent on agriculture as the main source of revenue. In an agrarian country such as India, agriculture plays a pivotal role in actualizing the sustainable development agenda. Agriculture worldwide is undergoing accelerated transformation, driven by continued growth in population, shifting consumption patterns and the impact of environmental changes.

Perhaps, the Green Revolution remains the most significant period of Indian agriculture in the last century. An input-intensive and technology-focused approach helped India avert potential famines and meet its food security needs by reducing food imports. While the Green Revolution ensured India's self-sufficiency for food, its long-term impacts are now visibly evident. Be it degrading topsoil, declining groundwater levels, contaminating water bodies, and reducing biodiversity. It is evident that input-intensive agriculture is both a contributor and a victim of climate change.

The Indian Agriculture has changed in its dimensions after globalization and needed structural changes and reforms to meet these emerging challenges. Each of the challenges need new interventions, new outlook, new approaches, new knowledge, new technology and trained human resources to ensure local viability and global competitiveness of Indian agriculture. New agriculture must be globally competitive and locally viable.

Farming demands resilience not only to lift productivity but also to ensure overall sustainability of the agriculture sector. Today this movement for sustainable agriculture is garnering increasing support and acceptance within mainstream agriculture. Not only does sustainable agriculture address many environmental and social concerns, but it offers innovative and economically viable opportunities for growers, laborers, consumers, policymakers and many others in the entire food system.

Taking due cognizance of rapidly changing multiple factors, Sustainable agriculture production, with holistic principles, holds the key to finding an answer to these challenges. Sustainable growth and development of agriculture – that focuses on balancing the requirements of people, planet and nature - is no longer an option. It is an imperative.

FICCI's 2nd edition of Sustainability Agriculture Summit 2022 would help in understanding the agricultural innovations to enhance food security and productivity in a sustainable manner. FICCI along with YES BANK is pleased to release this knowledge report on occasion of 2nd edition of Sustainability Agriculture Summit 2022.

Mr. TR Kesavan
Chairman, FICCI National Agriculture Committee &
Group President, TAFE Ltd.

Foreword



The rapidly burgeoning multi-dimensional crisis of climate change, food, energy and water insecurity and raising social inequality has disrupted our business-as-usual approach, forcing us to redefine the paradigms of a 21st century economy. Prioritizing sustainability, that focuses on addressing social and environmental concerns while striving for economic advancement, has become a key imperative for responsible growth across all sectors of the economy.

The agriculture sector plays a pivotal role in actualizing India's sustainable development agenda. While this sector continues to satisfy the food and fiber needs of a growing Indian population, it is also the largest user of natural resources in the country. It is estimated that agriculture accounts for more than 80% of India's total water usage and about 60% of land use. The drive to achieve increased agriculture production to meet the country's food security needs has come at a high ecological cost. Poor natural resource management, injudicious use of agricultural inputs and vulnerability to climate change events has caused significant soil degradation, excessive groundwater extraction and high economic risk to farmers. While these new multidimensional challenges are hindering growth in production on one hand, growing population coupled with rapid growth in income levels is resulting in significant increase in demand for high quality agricultural produce on the other. Overcoming these complex challenges calls for collaborative multi-stakeholder action that emphasizes on driving transformative agricultural growth aligned to the sustainable development agenda.

Government of India has taken numerous proactive steps to promote sustainable agriculture and combat climate change. Initiatives such as the National Mission for Sustainable Agriculture, 'Per Drop More Crop' component of Pradhan Mantri Krishi Sinchayee Yojana and the National Innovations in Climate Resilient Agriculture program clearly reflect the keen interest of the government to secure and build sustainability across the agricultural supply chain.

While the Indian government is championing the cause of sustainable agriculture, there is a need for unprecedented efforts from the private sector to complement these efforts. It is critical for business leaders to review their product portfolio and business processes through the prism of sustainability and implement specific interventions across their supply chain that improve the economic viability of farms, promote efficient use of natural resources, combat climate change and popularize sustainable consumption.

YES BANK strongly believes that "Environmental, Social and Governance" performance is not just as important as financial performance but is also closely interlinked with it. YES BANK was the first bank in India to voluntarily publish a standalone Sustainability Report aligned to GRI standards in FY2012-13, at a time when the thrust on sustainability reporting was still at its nascency. The Bank has developed an internal Sustainable Finance Taxonomy for defining green and social activities and driving financing to sustainability-aligned sectors and initiatives. YES BANK is committed to work with various stakeholders not only to build knowledge, frameworks and methodologies required to mainstream "sustainability thinking" but also to learn, imbibe and share best practices that could be collaboratively implemented on ground in this regard.

As knowledge partners to FICCI's "Sustainable Agriculture Summit and Awards 2022", YES BANK is pleased to develop and release this FICCI-YES BANK knowledge report on "Promoting Sustainability in Indian Agriculture: Focus Areas for Responsible Growth". This report highlights the critical role that agriculture plays in achieving Sustainable Development Goals, identifies key initiatives that could be focused on by the private sector while developing a sustainability action framework and suggests select enabling policy actions that could accelerate multi-stakeholder contribution to responsible growth in the Indian agriculture sector.

I sincerely hope that this knowledge report will further contribute to the commendable efforts being taken up by various stakeholders in shaping strategic interventions that are instrumental in bringing long term sustainability to the agricultural ecosystem of India.

Prashant Kumar
Managing Director & CEO
YES BANK Ltd.

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Executive Summary

Indian agriculture has witnessed remarkable growth in production over the last seven decades. This transformative growth, which was achieved primarily on account of major improvements in agricultural productivity, has catapulted the country from being a food deficit nation and a net importer of food grains at the time of independence to a global leader in production of a number of agricultural commodities today. However, productivity advancement has been accomplished with significantly high ecological costs. Excessive monoculture of water guzzling crops, poor management of natural resources and injudicious use of agricultural inputs has caused significant soil degradation, excessive groundwater extraction and high economic risk to farmers. Compounding these challenges, is the vulnerability of agriculture to climate change related weather-events such as extreme temperatures, floods, droughts and vagaries of monsoon - which are becoming frequent, intense and almost regular in some regions of the country.

Highlighting the imminent need for sustainability focused initiatives that could overcome these multi-dimensional challenges and enhance responsible growth in the Indian agriculture sector, chapter one of this report delves into the role of agriculture in attaining the Sustainable Development Goals (SDGs); lists out various government efforts to promote sustainability and highlights the scope for agribusiness companies to utilize the "SDG lens" for development of their "Sustainability Action Framework".

In an agrarian country such as India, where more than 50% of the total workforce is engaged in agriculture and allied sector activities, agriculture plays a pivotal role in actualizing the sustainable development agenda. While the agriculture sector continues to satisfy the food, fiber and multiple other



demands of a growing population, it is also the largest user of natural resources in our country. It is estimated that agriculture accounts for more than 80% of India's total water usage and about 60% of land use[1]. Moreover, agriculture contributes to about 14% of India's total GHG emission[2]. Consequently, sustainability focused interventions in the agriculture sector have a direct or indirect impact on all the 17 SDGs albeit in varying degrees. An overview of the relevance and role that various interventions could play in achieving specific sustainable development goals have been listed out in the report.

India is strongly committed to achieving SDG targets by 2030. The Indian Government is targeting sustainable development while combating poverty, ushering economic growth and improving the ecosystem. The Government has independently committed to drop emissions intensity per unit of GDP by nearly 33% to 35% (with respect to its 2005 levels) by 2030. Currently there are several policy initiatives and development schemes formulated by the Government of India to help realize the sustainability vision in the agriculture sector. About 50 such government initiatives have been listed out and mapped to specific SDGs that they impact. With specific reference to climate action, the Government of India, along with state governments, has taken numerous proactive steps to combat climate change and to promote sustainable agriculture. For instance, the National Mission for Sustainable Agriculture (NMSA) focuses on sustainable development of agriculture through use of improved crop seeds, water use efficiency, integrated pest management, credit support and improved access to markets. Within NMSA, Rainfed Area Development is a component focusing on Integrated Farming System (IFS) which promotes supplementary farm-based livelihood activities so as to provide greater resilience & sustenance to farmer in the wake of extreme climatic events. Other key government initiatives include the 'Per Drop More Crop' component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY- PDMC) which focuses on enhancing water use efficiency and 'National Innovations in Climate Resilient Agriculture' (NICRA) anchored by the Indian Council of Agricultural Research (ICAR) that focuses on developing climate resilient technologies through short term and long term research and farm level demonstrations so as to enhance climate resilience across vulnerable areas of the country.

Many far-sighted agribusiness companies have already embraced sustainability as a core value and are focusing on the triple bottom line of people-planet-profit to compliment Indian Government's efforts to deliver on a wider range of sustainable development goals across the agriculture value chain. Many more agri-businesses, big and small, need to create value beyond profits, by contributing to sustainable solutions that drive responsible growth in agriculture, benefit agrarian communities and preserve our planet. The Sustainable Development Goals (SDGs) promulgated by the United Nations form a very powerful lens that could guide private companies assess materiality of relevant social and environmental issues impacting sustainability across their value chains. A report by FAO identifies five principles and 20 interconnected actions that could guide decision-makers take actions to "transform Food & Agriculture to achieve SDG goals"[3]. Agribusinesses could utilize the "SDG lens" to identify actions that they are already taking as part of their current business operations or that they need to take going forward for positively impacting sustainable agriculture development.

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[1] Paper by India on National Dialogue Action Track 4: Advance Equitable Livelihoods, United Nations Food Systems Summit 2021

[2] Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC).

[3] FAO report titled "Transforming Food & Agriculture to achieve the SDGs – 20 interconnected actions to guide decision makers", 2018.

Chapter two attempts to use the "sustainability lens" to identify focus areas and interventions in the agriculture sector towards which multiple stakeholders could contribute to achieve responsible growth. Organizations examining agriculture sector through the sustainability lens are presented with a diverse basket of complex issues that compete for prioritization. Sustainability issues that could be addressed across the agriculture value chain range from maximizing yields and farmer income, minimizing natural resource depletion, reducing post-harvest loss, bolstering food security and job creation. It is critical for decision makers to review their products and business processes to identify specific focus areas that have a direct impact on the four pillars of sustainable agriculture namely – sustaining the economic viability of farms; making the most efficient use of natural resources; protecting the quality of environment and, sustainably meeting demand of consumers. Based on this hypothesis, this report postulates that Sustainability initiatives in the agriculture sector can be viewed from four key lenses namely farm productivity and farmer income, natural resource management, climate adaption and sustainable consumption. Fourteen specific focus areas have been identified, which if implemented, would directly contribute to one or more of these four sustainability lenses. A snapshot of the fourteen focus areas is captured in the table below.

