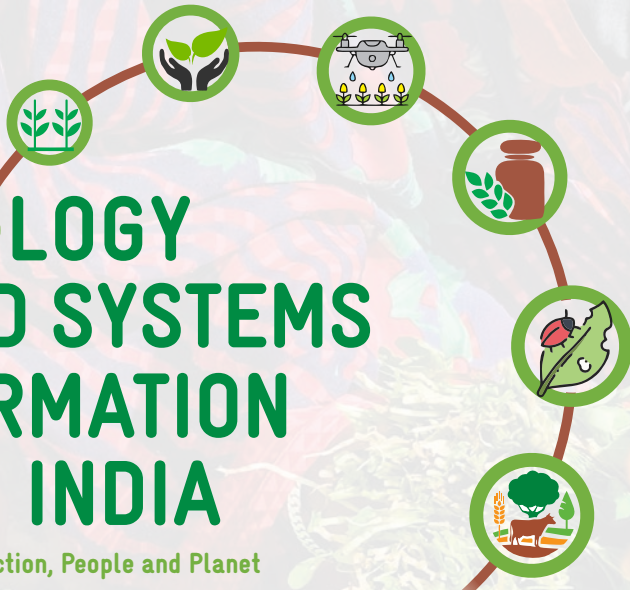


PATHWAYS FOR AGROECOLOGY AND FOOD SYSTEMS TRANSFORMATION IN INDIA

Production, People and Planet
A Compendium of Essays



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This report does not claim to be scientifically complete.

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Message

The Indo-German Development Cooperation is 63 years young and works with Union and State Governments as well as other organisations in India on issues of environment, climate change, sustainable agriculture, renewable energy and urban development. As a service provider with worldwide operations in the fields of international cooperation for sustainable development and international education work, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH works with its partners to develop effective solutions that offer people better prospects and sustainably improve their living conditions. GIZ is a public-benefit federal enterprise and supports the German Government and a host of public and private sector clients in a wide variety of areas, including economic development and employment promotion, energy and environment. The projects of GIZ India in the thematic fields of Environment, Climate Change and Biodiversity are working jointly with the Indian Ministries of Agriculture and Farmer's Welfare (MoAFW), Environment, Forests and Climate Change (MoEFCC), Rural Development (MoRD), the National Bank of Agriculture and Rural Development (NABARD) among others on issues of agroecological transformation, sustainable agriculture and aquaculture, water security, climate change mitigation and adaptation and green financing.

The Green and Sustainable Development Partnership launched on 02 May 2022 during the 6th India-Germany Inter-Governmental Consultations (IGC), jointly chaired by Prime Minister Narendra Modi and Chancellor Olaf Scholz in Berlin, Germany, further strengthens these areas of mutual interest and cooperation. Both Governments are looking forward to work together for the protection of the planet and for shared, sustainable, and inclusive growth, leaving no-one behind. Another significant Joint Declaration of Intent signed between the two Governments on that day is on 'Agroecology and Natural Resource Management'. It recognises and provides a mutual high priority to these topics.

The first ever United Nations Food Systems Summit (UNFSS) was convened in 2021 as part of the Decade of Action to achieve the Sustainable Development Goals (SDGs) by 2030. This People's Summit promoted that we all must work together to transform the way the world produces, consumes, and thinks about food. It gave rise to several multi-stakeholders' initiatives led by civil society, farmers, women, youth, and indigenous groups in the member states. The linkages between food systems transformation and the agroecological processes become very crucial in tackling these and most other global goals, including those related to SDGs, Land Degradation Nexus (LDN) and the Paris Agreement.

I am happy to note that this compilation of all articles covering the whole scope of discussions derived from the Food System Dialogues, that have been organised by GIZ India in the context of the UNFSS, is being published. Through our ongoing and upcoming initiatives of the Indo-German Development Cooperation, I hope we will be able to contribute much more to agroecological transformation and food systems development in the future.

Mohamed El-Khawad

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Foreword

As the second most populous country in the world, India is emerging as an economic power and is now counted as one of the biggest agricultural economies in terms of production. However, despite the achievements of the Green Revolution, intensive agricultural practices with excessive fertiliser and pesticide use, unsustainable management of natural resources and climate change are affecting people's livelihoods and are threatening food security, especially in terms of access to food and safe and healthy food.