Sustainability lenses	Key focus areas for intervention
Farm productivity and farmer income 	• Sustainably improving farm productivity • Promoting farmer collectives to improve economies of scale • Improving post-harvest efficiencies • Unlocking digital technologies to improve farmers' access to inputs and markets • Capacity building and skill development of farmers
Natural Resource Management 	• Soil conservation • Water conservation • Tapping renewable sources of energy • Promoting sustainable farming practices & systems • Biodiversity conservation
Climate adaptation 	• Building climate resilience • Carbon sequestration
Loss reduction and sustainable consumption 	• Loss reduction across the supply chain • Promoting sustainable consumption

Sustainability initiatives across these key focus areas have the potential to greatly accelerate the transition to responsible agriculture growth. However, adoption and implementation of such initiatives would require well targeted, collaborative, coordinated and coherent actions initiated simultaneously across multiple likeminded stakeholders. The third and concluding chapter of this report suggests select enabling policy actions that could accelerate multi-stakeholder contribution and strongly augment implementation of sustainability focused initiatives that boost responsible growth in agricultural production. These suggestions are broadly bucketed into two overarching areas of action namely:

- Support technologies and innovations that align with sustainable development goals
- Incentivize shift towards environmentally sustainable agricultural processes and practices

Realizing sustainable growth in agriculture would require profound commitment and significant collaborative efforts by multiple stakeholders. The Indian government is strongly committed to achieving the sustainability agenda and has rolled out several initiatives, policies and programs directed towards achievement of Sustainable Development Goals through agriculture. The private sector can also play a pivotal role in adopting and promoting environment friendly practices themselves as well as enlisting, educating and motivating farmers and all their supply chain stakeholders to embrace sustainability initiatives. With such committed efforts of all stakeholders and considering India's strength in terms of capacity and diversity of agricultural produce, the aspiration of achieving transformative agricultural growth while meeting Sustainable Development Goal targets is within our Country's reach.

1. Introduction

Sustainable agriculture - need of the hour

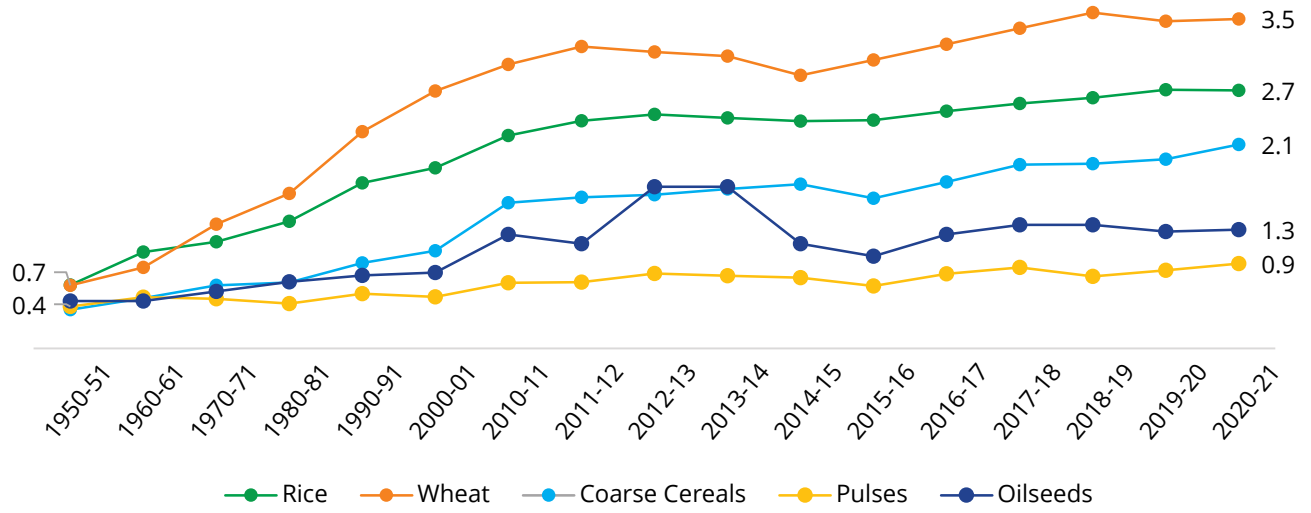
Over the decades since independence, Indian agriculture has seen transformative growth. Productivity of foodgrains has increased from 0.5 MT/Ha in 1950-51 to 2.4 MT/Ha in 2020-21. The per capita availability of food grains has increased from 144.1 kg per annum in 1950-51 to feed a population 0.36 Billion, to 187.1 kg per annum to feed a population of 1.34 Bn in 2019-20. This growth in productivity has been driven by better farmers' access to and use of various factors of production. For instance, domestic fertilizer consumption per hectare (in terms of Nitrogen, Phosphorus and Potassium) has increased from 2.17 kg per hectare in 1961-62 to 137.15 kg per hectare in 2020-21.[4]



[4] *https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%20-%202021%20(English%20version).pdf*

While productivity improvement did drive agricultural production in the recent past, its positive effects have started tapering off as the aftereffects of poor management of natural resources and injudicious use of agri-inputs are play out in the form of inefficient crop production (refer exhibit 1).

Exhibit 1: Trend in Productivity of Food Grains (MT/ha) from 1950-51 to 2020-21



Source: RBI, Ministry of Agriculture & Farmers Welfare, Government of India

Compounding these challenges, is the vulnerability of agriculture to climate change related weather-events such as floods, draughts and natural hazards- which are becoming frequent, intense and almost regular in some regions of the country. According to International Panel on Climate Change report, the predicted temperature rise for India is in the range of 0.88–3.16°C by 2050 and 1.56–5.44°C by the year 2080. Studies show significant negative impacts of climate change, predicting yield reduction by 4.5% to 9.0%, depending on the magnitude and distribution of warming.[5] An IARI study suggests that for every one-degree change in temperature, wheat production loss will average at 4-5 Mn MT. Depending on the modeling technique, it has been estimated that rice yields can be impacted by up to 40% while for wheat it could be up to 52%[6].

While production and supply of food faces multidimensional challenges that hinder growth, the demand side is asking for more from Agriculture. Indian agriculture needs to feed about 300 million more people by 2050. Rapid growth in the Indian economy is expected to increase incomes and expand the middle class significantly. This financially empowered middleclass will demand higher quantity and quality of food, including more protein.

Clearly, sustainable growth and development of agriculture – that focuses on balancing the requirements of people, planet and nature - is no longer an option. It is an imperative.

[5] *Intergovernmental Panel on Climate Change Report (IPCC), 4th Assessment report*

[6] *Climate Change and Indian Agriculture: Impact, Adaptation and Vulnerability – Salient Achievements from ICAR Network Project, 2012, Eds. S. Naresh Kumar, Anil Kumar Singh, P.K. Aggarwal, V.U.M. Rao and B. Venkateswarlu. IARI Publication*

Exhibit 2: Need for Sustainable Agriculture in India

Why sustainability is no longer an option

Increasing population



India's population is expected to reach 1.6 Bn by 2050.

Thus to ensure food security there is a need for higher levels of productivity

Shifting dietary pattern



In 2050, the projected consumption of poultry meat in India will be 2.3 times higher and that of other livestock products will be 1.4-1.8 times higher than current levels. Milk demand is also projected at 401 Mn MT in 2050

Increase in urbanization



The level of urbanization in India is likely to increase from the present 31% to nearly 52% by 2050

Declining productivity



Projections show yields of India's crops falling by 1.8- 6.6% by mid-century (2041–60) and by 7.2-23.6% by end-century (2061–80) under a middle of the road scenario for climate change.

Increasing farm land fragmentation



The prevailing conditions of fragmented land holdings are expected to worsen in the upcoming years.

The average land holding is expected to drop to 0.30 ha by 2050 in India

Declining water resources



Nearly 80% of water in India goes to agriculture, primarily from groundwater sources.

By 2050, agriculture will require 1072 BCM of water. Quantity demanded is expected to increase by 1.6 times

Degrading soil



The extent of degraded land in India is >105 Mn ha, nearly 32% of India's areas

As per estimates, 5.3 Bn MT of soil is degraded each year due to incorrect fertilization in India

Rising Temperature



Avg temp increase by 2.4°C to 4.4°C by 2100

Heatwaves to increase by 3x-4x by 2100

Increased frequency of dry spells leading to droughts

GHG emissions



India's GHG emissions are projected to have crossed 3.0 Bn MT in 2020 and are estimated to reach 3.7 Bn MT by 2030.

The agriculture sector contributes 14% of the total emissions.

Source: Global Food Policy Report, 2022; https://population.un.org/wpp/Publications/; Vision 2050- ICAR-Central Institute of Agricultural Engineering, https://m.rbi.org.in/Scripts/BS_ViewBulletin.aspx?Id=21004, YES BANK Analysis

To drive agricultural growth in a sustainable manner, there is a need to balance socio-economic imperatives with that of ecological and environmental preservation. A long-term vision and strategy needs to be framed for achieving sustainability throughout the agricultural value chain. This strategy needs to be oriented such that various participants and beneficiaries across the agri value chain contribute towards achieving a common goal of inculcating socio-environmentally sustainable actions into all their economic activities – to secure future sustenance and growth.

Framework for sustainable development

The Agenda 2030 for sustainable development adopted by UN forms the most apt and accepted framework that could be utilized for identifying the right initiatives (by any stakeholder) that contributes directly to the sustainable development goals. UN member nations came together in 2015 to adopt the

2030 Agenda for sustainable development. This agenda focuses on ending poverty, improving health & education, reducing inequality, achieving economic growth, tackling climate change and working towards preserving oceans and forests. It identifies 17 Sustainable Development Goals (SDGs) which could serve as a guidance for all stakeholders to align their sustainable initiatives with a common vision (exhibit 3). SDGs aim in being universal, holistic and quantifiable – focused on balancing environmental, social & economic development. UN Statistical Commission has promulgated a global indicator framework comprising 169 targets and 231 indicators for measuring the progress in achieving these SDGs.

Exhibit 3: Sustainable development goals



Source: sdgs.un.org

Role of agriculture in attaining sustainable development goals (SDGs)

In an agrarian country such as India, where more than 50% of the total workforce is engaged in agriculture and allied sector activities, agriculture plays a pivotal role in actualizing the sustainable development agenda. Agriculture sector is the largest user of natural resources in our country. It is estimated that agriculture contributes 80% of India's total water usage and about 60% of land area in the country is under agriculture[7].