Recognising the importance of transforming our agriculture and food systems for sustainable and equitable livelihoods towards the achievement of the Sustainable Development Goals by 2030, the first United Nations Food Systems Summit (UNFSS) was held during the United Nations General Assembly in New York in 2021. Designed as a people's summit, researchers, policy makers, civil society and indigenous people came together to engage, discuss, and develop possible solutions to ensure a just and inclusive transformation of our food systems.

As part of the UNFSS, several multi-stakeholder forums, so-called 'Coalitions of Partners', have been formed in the backdrop of the event in the form of Food System Dialogues. An initiative was also taken by the Food Future Foundation with the support of the Confederation of Indian Industry Food and Agriculture Centre of Excellence (CII-FACE) and the Global Alliance for Improved Nutrition (GAIN), the 'Coalition of Partners for Food System Transformation in India' was formed, to which GIZ also contributed intensively. One of the agreed outputs was to contribute to the UNFSS 2021 and its targets. The coalition convened different stakeholders to gather knowledge and expertise to develop a joint narrative on agriculture and food systems transformation in India. The coalition organised workshops with schools and universities to engage with the youth, but also engaged with policy and research experts from multiple sectors related to agricultural production and food systems.

GIZ India hosted and facilitated eleven consultative Food System Dialogues on topics close to the Indo-German fields of cooperation, which are also the ones documented here. During these dialogues, researchers, policy makers, private sector as well as civil society representatives were engaged in multi-perspective and inter-disciplinary discussions. Each dialogue was concluded with a joint 'Vision 2030 Statement' and come up with a set of coherent action pathways to enable the envisioned transformation. The results and insights from the Food System Dialogues were then consolidated by experts during another round of consultations and documented in fifteen articles, with more than 100 experts participating and contributing in the consultations. These were shared as inputs to the Coalition, which was to consolidate them and publish them as the 'India's Food System Vision 2030' Report.¹

As GIZ India, we decided to publish a more comprehensive version in form of this report, including all articles in their full length covering the whole scope of discussions derived from the Food System Dialogues. Presenting the complete dialogues that formed the 'Vision 2030 Statements' and the actionable areas, the following compilation is a resource for evaluating projects and setting targets, defining success areas but also identifying problems and future possibilities to enhance contributions to India's food systems transformation and agroecological transformations, and hence, the achievement of the Sustainable Development Goals by 2030.

We would like to thank all the lead authors who gave all of their experience and time pro bono to develop the base concept notes, present them in the consultations and then help incorporate the discussant inputs. All the experts from India and abroad, who participated in the virtual consultations (for these were the times of the COVID-19 induced lockdowns) and gave their inputs deserve a great thank you. And a special thank you to my GIZ colleagues who helped design and coordinate the process of consultations and development of this report, including Kirti Prasanna Mishra and his team from Ecociate who worked tirelessly along with the GIZ team.

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¹Food Future Foundation (2021): "India Food System Vision 2030 Report". Available online at: <http://www.foodfuturefoundation.org/india-food-system-vision-2030-report/>. Last accessed: 08.09.2022.

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Section: I

**Production: Sustainable
Production of Our Food**



1

Integrating a Farming System for Sustainable and Nutrition Oriented Food Systems

Lead Author: **Ashwini Chandak**¹



VISION STATEMENT

Inclusive and integrated farming systems that contribute to a food system that ensures nutritional security for communities and consumers for better human and environmental health.

1.1 Actionable Agenda

The Agriculture Census (2015-16) indicates that there are 146 million operational holdings in the country out of which 86% are marginal and small ones. These fulfil basic needs of households, including food (cereal, pulses, oilseeds, milk, fruit, honey, meat, etc.), feed, fodder, fibre, etc., warranting an attention about Integrated Farming Systems (IFS). Undoubtedly, the majority of farmers are doing farming since long, but their focus was on individual components and not in an integrated manner. At the Indian Council and Agricultural Research (ICAR) and State Agricultural Universities (SAUs) level, many efforts have been made aiming at increasing the productivity of different individual components of farming systems, such as crop, dairy, livestock, poultry, piggery, goat keeping, duckery, apiculture, sericulture, horticulture, mushroom cultivation etc. However, they are lacking in their integration by following an integrated farming system approach. The integration is made in such a way that a product of one component becomes input for other enterprises with a high degree of complimentary effects on each other. Preliminary research investigations advocated the benefits of productivity improvement by 30-50% depending upon the number and kind of enterprises and their management.

This report presents the information on farming systems, keeping in mind the work done so far to realise better productivity, profitability and sustainable production

systems that would help to solve the fuel, feed, and energy crisis, create more employment avenues, ensure regular income, and encourage agriculturally oriented industry.

1.2 Major Challenges

The growth rate of agriculture in the recent past is very slow despite rapid economic growth in India. According to the Economic Survey of India (2008) the growth rate of food grain production decelerated to 1.2% during 1990-2007, lower than the population growth of 1.9%. In the subsequent years, growth rate of food production has significantly fluctuated while almost always growing at a lesser or an equal rate than the population growth rate. It is projected that India's population will touch 1370 million by 2030 and 1600 million by 2050. To meet the demand, the production must be raised to 289 and 349 Million Tonnes (mt) of food grains during the respective periods. The current scenario in the country indicates that the area under cultivation may further dwindle and more than 20% of current cultivable area will be converted for non-agricultural purposes by 2030.² However, in the year 2019-20 (as per fourth advance estimates), total food grain production in the country is estimated at a record 296.65 mt, which is higher by 11.44 mt than the production of food grain achieved during 2018-19 (285.21 mt). Further, the production during 2019-20 is higher by 26.87 mt than the previous five years' (2014-15 to 2018-19), averaging a production of 269.78 mt.

¹Lead Author: Mr. Ashwini Chandak, Director and Practice Head, Ecosystem Integration and Knowledge Dissemination, Ecociate Consultants Private Limited.

Discussants and contributors: from Mr. Yogesh Sawant (BAIF), Mr. Pramod Pradhan (SWISSAID), Mr. Kundan (FAO, India), Ms. Madhuri Mewale (Independent), Mr. Ashuman Das (WHH), Mr. Ravindra (WASSAN), Dr. Chadag V Mohan (World Fish), Mr. Rajeev Ahal (GIZ).

²Gill, M. S.; Samra, J. S.; Singh, G. (2005): "Integrated farming system for realizing high productivity under shallow water-table conditions". Research bulletins, Department of Agronomy, PAU, Ludhiana, pp. 1-29.

The size of operational farm holdings in India is declining and over 85 million out of 105 million are below the size of 1 ha. Due to ever increasing population and decline in per capita availability of land in the country, practically there is no scope for horizontal expansion of land for agriculture. Only vertical expansion is possible by integrating farming components which require lesser space and time to ensure reasonable returns to farm families. The IFS therefore assumes greater importance for sound management of farm resources to enhance the farm productivity and reduce the environmental degradation, improve the quality of life of the poor farmers and maintain sustainability. To sustain a positive growth rate in agriculture, a holistic approach is the need of the hour. Farming systems are a mix of farm enterprises in which farm families allocate resources for efficient utilisation of the existing enterprises for enhancing productivity and profitability of the farm. These farm enterprises are crop, livestock, aquaculture, agro-forestry, agri-horticulture, and sericulture.³

In such diversified farming, though crop and other enterprises coexist, the thrust is mainly to minimise the risk. On the other hand, there is a complimentary effect through effective recycling of wastes and crop residues which encompasses additional source of income to farmers in IFSs. This results from a mix of enterprises and cropping.

1.3 Current Status of Integrated Farming Systems

It is an interdependent, interrelated, often interlocking production system based on few crops, animals, and related subsidiary enterprises in such a way that maximises the utilisation of nutrients of each system and minimises the negative effects of these enterprises on the environment. Under Indian conditions, where many farmers are categorised as small and marginal farmers, it becomes very necessary to find out the farming techniques which are best suited to them. Traditional farming systems of cultivating only specific crops and some livestock species in a specific season are not as profitable as an IFS.

1.3.1 Goals of IFS

The four primary goals of IFS are:

- Maximising of yield of all component enterprises to provide steady and stable income.
- Rejuvenating/ameliorating a system's productivity and achieving agroecological equilibrium.

- Avoiding build-up of insect-pests, diseases and weed population through natural cropping system management and keep them at low level of intensity.
- Reducing the use of chemicals (fertilisers and pesticides).

1.3.2 Elements of IFS

Important elements, including but not limited to (i) Watershed, (ii) Farm ponds, (iii) Bio-pesticides, (iv) Bio-fertilisers, (v) Plant products as pesticides, (vi) Biogas, (vii) Solar energy, (viii) Compost making (Vermi, improved etc.) (ix) Green manuring and (x) Rainwater harvesting, may be included in IFS demonstrations depending upon the individual farmers resources, interest, and opportunities.