Consequently, initiatives and interventions in the agriculture sector have a direct or indirect impact on all the 17 SDGs albeit at varying degrees. While agriculture is the main focus for SDG 2, which aims to "End Hunger, achieve food security and improve nutrition and promote sustainable agriculture", sustainability initiatives in agriculture and it's allied sectors have direct implications on at least 10

[7] *Paper by India on National Dialogue Action Track 4: Advance Equitable Livelihoods, United Nations Food Systems Summit 2021*

more sustainable development goals including - SDG1 (No Poverty), SDG 4 (Quality education), SDG 5 (Gender Equality), SDG 6 (Clean Water & Sanitation), SDG 7 (Affordable 7 Clean Energy), SDG 8 (Decent work & Economic Growth), SDG 12 (Responsible Consumption & Production), SDG 13 (Climate Action), SDG 14 (Life Below Water) and SDG-15 (Life on Land). An overview of the relevance and role that initiatives in agriculture could play in achieving these select sustainable development goals is captured in exhibit 4 herewith.

Exhibit 4: Role of Agriculture in achieving select SDGs

 **End Poverty in all it's forms everywhere**	• Given that about 50% of Indian population is dependent on agriculture, eradicating or reducing poverty is directly related to increasing incomes and returns for farmers in specific and for stakeholders across the agricultural value chain in general • It is estimated that growth in the agriculture is atleast twice as effective as growth in other sectors in reducing poverty. • Interventions across the agriculture value chain can contribute to decreasing poverty primarily by increasing incomes, creating employment opportunities and mobilising economic activities (including agriculture dependent non-agricultural activities) in rural communities.
 **End hunger, achieve food security and improved nutrition and promote sustainable agriculture**	• This SDG is the most relevant and directly related to Agriculture • As per the National Family Health Survey-4, around 22% of India's adult population (15 – 49 years) is undernourished and more than 58% of Indian children (up to 5 years) are anemic. • Interventions that address the following objectives have a direct impact on achieving this SDG: – Envisage increase of agricultural productivity and income of small farmers through secured access to land, inputs,knowledge, financial services, markets and opportunities for value addition – Maintain and manage the genetic diversity of seeds, cultivated plants and farmed and domesticated animals – Increase in investment in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity – Measures to ensure proper functioning of agri-commodity markets in order to avert extreme food price volatility – Initiatives that prevent trade restrictions and distortions in global agricultural markets



Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

- Indian farming community is dominated by small holder farmers, and there are more than 40 critical farming activities that need attention and informed decision making to ensure good yield and RoI.
- Knowledge regarding newer sustainable practices need to be disemminated to farmers to generate sustainable profits
- Initiatives such as agricultural extension, farm advisory and knowledge transfer and training programs that are extended to farmers and stakeholders across the agriculture value chain promote lifelong learning opportunities, substantially increase the number of youth and adults who have relevant skills for employment and spur entrepreneurship (for instance the village level agri-entrepreneurs extending various services to farmers and capacity building of FPOs among others).



Achieve gender equality and empower all women and girls

- In rural communities, agriculture and allied sector is the primary source of livelihood that includes 80% of all economically active women, out of which 33% constitute agricultural labour force and 48% are self-employed farmers.
- Initiatives and reforms that specifically give women farmers and women workforce across the agri value chain equal rights to economic resources, financial services, access to ownership and control over land and other forms of property, inheritance and natural resource auger well for achievement of this SDG.



Ensure availability and sustainable management of water and sanitation for all

- India has 4% of global freshwater resources & supports 19% of the world's population. Nearly 80% of water in India goes to agriculture, primarily from groundwater sources.
- Initiatives that increase water use efficiency, increasing agricultural water productivity (more crop for drop), ensure sustainable withdrawal of groundwater, facilitate in integrated water resource management and protect or restore related ecosystems have a direct impact on ensuring availability and sustainable management of water resources.

 **Ensure access to affordable, reliable, sustainable and modern energy for all**	• The agricultural sector constitutes nearly 18.5% of India's total energy consumption. Consumption is expected to rise by nearly 54% between 2015 and 2022[8]. • Providing access to affordable and reliable energy for activities across the agriculture value chain could significantly increase farm productivity, reduce cost of cold storage, lower cost of processing and value adddition and reduce post harvest loss • Improving access to sustainable and modern energy – such as solar energy will reduce dependence on fossil fuel • There is an increased demand from agriculture for production of bio-fuel.
 **Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all**	• Agriculture and allied sector continue to serve as the principal source of employment and source of livelihood for about 50% of the country's population. While the contribution of agriculture to national GDP has come down from about 52.3% in 1950-51 to about 20.2% in 2020-21, the gross value added (nominal at base price) has increased from about INR 100 billion in 1950-51 to about INR 37.8 trillion in 2021[9]. • Initiatives that facilitate achieving higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added products will contribute directly to this SDG • May be supported by development-oriented initiatives that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
 **Ensure sustainable consumption and production patterns**	• India generates about 350 Mn MT of agricultural waste every year.[10] • FAO estimates >40% of food produced is wasted in India, and its costs could be as high as USD 14 Bn. • Initiatives that reduce food waste across the agriculture value chain – including at production, post harvest handling, retailer and consumer level contribute to achieving this SDG. • Initiatives that promote sustainable management and efficient use of natural resources and promote sustainable agricultural production patterns also contribute to this SDG

[8] *Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC)*

[9] *National Statistics Office (NSO), DAC&FW*

[10] *https://icar.org.in/sites/default/files/Creating-Wealth-From-Agricultural-Waste.pdf*

 **Take urgent action to combat climate change and its impact**	• Indian agriculture is highly vulnerable to climate change. According to Economic Survey, 2018, India faces annual loss of US$ 9-10 billion due to the adverse effects of climate change - with small and marginal farmers being the most affected segment. • This SDG encompasses all initiatives that strengthen resilience and and adaptive capacity of agriculture to the impact of climate change • Emperical evidence indicates that agriculture sector contributes to 14% of total GHG emissions of India. A key focus area could be to lower agricultural greenhouse gas emmission without affecting food production
 **Conserve and sustainably use the oceans, seas and marine resources for sustainable development**	• India has a coastline of 8118 KM and an EEZ of 2.02 million Sq. Km Indian fisheries sector is one of the fastest growing agriculture allied sector. It provides livelihood to more than 2.8 crore fishers, fish farmers, fish workers and vendors at the primary level[11]. • It is critical to sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration. This includes effectively regulating harvest, implementing science based management inorder to restore fish stock in shortest time possible so as to facilitate maximum sustainable yield and also provide access for small scale artisanal fishers to marine resources and markets.
 **Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**	• Though this SDG primarily focuses on sustainable forest management, a key component is to halt and reverse land and soil degradation - including land affected by desertification, drought and floods. • Agricultural activity is one of the key contributors to land and soil degradation due to the indiscriminate use of chemical farm-inputs as well as over-extraction of groundwater that is leading to desertifiction. • In addition to promoting agroforestry & biodiversity, initiatives that conserve soil and optimise the use of agro-chemicals could contribute to achieving this SDG.

Source: UN, FAO, YES BANK Analysis

[11] *https://pib.gov.in/PressReleasePage.aspx?PRID=1861435*

Government efforts to promote sustainable agriculture

India is strongly committed to achieving the SDG targets by 2030. The country has independently committed to drop emissions intensity per unit of GDP by nearly 33% to 35% (with respect to its 2005 levels) by 2030. Further, the country has also planned to create an additional carbon sink of 2.5-3 billion tonnes by increasing tree cover[12]. On a global scale India has played a key role in framing of the SDGs while on an internal level the Government is making multiple efforts focused on collective and inclusive development. The Indian Government is targeting sustainable development while combating poverty, ushering economic growth and improving the ecosystem. For example, the government has run the world's largest financial inclusion programme, namely the Pradhan Mantri Jan Dhan Yojana (PMJDY) with the objective of ensuring access to various financial services to the weaker sections and low-income groups of the country. With the recently launched 'Lifestyle for Environment initiative' during the UNFCCC COP26 (2021) India seeks to promote an environmentally conscious lifestyle that focuses on 'mindful and deliberate utilization' instead of 'mindless and wasteful consumption. Such initiatives are clear testaments to India's commitment to sustainable and responsible growth and development.

Agriculture serves as an important focal point for achieving sustainability development as it can sustainably secure food supply, transform the socio-economic landscape of the country and enhance resource-use efficiency. Currently there are several policy initiatives and developmental schemes formulated by the Government of India to help realize the sustainability vision in the agriculture sector. An indicative list of various such initiatives and SDGs that they intend to impact is captured in exhibit 5 below.

Exhibit 5: Indicative list of Central Government Schemes and Initiatives that have a bearing on various SDGs

SDGs	Key Schemes
	• National Rural Livelihood Mission (NRLM) • National Land Record Management Programme (NLRMP) • Pradhan Mantri Fasal Bima Yojana (PMFBY)
	• National Food Security Mission (NFSM) • Mission for Integrated Development of Horticulture (MIDH) • National Mission on Sustainable Agriculture (NMSA) • National Oilseed and Oil Palm Mission (NOPM) • Rashtriya Krishi Vikas Yojana (RKVY) • Livestock Health and Disease Control • National Programme for Bovine Breeding and Dairy Development • Animal Husbandry Infrastructure Development Fund • Agri-Infrastructure Fund • Pradhan Mantri Kisan SAMPADA Yojana

[12] *https://www.niti.gov.in/writereaddata/files/India%20VNR_Final.pdf*

SDGs	Key Schemes
	• National Mission on Agriculture Extension and Technology • Agricultural Technology Management Agency (ATMA) scheme
	• Support to Training and Employment Programme for Women (STEP) 2014
	• National Rural Drinking water Programme • Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) • National River Conservation Programme (NRCP) • Namami Gange - Integrated Ganga Conservation Mission • Inter-linking of rivers
	• National Solar Mission • India Energy Policy
	• Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) • PM Formulation of Micro Food Processing Enterprises Scheme • Production Linked Incentive Scheme for Food Processing Sector
	• National Policy on biofuels • National Clean India Fund • National Clean Energy Fund • National Clean Air Programme (NCAP) • Pradhan Mantri Krishi Sampada Yojana • Renewable Energy: Renewable Energy Global Investment Promotion Meet and Expo (RE-INVEST), Feb-2015 • Soil Health Card Scheme
	• National Action Plan on Climate Change (NAPCC) • National Solar Mission • National Mission for Enhanced Energy Efficiency • National Mission for Sustainable Habitat • National Water Mission • National Mission for Sustaining the Himalayan Ecosystem • National Mission for Sustainable Agriculture • National Mission on Strategic Knowledge for Climate Change • National Cyclone Risk Mitigation Project

SDGs	Key Schemes
	• National Plan for Conservation of Aquatic Eco-System • Pradhan Mantri Matsya Sampada Yojana
	• National Afforestation Programme (National Mission for a Green India) • Integrated Development of WildLife Habitats • Project Tiger • Project Elephant • National Environmental Policy 2006 • National Agroforestry Policy (2014) • National Action Programme to Combat Desertification

Source: https://www.niti.gov.in/sites/default/files/2019-01/Mapping%20-SDGs%20V12%20-%208%20delinked%20schemes%20%20110116_1_0.pdf, YES BANK analysis

To ensure sustainable development, Indian policy makers have consistently taken proactive steps to combat climate change and build climate resilience across the agriculture sector. The government launched National Mission for Sustainable Agriculture (NMSA) in 2014-15 which derives its mandate from Sustainable Agriculture Mission, one of the eight missions outlined under National Action Plan on Climate Change (NAPCC) adopted by Government of India. NMSA focuses on the key dimensions encompassing Indian agriculture including improved crop seeds, livestock and fish cultures, water use efficiency, pest management, improved farm practices, nutrient management, agricultural insurance, credit support, markets, access to information and livelihood diversification. Within NMSA, Rainfed Area Development is a component focusing on Integrated Farming System (IFS) which promotes supplementary farm-based livelihood support activities apart from crops/cropping system (animal husbandry, forestry etc.) to provide greater resilience & sustenance to farmers in the wake of extreme climatic events. To promote agro-forestry as a farming system, National Agro-forestry Policy has been formulated by Government of India.