1.3.3 Advantages of IFS

- **Increased productivity:** Increase in productivity of different components through increased economic yield per unit area and time or minimised per unit of cost involved by virtue of intensification of crop and allied enterprises.
- **Improved profitability:** Improvement in profitability mainly by reducing costs through recycling of wastes of one enterprise as energy inputs for other systems.
- **Advanced sustainability in production:** Greater sustainability in production on farm due to integration of diverse enterprises of different economic importance. Recycling of wastes being in-built in the system, this helps to reduce dependence on external high-energy inputs, thus conserving natural and scarce resources.
- **Applied recycling:** In IFS, effective recycling of waste material (crop residues and livestock wastes) helps to make a farm self-sufficient in terms of avoiding outside inputs – fertilisers, agrochemicals, feeds, energy, etc. The recycling of wastes for production helps to avoid piling of wastes and consequent pollution.
- **Provided year-round income:** Due to maintenance of different enterprises with crops, eggs, milk, mushroom, honey and cocoons silkworm, it provides income throughout the year. The farming system provides cashflow to the farmer all year by way of disposal of various produce/products. This will help resourcing low-income farmer to get out from the clutches of moneylenders/agencies.

³Varughese, K.; Mathew, T. (2009): "Integrated farming systems for sustainability in coastal ecosystem". Indian J Agron. 54(2): 120-127.

- **Adapted new technology:** Because of the linkage of dairy/mushrooms/sericulture/fruit crops/vegetable crops/flower cultivation etc., all year cash availability has the potential of inducing small and marginal farmers to adopt new technologies. IFS is not only to support marginal and small farmer in making their agriculture sustainable, but additionally resourceful farmers also can fully utilise available technology to get greater benefit from it. Flow of money throughout the year induces an acceptance phenomenon in farmer communities to adopt the latest technology and therefore be more time efficient.
- **Provided energy:** An alternative energy source can be established to reduce the dependence on fossil energy sources within short time. Organic wastes available in the system can be utilised to generate biogas. This could be used when required during crises times. Further, biogas production can meet household energy requirement. Thus, IFS goes a long way in solving the energy crises.
- **Mitigated fodder crisis:** Fodder/pasture/tree species included in the system help to get more fodder and thus solve fodder crises to some extent. Due to effective use of land, plantation of perennial or annual fodder crops or combination of it can result in year-round availability of feed for animal. Moreover, some legumes fodder can fix nitrogen in soils by increasing soil fertility. Combined, these measures reduce the risk of future fodder crises.
- **Solved fuel and timber crisis:** The silvi component used in the system provides fuel and timber wood. A linking of agro- and silviculture can avail fuel or timber without deteriorating other components. This will also greatly help to keep forestation, preserving our natural ecosystem.
- **Generated employment:** Diverse components in IFS can provide enough scope to employ farm labour round the year. IFS expands the entrepreneur's knowledge about production systems and hence improves the literacy level.
- **Expanded agro-industries:** IFS provide an opportunity for the growth of agri-oriented industries. When one of produce linked in IFS graduates to commercial level, there might be surplus value creation leading to development of allied agro-industries.
- **Increased input efficiency:** IFS provide good scope to use inputs in different components, including greater efficiency and benefit-cost ratio. There is also the advantage of increased input use efficiency.
- **Improved standard of living of the farmer:** Overall, IFSs improve the living standard of farmers due to products like edible mushroom, fruits, eggs, milk, honey, vegetables etc.
- **Increased availability of nutritious and balanced food:** Different component supply different nutrients, which can fulfil one's daily required nutrients. The integration of different production systems provides an opportunity to solve malnutrition problems due to the production of a variety of food products.
- **Increased environmental safety:** Effective recycling of waste material and others raw materials through IFS models results in minimising environment pollution.

1.3.4 Possible Outputs of IFS

IFS leads to the production of better and more nutritious food. To strengthen the food chain, it is essential to eliminate nutritional disorders which have resulted from a deficiency of mineral nutrients and vitamins in food. Horticultural and vegetable crops can provide 2-3 times more energy production than cereal crops on the same piece of land. Therefore, including them in the existing systems can ensure nutritional security. Similarly, the inclusion of beekeeping, fisheries, sericulture and mushroom cultivation on account of space conservation gives additional high-energy food without affecting the production of food grains. Integration of these enterprises certainly helps the production, consumption, and decomposition in a realistic manner in an ecosystem.

Likewise, it is pre-requisite in farming systems to ensure efficient recycling of resources, particularly crop residues, because 80-90% of the micronutrients remain in the biomass. In the Indo-Gangetic plains, where rice straw is not recycled in an effective way and even in Punjab, where rice cultivation is practised on 2.6 m ha, paddy straw is destroyed by burning. To curtail such precious input loss, the use of second-generation machinery for efficient crop residue management to conserve moisture, improve soil micro-organism activities, regulate soil temperature, check soil erosion, suppress weed growth and on decomposition improves soil fertility. Its beneficial effect can also be accrued by incorporating with the soil. The crop residue can be used as floor thatch for cattle shed, composting, growing mushroom and for dry fodder. Multiple use of water for raising crops, fruits, vegetables, and fishery may also enhance the water productivity.

Likewise, in villages, the sewerage water can be purified through Hydrilla biomass before its release to fishponds. Besides, the community land in the villages, which are accessible to better use, must be used for productive purpose. Therefore, adoption of concepts like social forestry, water harvesting and recycling fishery, and stall feeding to the animals (goatery/piggery) will add to the profit margin with numerous indirect benefits of employment and improved ecology of the area. Such types of enterprise integration generate additional income varying from INR 20,000-25,000/ha under irrigated and INR 8,000-12,000/ha under rainfed ecosystem. The income enhanced due to integration of processing and on-farm value addition by 25-50%, yield improvement on account of soil health improved by 0.5-1.0 tonne/ha, cost reduction by INR 500-1,000/ha and employment generation by 50-75 person-days/household have also been observed.⁴

Survey on farming systems in the country revealed that milch animals, cows and buffaloes irrespective of breed and productivity, are the first choice of the farmers as an integral part of their farming system. However, from economic point of view, vegetables, and fruits (mango and banana in many parts of the country) followed by bee keeping, sericulture, mushroom and fish cultivation were the most enterprising components of any of the farming systems prevalent in the country. The average yield gaps between 27 pre-dominant and 37 diversified farming systems were examined across the agro-climatic zones through detailed survey on characterisation of on-farm farming systems. Diversification of farming system by integration of enterprises in varied farming situations of the country enabled to enhance total production in terms of rice equivalent yield ranging from 9.2% in eastern Himalayan region to as high as 366% in Western-plain and Ghat region when compared to prevailing farming systems of the region.

A number of success stories on IFS models, including Sukhomajri Watershed of Chandigarh, Fakot Watershed in hilly areas of Uttarakhand, the Water Technology Centre for Easter Region (WTCER) model for coastal and irrigated alluvial lands of Orissa, Darshan Singh Model for irrigated conditions of Punjab, the Project Directorate for Cropping Systems Research (PDCSR) model for western Uttar Pradesh and many more in different parts of the

country suggest that farmers' income can be increased manifold by way of diversification of enterprises in a farming system mode for sustainability and economic viability of the small and marginal category of farmers. The role of IFS in doubling of farmer's income by 2022 seems well aligned.

1.3.5 Productivity Enhancement through IFS

This chapter discusses the highlights of the research investigations carried out in India towards farming system outcomes to conceptualise its significance towards farming community livelihood. In a study conducted at ICAR Research Complex, Goa, it was revealed that rice-brinjal crop rotation is the best in terms of productivity and profitability, owing to higher yield of the brinjal. The system yielded a total productivity of 11.22 t/ha rice grain equivalent yield with a net return of INR 46440/ha. Further, with the integration of mushroom and poultry production (based on the resources availability within the system), the system productivity was increased to 21,487 kg/ha, especially with rice-brinjal rotation leading to an additional return of INR 30,865/ha with integration. In addition, the system approach was found to be sustainable as reflected from the changes in soil organic carbon and indicated by the sustainability yield index.⁵

In Tamil Nadu, the IFS increased the net return on an average of INR 31,807/ha/year over the arable farming area. While in Goa, when coconut was integrated with crop, vegetables, mushroom, poultry, and dairy enabled to enhance INR 17,518/ha/annum over the coconut cultivation alone. In Madhya Pradesh, the integrated farming gave a margin in net return of INR 17,198/ha/year over the arable farming. In Uttar Pradesh, the average enhancement in return was INR 45,736/ha/annum over the existing crop-based farming system.