Similarly, the Mission Organic Value Chain Development for North Eastern Region (MOVCD-NER) promotes holistic, organic farming, which aims at development of end to end organic value chains, thereby conserving biodiversity in the North East Region of India. The Department of Agriculture Cooperation & Farmers' Welfare is also implementing 'Per Drop More Crop' component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY- PDMC). The PMKSY-PDMC focuses on enhancing water use efficiency at farm level through Micro Irrigation technologies viz. Drip and Sprinkler irrigation systems. During the last five years (2015-16 to 2019-20), an area of 4.7 Mn ha has been covered under Micro Irrigation through PMKSY-PDMC.

ICAR under the Ministry of Agriculture and Farmers' Welfare launched a flagship network project 'National Innovations in Climate Resilient Agriculture' (NICRA) during 2011 to develop climate resilient technologies through short term and long term research, and also to demonstrate the existing technologies on farmers' fields for enhancing the resilience across vulnerable areas of the country. ICAR has also prepared District Level Contingency Plan and a district level climate vulnerability atlas for

undertaking location specific adaptation activities both by public, private and non-governmental sector. ICAR has developed several in situ and ex situ water conservation technologies and improved dryland agriculture technologies, which are being upscaled through the Integrated Watershed Management Program (IWMP) and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA).

Apart from these, the Government is also working towards developing the Agriculture Transformation Index which is intended to measure the state-wise performance across six pillars of inputs, sustainability, productivity and diversification, policy, preservation, processing and exports, and farmers' income and welfare. This is an effort towards sustainable intensification and farmer livelihood enhancement.

Role of private sector

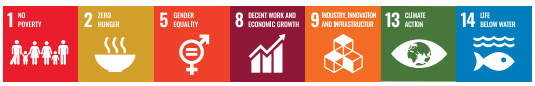
While the Indian government is taking up numerous policy initiatives to achieve sustainable development in agriculture, there is a need for unprecedented efforts from the private sector to complement these efforts. Many think that sustainability is mainly for the government to achieve. However, sustained business success is inherently linked to sustainable development. It is critical for agribusinesses to internalize the dependencies of their business on the sustainability of the ecosystem in which they operate and identify strategic interventions to deliver products and solutions that advance their business interests while also aligning to the overall sustainable agriculture development agenda.

Sustainable Development Goals (SDGs) form a very powerful lens that could guide private companies to assess materiality of relevant social and environmental issues impacting sustainability across their value chains. Agri-businesses need to utilize the "SDG lens" to create value beyond profits, by contributing to sustainable solutions that drive responsible growth in agriculture, benefit agrarian communities and preserve our planet.

The first step towards utilizing the "SDG lens" is to clearly understand the 17 SDGs and to map out how various products, processes and stakeholder engagements of a company impact these SDGs. A report by FAO identifies five principles and 20 interconnected actions that could guide decision-makers take actions to "transform Food & Agriculture to achieve SDG goals" (exhibit 6)[13]. Agribusinesses could utilize this framework to identify actions that they are already taking as part of their current business operations or that they need to take going forward for positively impacting sustainable agriculture development.

[13] *FAO report titled "Transforming Food & Agriculture to achieve the SDGs – 20 interconnected actions to guide decision makers", 2018.*

Exhibit 6: 20 actions aligned to 5 key principles of FAO's vision for sustainable food and agriculture

Actions	SDGs impacted
Principle 1 Increase productivity, employment and value addition in agriculture	
1. Facilitate access to productive resources, finance and services	
2. Connect smallholders to markets	
3. Encourage diversification of production and income	
4. Build producers' knowledge and develop their capacities	
Principle 2 Protect and enhance natural resources	
5. Enhance soil health and restore land	
6. Protect water and manage scarcity	
7. Mainstream biodiversity conservation and protect ecosystem functions	
8. Reduce losses, encourage reuse and recycle, and promote sustainable consumption	
Principle 3 Improve livelihoods and foster inclusive economic growth	
9. Empower people and fight inequalities	
10. Promote secure tenure lights	
11. Use social protection tools to enhance productivity and income	
12. Improve nutrition and promote balanced diets	

Actions	SDGs impacted
Principle 4 Enhance resilience of people, communities and ecosystems	
13. Prevent and protect against shocks: enhance resilience	
14. Prepare for and respond to shocks	
15. Address and adapt to climate change	
16. Strengthen ecosystem resilience	
Principle 5 Adapt governance to new challenges	
17. Enhance policy dialogue and coordination	
18. Strengthen innovation systems	
19. Adapt and improve investment and finance	
20. Strengthen the enabling environmental and reform the institutional framework	

Source: FAO

Once the action areas for creating positive impact on SDGs are identified, agribusinesses need to commit to delivering on them by setting goals for each selected action, collaborating with various stakeholders, including government, to deliver on their commitments, monitor progress in achieving these goals and transparently report and communicate on their achievements.

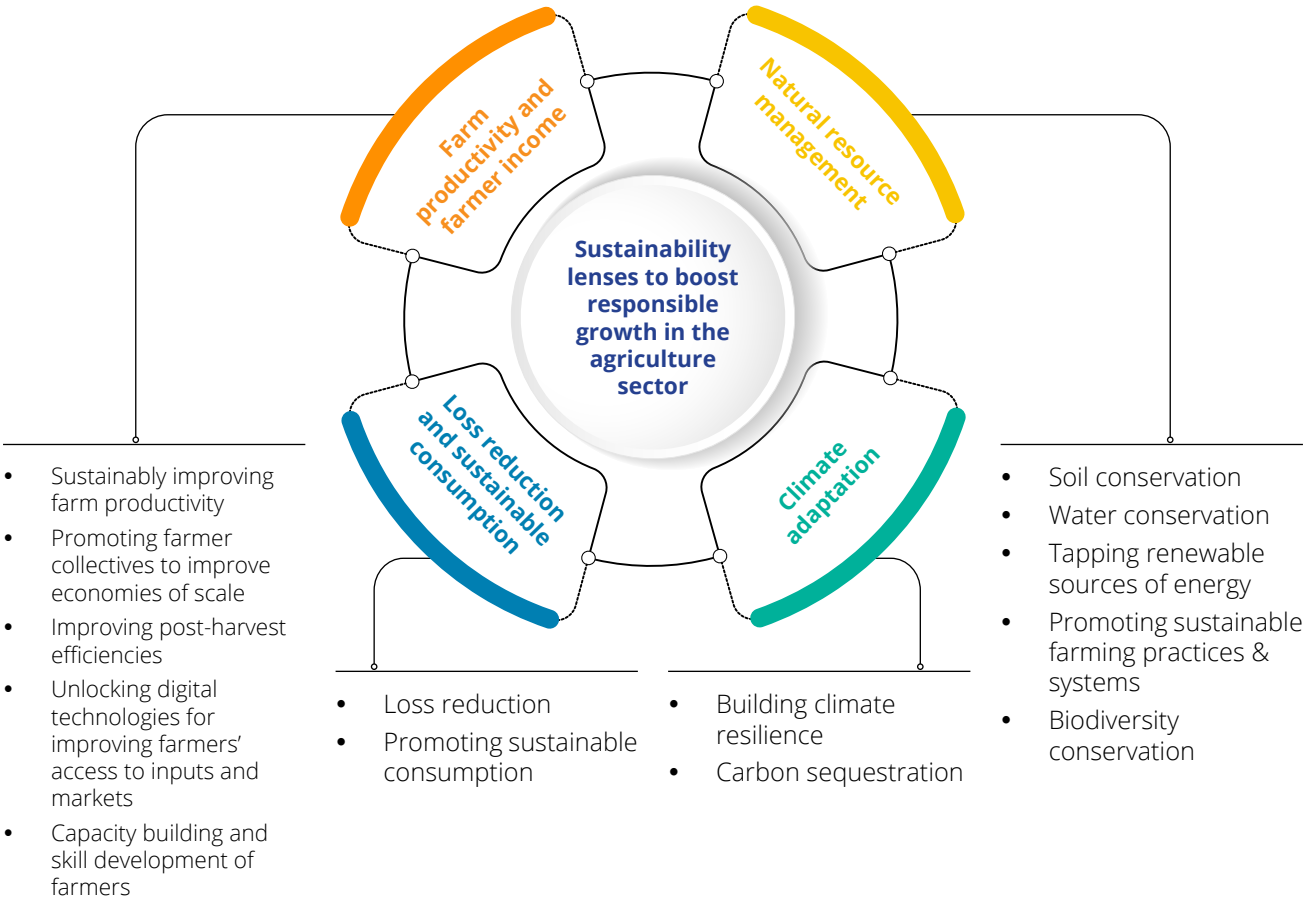
Many far-sighted agribusiness companies have already embraced sustainability as a core value and are focusing on the triple bottom line of people-planet-profit to deliver on a wider range of sustainable development goals. It is time that all agri-business companies utilize the "SDG lens" to act as change agents who support large scale sustainability focused growth and transformation in the agricultural ecosystem.