In Haryana, Singh et al.⁶ conducted studies of various farming systems on 1 ha of irrigated and 1.5 ha of unirrigated land and found that mixed farming with crossbred cows under irrigated conditions yielded the highest net profit (INR 20,581), followed by mixed farming with buffaloes (INR 6,218) and lowest in arable farming (INR 4,615). In another study conducted with 240 farmers of Rohtak (wheat-sugarcane), Hisar (wheat-cotton) and Bhiwani (gram-bajra) districts in Haryana which represented zones of different crop rotations revealed that

⁴Gill, M. S.; Singh, J. P.; Gangwar, K. S. (2009): Integrated farming system and agriculture sustainability. *Indian J Agron*, 54(2): 128-139.

⁵Korikanthimath, V. S.; Manjunath, B. L. (2009): "Integrated farming systems for sustainability in agricultural production". *Indian J Agron*. 54(2): 140-148.

⁶Singh, C. B.; Renkema, J. A.; Dhaka, J. P.; Singh, K.; Schiere, J. B. (1993): "Income and employment on small farmers. Proceeding an international workshop on feeding of ruminants on fibrous crop residues: Aspects of treatment, feeding, nutrient evaluation, research, and extension". Karnal, Haryana, 4-8 February, 1991, pp. 67-76.

maximum returns (INR/ha) of 12,593, 6,746 and 2,317 were obtained from 1 ha with buffaloes in Rohtak, Hisar and Bhiwani, respectively.

The highest net return from Rohtak was attributed to the existence of a better soil fertility type and of irrigation facilities coupled with better control measures compared to other zones. In terms of total man days, Rohtak had the highest employment potential followed by Hisar and Bhiwani. The employment potential under mixed farming conditions was predominantly from livestock rather than crop production.⁷

Another study involving cropping, poultry, pigeon, goat, and fishery was conducted under wetland conditions of Tamil Nadu by Jayanthi et al.⁸ Three years results revealed that integration of crop with fish (400 reared in three ponds of 0.04 ha each), poultry (20 babbok layer bird), pigeon (40 pairs), and goat (Tellichery breed of 20 female and one male in 0.03 ha deep litter system) resulted in higher productivity, higher economic return of INR 1,31,118 (mean of three years). Integration of enterprises created employment opportunities where, in comparison to 369 mandays/year generated in cropping system alone, cropping with fish and goat created additional 207 mandays/annum. The resources were recycled in such a way that fish were fed with poultry, pigeon and goat dropping. Similarly, extra poultry, pigeon and goat manure and composted crop residue of banana and sugarcane were applied to the crops. The four conventional cropping systems tried were rice-rice-blackgram, maize-rice-blackgram, maize-rice-sunhemp and rice-rice-sunhemp.

1.3.6 IFS at Indian Government Level

To strengthen all aspects of cropping systems' research, the PDCSR was established at Modipuram (Meerut) with effect from March 1989, with 'AICRP on Cropping Systems' as one of the constituent schemes of the Directorate. Furthermore, earlier two components, namely 'On-Station Research' and 'On-Farm Research' remaining intact. To promote IFS, in the years 2009-10, Government renamed PDCSR Project Directorate for Farming Systems Research (PDFSR). The Project Directorate for Farming Systems Research (PDFSR) was renamed as ICAR-Indian Institute of Farming Systems Research (IIFSR) during

November 2014 and the mandate was redefined further as given below:

- Conduct research in integrated farming systems on production technologies for improving productivity and resource use efficiencies.
- Develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- Conduct on-farm testing, verification, and refinement of system-based farm production technologies.
- Coordinate and monitor integrated farming systems research in the country.

Development of region specific on station IFS models has been carried out since 2011-12. In its annual report, IIFSR has reported the development of 37 IFS models across 31 locations (state), covering 15 agro-climatic regions along with the results. Annexure 2 captures a case study of Southern Plateau and Hills agro-climatic region in Rajendernagar station, Telangana.

1.4 Linkages with the Sustainable Development Goals

Agriculture and allied sectors are crucial to the achievement of the 17 Sustainable Development Goals (SDGs) adopted by 193 countries in 2015, setting targets for 2030 and referred to as Agenda 2030. Sources of both food and raw material – agriculture, crops, livestock, aquaculture, fisheries, and forests – trace back to the birth of human civilisation. Agriculture is the world's biggest employer and the main source of food and income, especially for the extreme poor. The SDGs are interconnected in many contexts and a link with agriculture is clear for many of them. Table 1 indicates the linkages between IFS and SDGs.