2. Sustainability lenses to boost responsible growth in the agriculture sector

Organizations examining the agriculture sector through the sustainability lens are presented with a diverse basket of complex issues that compete for prioritization. Sustainability issues that could be addressed across the agriculture value chain range from maximizing yields and farmer income while minimizing natural resource depletion to the importance of reducing post-harvest loss, bolstering food security and job creation. It is critical for decision makers to review their products and business processes to identify specific focus areas that have a direct impact on the four pillars of sustainable agriculture namely – sustaining the economic viability of farms, making the most efficient use of natural resources, protecting the quality of environment and combating climate change and sustainably meeting demand of consumers. Using the SDG Lens, agribusinesses could identify key initiatives and goals that form the basis for developing a sustainability action framework that mobilizes resources and efforts to orient product development, operations and technology towards contributing to positive social and environmental impact while achieving their economic aspirations. Sustainability initiatives in the agriculture sector can be viewed from four key lenses namely improvement of farm productivity and farmer income, enhancing natural resource management, promoting climate adaptation and promotion of sustainable consumption (refer Exhibit 7).



Exhibit 7: The four lenses framework for classification of sustainability initiatives in Agriculture



Source: YES BANK Analysis

The first lens focuses on sustainably improving farm productivity, farmer income, farmer capacity and farm economics. Sustainable increase in productivity should happen in tandem with enhancing natural resource management and improving climate resilience. The second sustainability lens looks at enhancing natural resource management. All initiatives that contribute in conservation of key natural resources such as soil, water and biodiversity; renewable sources of energy and sustainable farming practices are bucketed into this segment of sustainability. The third lens delves into promotion of climate adaptation which focuses on two key focus areas of building climate resilience and carbon sequestration. The fourth lens addresses the aspect of loss reduction and sustainable consumption.

Farm productivity and farmer income

Producing more from less remains the key ask for sustainable agriculture development, thereby placing a distinct focus on innovations, technologies and other initiatives that rise farm productivity. Hence, any product, process, technology or innovation that have a direct impact on productivity improvement

plays a significant role in sustainable agricultural development. However, productivity rise needs to necessarily translate into increased farmer income. Hence, along with productivity improvement, four more focus areas have been identified that contribute directly to increasing farmer income. They include:

- Promoting farmer collectives
- Improving post-harvest efficiencies
- Unlocking digital technologies to improve farmers' access to inputs and markets
- Capacity building and skill development of farmer for taking up sustainability initiatives

Initiatives taken up across focus areas addressing farm productivity and farmer income align to the following Sustainable Development Goals.



Sustainably improving farm productivity

Improving farm productivity is the most pressing need for sustainable agriculture development in India as it is vital for ensuring food security as well as boosting farmer income. Farm productivity in India stands much lower than the global average in a number of agri-commodities. This is largely driven by the fact that agriculture is predominantly carried out by small and marginal farmers with limited access to knowledge, information and quality farm inputs at the right time. Any initiative that organizations involved in agriculture are taking to improve yields directly contribute to sustainable development. However, technologies and products developed for this purpose need to go through the prism of environmental and ecological safety and preservation, such that they not just improve productivity but also are safe to use and have no negative impact on natural resources and the environment. Most suitable initiatives for organizations supplying various farm inputs to farmers that have a positive bearing on sustainable agriculture development are captured herewith

Inputs	Select initiatives that are sustainability positive
Seed 	• Development and introduction of high yielding varieties that are climate resilient • Introduction of bio-innovations, such as GMO crops, that result in significant impact on productivity improvement while also reducing agriculture's environmental footprint while leading to climate adaptation
Fertilizer 	• Promoting judicious and balanced use of fertilisers • Introduction of low volume high uptake-efficiency fertilizers such as nano-urea • Promote slow release fertilizers (neem coated urea)

Inputs	Select initiatives that are sustainability positive
Plant protection chemicals 	• Promote judicious and safe use of agro-chemicals • Pesticide container recycling • Introduce low dose high precision "green chemistry" molecules for pest control
Farm mechanization 	• Developing and introducing equipment and machinery suitable for small farms • Improve access to farm machinery through Custom Hiring Centres
Agriculture finance 	• Develop innovative farmer financing products (including blended financing products) that improve access to finance for farmers

Another enabling factor in farm productivity enhancement is investment in agricultural research and education. Increasing investment in agriculture research, both in the public and private sector has a direct bearing on attaining the sustainable development goals.

Promoting farmer collectives to improve economies of scale

The small holder nature of Indian farmers calls for development of collective institutional systems. Organizing farmers into collectives and formation of Agri-clusters could be the one of the most critical pathways to achieve economies of scale, improve bargaining power of farmers and increase farmers' access to markets. This can aid in access to the right inputs & machinery at the right time, adoption of efficient farm production techniques and an efficient supply chain to deliver quality produce at reasonable price to end consumers. Forming groups or collectives helps improve credit & market accessibility, while also improving economies of scale. These groups act as platforms fostering better practices adoption, idea generation and knowledge dissemination.

Improving post-harvest efficiencies

All interventions taken to improve scientific post-harvest management can help in improving the efficiency of the agricultural production system and minimizing losses. The cost of production of many agriculture commodities may be very competitive in India. However, inadequate post- harvest infrastructure results in significant wastage and deteriorates quality, thus resulting in lower farmer income.

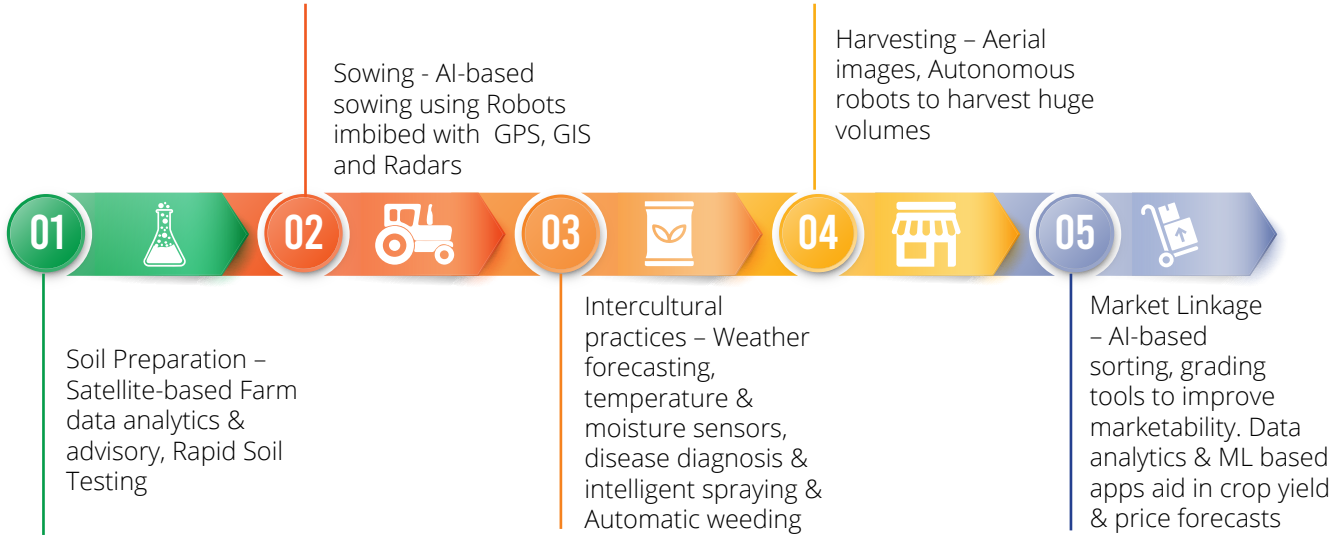
Initiatives such as providing access to primary processing and storage infrastructure at farm level, developing efficient post-harvest logistics, including cold chain and improving energy efficiency hence reducing cost of storage and logistics – have a direct impact on improving farmer income, conserving natural resources and thus on achieving sustainable development goals.

Unlocking digital technologies for improving farmers' access to inputs and markets

Digitalizing agriculture involves leveraging technology to ensure greater productivity, rationalize input consumption, improve predictability and minimize market related shocks. The digitization aspect does not only pertain to farmers' data but also includes data regarding the crops grown, existing land holdings and farm dimensions which help in building a smart, efficient, market driven as well as traceable agriculture supply chain.

Of late, there has been growing contribution of Agtech startups in introduction of a range of tools and technologies, such as data analyzers, robots, drones, remote sensors and apps to map field boundaries, monitor plant health, measure soil moisture, weather forecasts and dissemination of market price information. These digital technologies help in providing decisive solutions necessary for taking active measures towards sustainable agriculture production. To achieve bigger impact, large-scale adoption of tech innovations is crucial. Focused initiatives (such as partnering with start-ups, running incubator and accelerator programs) that support agri-tech startups and enable wider adoption of digital technology have a direct impact on boosting sustainability across the agriculture value chain.

Exhibit 8: AI/Tech Innovations across agricultural value chain which enables sustainable agriculture



Finance: Building transparency in credit provision through the use of Farm Data Analytics Technologies that aid in geo-fencing, provides access to fields' history thus, reducing the risk of default.

Source: YES BANK Analysis

Capacity building and skill development of farmers

Shift from unsustainable farm practices towards sustainable practices requires a major buy-in from the farmers. Farmers need to be made aware and trained on the latest sustainability focused agricultural practices, innovations and technologies which complement the existing ecological processes and

motivated to adopt such practices. This can be accomplished by intensive extension and knowledge dissemination efforts that could be taken up by various stakeholders including NGOs, corporates, Private companies. They could play a pivotal role in building capacity of farmers given the depth of knowledge, quality of manpower and breadth of engagement and relationships that they have with farmers.

Natural resource management

Natural resources form the basis for agricultural production system. Their management and conservation are critical for enhancing productivity sustainably. Unsustainable farming systems are responsible for depleting resources at a faster pace. Efforts made by the private sector when augmented with the policies instituted by the Government can have significant positive impact on enhancing sustainable use of natural resources.

The focus areas identified for stakeholders that address sustainable natural resource management mainly consist of interventions related to soil, water and biodiversity conservation which help make the ecosystem resilient. Apart from these, there needs to be sustained focus on harnessing renewable energy resources to decrease pressure on use of conventional energy (leading to lowering of carbon footprint).

Initiatives taken up across focus areas addressing enhanced natural resource management align to the following Sustainable Development Goals.