⁷Singh R; Singh, N; Phogat, S. B.; Sharma, U. K.; Singh, R; Singh, N. (1999): "Income and employment potential of different farming systems". Haryana AgrUniv J Res. 29(3-4). pp. 143-145.

⁸Jayanthi, C.; Rangasamy, A.; Mythili, S.; Balusamy, M.; Chinnusamy, C.; Sankaran, N. (2001): "Sustainable productivity and profitability to integrated farming systems in low land farms". In: Extended summaries, pp. 79-81. (Eds: A.K. Singh, B. Gangwar, Pankaj and P.S. Pandey), National Symposium on Farming System Research on New Millennium, PDCSR, Modipuram.

Table 1: IFS link with SDGs

SDG	Link with Integrated Farming System
SDG 1: End poverty in all its forms everywhere.	As most of the poor in the developing world are dependent on agriculture, ending poverty is linked to increasing returns from agriculture. Major indicators are ownership and control over land and natural resources, both of which are essential endowments for practicing agriculture.
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	Directly related to sustainable agriculture.
SDG 3: Ensure healthy lives and promote well-being for all at all ages.	Can only be achieved through nutritious food produced via agriculture and allied sectors.
SDG 6: Ensure availability and sustainable management of water and sanitation for all.	Increasing water use efficiency across sectors, integrated water resource management, and protection and restoration of water related ecosystems all have a bearing on agriculture.
SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all.	Reduction in agriculture’s dependence on fossil fuels and consequent pollution.
SDG 12: Ensure sustainable consumption and production patterns.	Sustainable management of all natural resources, sustainable production patterns, and reducing food loss and waste.
SDG 13: Take urgent action to combat climate change and its impacts.	Strengthening resilience and adaptive capacity of agriculture to the impacts of climate change, and lowering green house gas emissions without affecting food production.
SDG 15: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	All of these are the feedstock for agriculture activities; indiscriminate agriculture expansion has led to decline of forest area and biodiversity loss and overexploitation of land, resulting in degradation.

Source: Bhavani, R. V.; Rampal, P. (2020): “Harnessing Agriculture for Achieving the SDGs on Poverty and Zero Hunger and Zero Hunger”. ORF Issue Brief no. 407.

1.5 Pathways for 2030

- **Creating a comprehensive ‘database on farming system’ in relation to type of farming system, infrastructure, economics, sustainability etc. under different farming situation**

It is imperative to document traditional IFS models and challenges/opportunities across agroecological zones along with determining separate set of indicators to measure the productivity of agroecological approach. Looking at the success matrix of IFS to transform the food systems, it may be looked at from systems point of view and the benefits accrued from it in terms of nutrition, food security, climate change mitigation, youth involved, environmental benefits, gender sensitivity, ecosystem service, rainfed agriculture etc. instead of traditional yield and income-based approaches. Digitising farms to

understand the demographic and cropping profile of the farmers and accordingly devise the mechanism for extension and other services is yet another attention area. Moreover, traceability systems to measure the success of various interventions at the farm need to be in built for transparency and trustworthiness. Peer leanings; developing the best practices at farm levels and promoting them among the other farmers (Positive evidence). Global research partnerships to develop the evidence and solutions around the IFS and Agroecology based farming. Integrated research approach where number of stakeholders are involved to develop the positive solutions. Global and regional exchanges should be encouraged.

- **Developing research modules of farming systems under different holding size with varying economically viable and socially acceptable systems. Also, State Agricultural Universities**

(SAUs) may develop the education modules around IFS

The research pathway should include the assessment of agricultural productivity in agroecological zones by developing a methodology for measurement and rethinking the production system and the way it is viewed. This would require moving from a prescriptive model in farming to a system-based approach wherein collaboration and co-creation is focused and exercised. Listing out farmers as resource persons and trainers in the form of a digital map would be of benefit. This will also acknowledge that knowledge may exist beyond universities. Lack of resource persons to do the planning and take forward the extension agenda is an additional issue. Development of master trainers can be a good approach to ensure the last mile reach of extension services. There is a need to have integrated modules which build the capacity of various kinds of community resource persons (CRPs) around the IFS the National Rural Livelihood Mission (NRLM) is an example. Revising or re-designing the training modules based on the principles of IFS or AE are a way to achieve that. Developing course curriculum in UGC and other academics around the AE based farming systems would be important to further the research agenda. Additionally, available resources need to be brought together for better dissemination of IFS and agroecology based principles among the farmers and other stakeholders. There are numerous tools and resources available around the farming systems, however, desired changes have not been achieved. Behaviour change is key to change the practices. Thus, there is a need to introduce social behaviour change based approaches. Understanding farmer's circumstances or portfolios, ecosystem characteristics, available support systems etc. should influence the development of an intensive approach before designing the farming approaches. Integrating traditional farming practices and knowledge in IFS will be crucial. Exploring social media (e.g. YouTube channels promoting IFS) to promote knowledge, as well as promoting success stories are promising approaches as well.