Soil conservation

Soil conservation is vital in supporting terrestrial ecosystem, including agriculture. As per estimates by Ministry of Environment, Forest and Climate Change (2020), 32% of the land in India is considered degraded and 25% of it is undergoing desertification.[14] Just restoring land is not enough, consistent efforts need to be made towards its conservation. Major agricultural practices which aid in soil conservation are crop rotation, mulching, cover cropping, reduced or zero tillage and cross-slope farming. Other sustainable land management practices such as managing aquifer recharge, rangeland rehabilitation through reseeding and community-based grazing management, protection of wetlands, practicing agroforestry, and reducing forest fragmentation through afforestation can also be adopted.[15]

[14] *https://wotr.org/2022/06/17/action-points-india-global-land-outlook-report-2022/*
[15] *https://wotr.org/2022/06/17/action-points-india-global-land-outlook-report-2022/*

Exhibit 9: Causes and effects of land degradation and desertification

Causes of land degradation

- Overcultivation
- Over-grazing
- Forest conversion
- Urbanization
- Deforestation
- Extreme weather events

Effects of land degradation

- Loss of organic matter and nutrients
- Desertification
- Soil Sealing
- Decline in biodiversity
- Compaction & salinization

Source: https://www.who.int/news-room/questions-and-answers/item/climate-change-land-degradation-and-desertification

Water conservation

With monsoon becoming increasingly unpredictable the dependence on irrigation is increasing. In 2015 alone, Indian farmers have taken 12 Mn electricity connections and 9 Mn diesel pumps sets to pump up groundwater for irrigation use[16]. Such activities increase pressure on groundwater levels. It is crucial to manage water responsibly such that natural ecosystem is not harmed. Precision agriculture techniques help in improving the water use efficiency and curb water wastage. Techniques such as micro-irrigation and laser land levelers are gaining traction in India. Currently, such techniques are primarily used by medium to large farmers. To see effective change, these methods also need to be popularized, made accessible and promoted among small and marginal farmers. All initiatives that are focused on water use efficiency (such as introduction of drip irrigation) or those that develop ecosystems that conserve water have a direct impact on sustainable agriculture development.

Tapping renewable sources of energy

Out of the total electricity consumed in the country, 20% of the electricity is used for agriculture practices, mostly in irrigation.[17] India uses more than 4 Bn liters of diesel (13% of total diesel consumption in India) and around 85 Mn MT of coal per annum (19% of total coal consumption in India) to support water pumping for irrigation. If 50% of these diesel pumps were replaced with solar PV pump sets, diesel consumption could be reduced by about 225 Mn liters/year (7.5% of total diesel

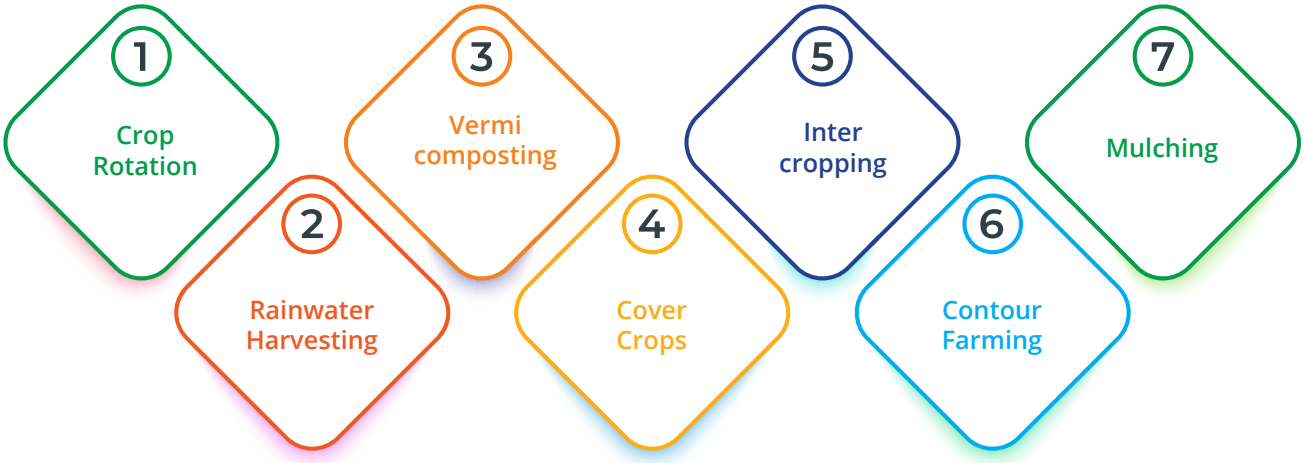
[16] *https://www.investindia.gov.in/team-india-blogs/renewable-energy-revolutionizing-farmers-incomes*
[17] *https://www.investindia.gov.in/team-india-blogs/renewable-energy-revolutionizing-farmers-incomes*

consumption in India).[18] With increasing cost-effectiveness of solar modules solarization of pumps is a feasible option. It can help in curbing the power needs and holds great potential to save 4 Bn litres of diesel annually and 5% of total greenhouse gas emissions.[19] Apart from application in pumps, solar power-based technologies can also be used in dryers, chilling and lighting systems and other off-grid applications. Promoting use of such renewable sources of energy could translate into significant reduction of GHG emissions, improved natural resource conservation, thus auguring sustainable development.

Promoting sustainable farming practices & systems

Sustainable farming practices are centered around keeping soil protected, supporting associated organisms, increasing water holding capacity, preventing pollution and offering sources of additional income. These practices by working with nature, conserve environment, strengthen adaptability towards climate variability and increase availability of healthier produce. These practices can be improvised or used in combination as per the local agro-climate. Although many practices are available, they are practiced by less than 4% of the total Indian farmers.[20] Some of the major practices followed currently are listed below in exhibit 10.

Exhibit 10: Popular sustainable agriculture practices in India



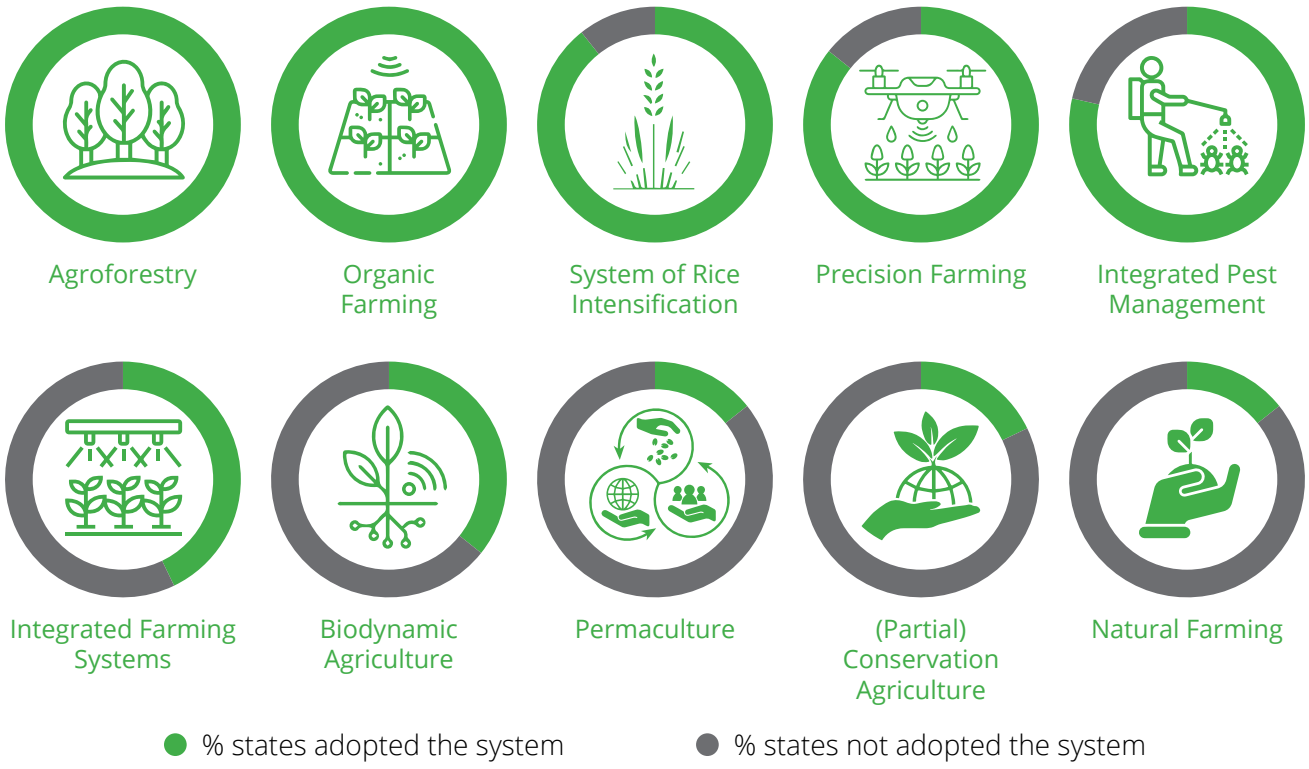
Source: CEEW FOLU, Sustainable Agriculture in India 2021, What We Know and How to Scale Up

Apart from such practices, there are sustainable agricultural systems which can be practiced. As per a study conducted by CEEW, practices such as agroforestry, organic farming, precision farming, integrated pest management and SRI method of rice cultivation are the most popular sustainable farming systems being adopted across several Indian states (refer to exhibit 11). However, these systems are associated with issues such as low yields in the initial years, substantial increase in the workload (in a sector which is already plagued with labor unavailability) and unavailability of necessary

[18] *https://www.weforum.org/agenda/2015/11/how-can-solar-energy-help-indias-farmers/*
[19] *https://www.investindia.gov.in/team-india-blogs/renewable-energy-revolutionizing-farmers-incomes*
[20] *CEEW FOLU, Sustainable Agriculture in India: What we know and How to scale up, 2021*

materials (such as animal waste, cow urine, mulch, plant parts etc). Initiatives that promote sustainable farming systems and practices contribute significantly to natural resource protection. However, the issues of low productivity and economic viability need to be addressed.

Exhibit 11: Geographical spread of sustainable agriculture systems in India (2021) (in terms of number of states)



Source: CEEW FOLU, Sustainable Agriculture in India 2021, What We Know and How to Scale Up

Zero Budget Natural Farming in Andhra Pradesh

Zero Budget Natural Farming (ZBNF) also known as community managed natural farming is a way of establishing agroecology at a large scale. It primarily involves four key components:

- jeevamrutham: a soil inoculant made of cow dung, urine, pulse flour, jaggery, and soil;
- beejamrutham: a seed coating made of similar ingredients;
- acchadana: mulching;
- whapasa: soil aeration;

The key motivations to adopt ZBNF are a need to move away from conventional agriculture, socio-economic conditions and climate change situations. Andhra Pradesh Government adopted

ZBNF in 2015 based on the success of previous natural farming programs in the state. The Rythu Sadhikara Samstha (RySS) was appointed to oversee the implementation of the program. ZBNF was launched as a pilot program in 700 villages and nearly 40,650 farmers were enrolled in 2016. As of March 2020, nearly 623,300 farmers were enrolled in the program (that is almost 10.5% of total farmers in the state) and the total land cultivated was 3% of total net sown area in the state. By 2027, it has been targeted to expand ZBNF to all 6 million farmers and 8 million hectares.[21]

Biodiversity conservation

Measuring and improving biodiversity is critical to ensure the survival of all species. Maintaining biodiversity levels directly affects agriculture as it involves all the species aiding directly or indirectly in cultivation - such as pollination, protection from predator species and combating climate change.

For instance, forests (including agroforests) act as major sinks of CO2, preserve cyclical processes and contribute towards transformative agricultural practices. The conservation of forests can help reduce emissions and thereby combat climate change. In order to make significant impact there is a need to mobilize forest fringe communities, address their needs and increased involvement of other stakeholders in building capacity of these communities such that forests are conserved. This can be achieved with help from the private sector companies with a greater CSR focus on forest conservation and agroforestry.

Incentivizing forest protection and restoration

In India, during the 14th Finance Commission, the tax devolution formula included forest and ecology with a 7.5% weightage. It is a performance-based instrument through which the share released was linked to completion of forest management plans by the state forest departments. This compensates states for the opportunity cost of maintaining forests and providing ecosystem services. Estimates indicate that 6.9 Bn USD to 12 Bn USD were to be transferred to states annually between 2015 to 2020, making this one of the largest ecological fiscal transfer systems in the world.[22] In the 15th FC, this has been increased to 10% and the estimated tax devolution is 58 Bn USD over five years[23]. States with greater forest cover would have a larger share of the forest cover-based tax devolution than their counterparts with lesser dense forest cover. The top five states in India in forest cover are Arunachal Pradesh, Madhya Pradesh, Chhattisgarh, Maharashtra and Odisha, together these states make up 49% of the total forest cover in India.

Climate adaptation

The impact of climate change on agriculture cannot be understated. As per various forecasts, the average temperature across India is projected to rise in the range of 2.4°C to 4.4°C by 2100. Increased incidence of localized extreme precipitation events has increased flood risks and projections show increase in flood intensity and occurrence in the Indus, Ganges, and Brahmaputra River basins. The yield forecasts are decreasing and show India's crops falling by 1.8 to 6.6 % by mid-century (2041–2060)

[21] *https://createsolutions.tufts.edu/wp-content/uploads/2021/12/CREATE_ZBNF_Rose_Halstead_Griffin.pdf*

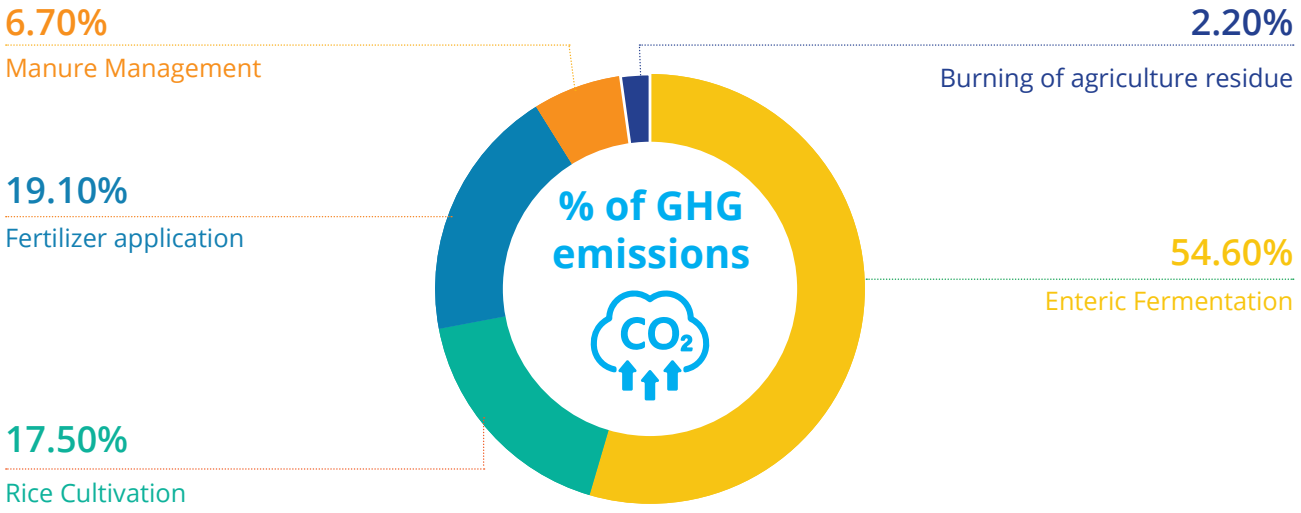
[22] *https://www.foodandlandusecoalition.org/wp-content/uploads/2019/09/FOLU-GrowingBetter-GlobalReport.pdf*

[23] *https://www.tncindia.in/what-we-do/our-insights/stories-in-india/money-grows-on-trees/*

and by 7.2 to 23.6 percent by end-century (2061–2080) under a middle-of-the-road scenario for climate change. Yield losses are projected to be higher in rainfed conditions, and yield losses in wheat and maize are projected to be higher than yield losses in rice.[24]

GHG emissions are significant contributor to climate change. India's GHG emissions are estimated to reach 3.7 Bn MT by 2030[25]. The agriculture sector is a significant contributor of emissions and also one of the sectors most affected by it. As per the Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC), the agriculture sector contributes 14% of the total GHG emissions. Within the sector, 54.6% of GHG emissions were due to enteric fermentation, followed by 17.5% from rice cultivation, 19.1% from fertilizer applied to agricultural soils, 6.7% from manure management, and 2.2% due to field burning of agricultural residues[26] as indicated in Exhibit 12 below.

Exhibit 12: GHG emissions from Indian Agriculture



Source: Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC)

Hence, substantial investments in adaptation of new practices and technologies will be required to maintain current yields while decreasing ecological footprint. This can be primarily done by focusing on two key areas which include introducing and promoting initiatives that lead to climate resilience and increasing focus on carbon sequestration to manage the carbon footprint. Role of private sector and local community institutions will be critical in mitigating the impact of climate change.

Initiatives taken up to promote climate adaptation and reduction of greenhouse gas emission align to the following Sustainable Development Goals.



[24] *Global Food Policy Report, 2022*

[25] *At an annual growth rate of 3%*

[26] *https://www.downtoearth.org.in/blog/climate-change/indian-agriculture-the-route-post-cop-26-81154*

Building climate resilience

Building climate resilience in agriculture is essential to sustain current levels of production. One of the potential strategies for doing so, is developing cultivars tolerant to abiotic stresses (such as heat, salinity, flooding and drought) and biotic stresses (such as pests and diseases). Another step is promoting cultivation of indigenous hardy crops (such as millets). These crops are adapted to the local agro-climatic zones, require less water and are tolerant to the vagaries of nature. Other ways of enhancing climate resilience include initiatives like diversification of portfolio of farm activities; adoption of resource conserving technologies; improving availability of better climate information with in-depth analysis to support farmer decision making; investing in early warning systems and integrating disaster risk reduction in agricultural interventions.

Carbon sequestration

Driving carbon reduction is crucial to combat the effects of climate change as it has significant impact on production ecosystems, air quality and human health. Decarbonization in agriculture is not only limited to reducing methane emissions from cattle and rice cultivation, but also includes improving resource use efficiency (reduction in consumption of irrigation water, chemical fertilizers, energy in production and harvest related activities) and reduction in wastage. Sequestering carbon into agricultural soils which consequently enhance yields is beneficial both for the farmers and the environment. Soil acts as a natural sink for carbon as it gets stored in the soil and assimilated by plants. Beyond improving crop quality, enhancing biodiversity and preventing soil erosion; carbon sequestration can also aid the farmers monetarily. They can receive cash-based incentives as direct benefit through carbon credit trading for the carbon they help sequester in their lands. All initiatives that support carbon sequestration have a direct bearing on achievement of sustainable development goals.

Challenges and opportunities for carbon credit trading

Challenges	Opportunities
• Verification and accurate accounting of carbon is challenging • Long wait time for incentives to reach the farmers • In India, the average landholding is quite meagre so the credits received may not be feasible for the farmer to adopt regenerative practices • Less awareness among the farmers	• Simplification of measurement and verification processes in the future • Risk of participation for individual farmer can be reduced mostly by onboarding farmer groups • Improvement in market prices of carbon credits over the years • Increase in awareness on existence & benefits of carbon credit programmes

Loss reduction and sustainable consumption

India has come a long way from being a grain deficient country to being a leading producer of and a net exporter of agricultural produce. However, fast growing population, changing dietary habits, imbalanced nutrition and agricultural vulnerability to climate & natural disasters make food security a top priority for the country.

As per the assessment of Indian Council of Agricultural Research (ICAR) in 2016, about 3.9% to 6% cereals, 4.3% to 6.1% pulses, 2.8% to 10.1% oilseeds, 5.8% to 18.1% fruits, and 6.9% to 13% vegetables were lost during activities such as harvesting, post-harvesting activities, handling and storage[27]. Reducing losses in the agricultural production ecosystem as well as at the point of consumption is vital in the path of facilitating nutritional security and enabling sustainable consumption. All initiatives that result in efficient food waste reduction as well as sustainable and responsible consumption of food have a direct impact on sustainable agriculture development.

Initiatives taken up for loss reduction and promotion of sustainable consumption align to the following Sustainable Development Goals.



Loss reduction

With numerous initiatives being taken towards improvement of farm production, there is also an urgent need to make focused attempts to reduce wastage of farm produce. Interventions such as innovative postharvest solutions, improved supply chain & logistics, value addition and innovative packaging to improve shelf life help in cutting down wastage across the supply chain. The concept of adopting circular economy ecosystem could be a good example for reducing wastage and emissions at the production level as well as sustainably increase availability of farm produce for consumption.

Circular economy ecosystem

A circular economy ecosystem is a closed-loop production model where resources are reused in the production loop for improved value generation. This ecological model is based on the principles of 'Reduce, Reuse & Recycle'. The agricultural waste at various stages can be converted into bio-products which can be used as fertilizers, energy, materials and compounds. As per United Nations Conference on Trade and Development, applying circular economy principles to the development of the Indian food system could create annual benefits of INR 3,900 Bn in 2050[28]; reduce GHG emissions, water usage, and environmental degradation; and play a vital role in securing the long-term food supply.

Promoting sustainable consumption

Food & nutritional security is a multi-dimensional concept, requiring production of adequate quantities of high-quality produce while ensuring equal access to nutritious food for all. This calls for strong advocacy and promotion of nutritionally sound production systems. This can be achieved by supporting initiatives such as diversification of agriculture in favor of diverse crops (including high-value crops),

[27] *https://www.researchgate.net/publication/289637983_Assessment_of_Quantitative_Harvest_and_Post-Harvest_Losses_of_Major_CropsCommodities_in_India*

[28] *https://www.tpci.in/indiabusinesstrade/blogs/circular-agriculture-and-the-indian-fb-value-chain/#:~:text=A%20circular%20agriculture%20model%20has,%24%2061%20billion)%20in%202050.; https://ellenmacarthurfoundation.org/circular-economy-in-india*

livestock and fish. Apart from ensuring nutritional security, diversification could also help diversify farmer income which could further translate into nurturing stronger communities with greater access to nutritious foods. In the process of promoting consumption of safe and nutritious food, nutritionally sound diets need to be aligned to locally available crops (such as millets) such that production ecosystems are developed in an environmentally friendly manner, improving climate resilience and enhancing local economies and livelihoods.



3. Accelerating sustainability initiatives in agriculture sector – Key recommendations

Responsible agriculture growth has the potential to contribute directly or indirectly towards achieving all the 17 SDGs. Such growth, which is strongly aligned to sustainability agenda, can significantly increase the resilience of both people and the environment, mitigating climate change and sustainably producing food while conserving natural resources. It clearly places strong emphasis on the complementarities between the economic, social, and environmental dimensions of sustainable development.

Sustainability initiatives across key focus areas identified in the previous chapter have the potential to greatly accelerate the transition to responsible agriculture growth. However, adoption and implementation of such initiatives would require well targeted, collaborative, coordinated, and coherent actions initiated simultaneously across multiple likeminded stakeholders.



This chapter suggests select enabling policy actions that could accelerate multi-stakeholder contribution and strongly augment implementation of sustainability focused initiatives for improving responsible growth in agricultural production. The policy actions suggested are broadly bucketed into two overarching areas of action areas namely- 1) Providing support for technologies and innovations that align with sustainable development goals and 2) Providing incentives for encouraging shift to environmentally sustainable agricultural practices.

Support technologies and innovations that align with sustainable development goals

Technology and innovation are the major driving force for revolutionizing agriculture. Emerging technologies ranging from biotechnologies, digital tools, nanotechnology, big data, data analytics, data science, Artificial Intelligence and Machine Learning can upgrade decision making, allowing better risk and variability management to optimize yields, enhance climate resilience and improve economics. However, this can be achievable only if technology and innovation are adapted to the needs of small-scale farmers, and combined with significant investment in rural infrastructure, training, and education. Select recommendations that promote development, introduction and scaleup of innovative technologies in Indian agriculture context are captured herewith.

- **Strongly focus on development and wide scale adoption of high yielding and climate resilient crop varieties with high sustainability index.** Towards this, while private seed companies could play a critical role in introducing globally best varieties at a price affordable to Indian small holder farmers, government need to create an enabling environment for introduction of new hybrids as well as for protecting IPRs. Specific enabling policy interventions include – reviewing the repetitive procedures (such as the need for a three-year confirmatory trial for any hybrid seed being introduced into the state, in spite of it having been tested and approved elsewhere in the country); setting up common and standard procedures/guidelines across states for faster approvals and enforcing a predictable Intellectual Property Rights (IPR) regime & The Plant Variety Protection Act (PVP&FRA) landscape to assure and incentivize private companies to further invest in research and development of more resilient and efficient seed varieties. Measures could include offering tax breaks on private sector R&D investments.
- **Incentivize adoption of green products such as Bio-Pesticides and micronutrient fertilizers** by placing them at par with bio and organic fertilizers. Sustainable tools such as pheromone traps need to be heavily promoted. This could include incentivizing fertilizer and pesticide companies for incorporating customized, controlled release and stabilized fertilizers as well as green chemistry agrochemicals in their portfolio.
- **Support small holder farmers in adoption of modern farm mechanization technologies:** Due to paucity of labor, mechanization can aid in easing farm management processes and increasing their efficiency. Promoting measures such as establishment of farm machinery banks in PPP model can help augment productivity and cost efficiency. There persists a need to closely study the requirement of small farmers and develop cost effective machines that are best suited to small farm conditions. State governments could formulate a taskforce to promote adoption of innovative farm machinery that have a direct impact on both productivity as well as natural resource conservation (such as direct seeding technology, efficient field preparation, spraying and harvesting technology etc).

- **Promote climate smart financing to ensure better access to credit:** Evaluate the option of incentivizing financing institutions to apply a comprehensive lifetime assessment of GHG emissions to funding priorities. Devise a scheme tying Priority Sector Lending (PSL) and other targeted lending norms to Agri companies which have demonstrated high focus on implementing quantifiable and monitorable sustainability initiatives in the agriculture sector. Support and incentivize use of innovative blended finance instruments and mobilize public, private, and philanthropic investments that focus on improving farmers' access to finance.
- **Promote digitization for extension and information sharing:** Comprehensive digital platform may be developed and promoted for accessing state level/district level data on sowing time, practices and harvesting. New digital models could tap into a network of village entrepreneurs, supported by schemes such as the Pradhan Mantri Mudra Yojana (PMMY). Enhanced use of ICT, Drones and Smart Digital solutions could be adopted and incentivized for real time extension by both government and private sector. Incentivize technology transfer, agricultural extension and training including pilots and demonstrations to test, solve problems and encourage adoption; whilst ensuring equitable access to information, technologies and tools for sustainable production.
- **Increase emphasis on development of sustainable alternatives within the research and development agenda of agricultural research and education bodies.**
- **Continue investing in strengthening FPOs** – which are critical in improving farmers' access to inputs and markets.

Incentivize shift to environmentally sustainable processes and practices

There is a need to develop policies and fiscal instruments that facilitate and incentivize multi-stakeholder investment toward low emissions/ carbon positive, climate resilient and sustainable agriculture practices. Fiscal incentives can help to create an enabling framework for transformation to sustainable agriculture, complementing other approaches including regulatory instruments, market-based mechanisms, information tools and voluntary measures. Select recommendations for promoting adoption of environmentally sustainable agricultural practices are provided below.

- **Institute strong center-state cooperative mechanism which jointly disincentivizes overuse of natural resources** and rewards farmers producing (and companies procuring) through sustainable practices that also mitigate the impact of climate change. Centre must support states to develop climate tolerant regional/district level production clusters.
- **Adjust pricing and support mechanisms to incentivize and reward more efficient use of resources such as land, water and energy.** Phase out policies including those subsidies and market price support mechanisms that incentivize practices with harmful impacts on climate and environment, such as conversion of forests, peatlands and other fragile eco-systems for mono-crop agriculture and or other practices that lead to the degradation of natural resources measures (thereby increasing climate risk and undermining production)
- **Extensively promote soil conservation and soil health development programs at state level:** Concerted policy efforts are needed for soil regeneration in high stress regions by promoting conservation tillage, crop residue management technology such as Happy Seeder in wheat rice systems, DSR machines in Haryana/Punjab; promoting INM & soil health cards;

improving testing facilities and use of biochar to increase carbon storage could be considered.

- **Devise differential micro-irrigation incentives and provide DBT based investment subsidies for micro-irrigation and solar pumps.** Higher subsidies are needed for farmers in water stressed areas. Direct benefit transfers into farmers accounts could be considered instead of routing subsidies through companies. Centre may consider compensating water stressed states who adopt ecological practices. States like Punjab & Haryana which are highly water stressed will need to dedicate large financial and administrative resources to launch sustainability programs on mission mode, which would require support from the central government.
- **Integrate food safety laws in all Agri sustainability policies and increase consumer awareness** –Emphasize food safety & traceability compliance in food related consumer affair policies and awareness campaigns. Aligning food safety laws to pesticide regulatory framework and strengthen extension activities for ensuring judicious pesticide use.
- **Develop a crop residue management policy in each state,** clearly defining various competitive uses; adopt appropriate legislation on monitoring of on-farm crop residue handling through incentives and technology support.
- **Incentivize biodiversity conservation and mobilize forest fringe communities** to enhance their participation in conservation of natural resources. Incentivize private sector as well as states to promote climate friendly cropping and to adopt diversified efficient farming systems which withstand climate change situations.

Realizing sustainable growth in agriculture would require deep commitment and collaborative efforts by multiple stakeholders. The Indian government is strongly committed towards achieving the sustainability agenda and has rolled out several initiatives, policies and programs which are directed towards achievement of Sustainable Development Goals through agriculture. The private sector can also play a pivotal role in adopting and promoting environment friendly practices; enlisting, educating and motivating farmers to embrace sustainability initiatives and encouraging sustainable consumption. With efforts of all stakeholders considering India's strength in terms of capacity and diversity of agricultural produce, the aspiration of achieving transformative agricultural growth while meeting Sustainable Development Goal targets is within our Country's reach.

Abbreviations

Abbreviation	Extension
Bn	Billion
CEEW	Council on Energy, Environment and Water
CO_2	Carbon Dioxide
COP	Conference of the Parties
CSR	Corporate Social Responsibility
DBT	Direct Benefit Transfer
DSR	Direct Seeded Rice
FAO	Food and Agriculture Organization
FC	Finance Commission
FOLU	Food and Land Use Coalition
FPO	Farmer Producer Organization
GDP	Gross Domestic Product
GHG	Green House Gases
GMO	Genetically Modified Organisms
GoI	Government of India
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICT	Information Communication Technology
IFS	Integrated Farming System
INM	Integrated Nutrient Management
IPR	Intellectual Property Rights
IWMP	Integrated Watershed Management Program
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIDH	Mission for Integrated Development of Horticulture
Mn	Million
MOVCD-NER	Mission Organic Value Chain Development for North Eastern Region
MT	Metric Tonnes
NAPCC	National Action Plan on Climate Change

Abbreviation	Extension
NCAP	National Clean Air Programme
NCIF	National Clean India Fund
NFSM	National Food Security Mission
NGO	Non-Governmental Organization
NICRA	National Innovations in Climate Resilient Agriculture
NLRMP	National Land Record Management Programme
NMSA	National Mission on Sustainable Agriculture
NOPM	National Oilseed and Oil Palm Mission
NRCP	National River Conservation Programme
NRLM	National Rural Livelihood Mission
PDMC	Per Drop More Crop
PMJDY	Pradhan Mantri Jan Dhan Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PMMY	Pradhan Mantri Mudra Yojna
PSL	Priority Sector Lending
PV	Photo-Voltaic
PPV&FRA	Protection of Plant Varieties and Farmers' Rights Act
R&D	Research & Development
RKVY	Rashtriya Krishi Vikas Yojana
RySS	Rythu Sadhikara Samstha
SDGs	Sustainable Development Goals
SRI	System of Rice Intensification
STEP	Support to Training and Employment Programme for Women
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollars
ZBNF	Zero Budget Natural Farming

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