- **Preparing a policy draft for the consideration of planners for the promotion of IFS models at large scale with nominal financial assistance either through short/medium/long term loans and other promotional advantages**

A policy dialogue on balancing between food security, nutrition security and self sufficiency and sustainability at national and state level is required

to influence the policy around IFS. Accordingly, one must move within the departments for financing the different component of IFS (currently, the government machinery is not synched with the IFS approach), there is a felt need to have single window service provisions for the farmers at the Panchayat/Block level to avail the schemes related to IFS. Availability/convenience of services is a major concern as compared to only the finance or money alone. Exploring the option of integrating different components of IFS with the Kisan Credit Card and accordingly set the credit limits, promoting incentives for GP level in IFS at landscape level (on lines of Maharashtra Govt Swachata Mission Statewide competitions) and integrating IFS plans in Gram Panchayat Development Plans (GPDP) are some of the measures which may result in grassroot implementation and creation of evidence for further policy directions. Convergence of IFS at GP would be instrumental (WHH learning indicates so) in wider adoption. Also, convergence under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) can be explored for IFS. Part of the fund spent on subsidising costs of pesticides etc. could be used to financially support farmers for agroecological/IFS practices. Policy makers may be brought together by highlighting the associated risk and benefits (One health, World fish example in Odisha where different ministries/departments have come together to promote fisheries). Learnings from GIZ supported the Umbrella Programme for Natural Resource Management for financing the IFS kind of model in an innovative and collaborative approach can be utilised.

- **Assessing and refining the technologies developed at research station to be made more participatory and feedback centric for greater adoption in the cultivators' field**

Improving the planning capacity of the farmer by understanding what resources are available with the farmers, their needs and challenges and accordingly designing and implementing the IFS component and approaches is the most important aspect of co-creating IFS models. Markets for commodities coming from the sustainable cropping systems are a major concern and remunerative markets are either to be created or existing ones strengthened. Backing of certification to promote the systems which promote sustainability and have environmental benefits, would also be a market booster. Along with promotion of

appropriate technologies (based on implementable scale of operations) at different level of value chains, we need food system transformation for ensuring realisation of one health - environment, human, plant and animals. IFS must align and map solutions toward realising the same.

- **Mandating government's agricultural extension system to promote IFS. Creating IFS missions at state and national level to ensure its design and implementation. Also, collaboration with Civil Society Organisations and Community Based Organisations to scale up integrated farming**

We need to innovate support and service systems – the old systems are outdated – and new ones are not emerging. Research on costs of adoption of agroecological practices (developing cost benefits and educating farmers while planning) is the need of the hour. A digital agriculture extension approach for better reach at the lower cost and role of private sector in extension to move towards efficiency and scaling up needs to be carefully planned. Also, a farm system driven approach and not the crop systems-based approach may be the guiding principle for designing IFS. Moreover, instead of transferring available technology with research institutions, it is important to design need-based extension mechanisms.

- **Preparing a contingent planning to counteract the weather vagaries/climate threats under different farming situations**

IFS is one of the climate change adaptation strategies that have the potential to reduce vulnerability of farmers caused by climate change. Organic farming is key to support climate friendly IFSs and to identify barriers/enablers among farmers to practice it and then promote IFS widely for the overall health and environment benefits. Promoting agro-forestry models which has combination of different type of trees to meet varying requirements for food, fodder, fuel etc. would ensure a year around income with reduced risk from one system. High value vegetables with the agro-forestry for sustained income during the gestation period along with intercrops with tree-based models may be designed in accordance with agroecological regions. Such models diversify both farmer's income and risk during the time of crop failures or extreme climatic events. Indigenous varieties (which are climate resilient), need to be carefully placed in the overall IFS approach. Availability of seeds at the village or cluster level for

the farmers through seed production and establishing seed banks. Similarly, intercropping and food crop diversification is the key to effectively address weather vagaries. Local agro-advisory services in local language, which includes weather forecast, need to be part of the planning process. Lastly, an M&E system for assessing adoption and taking corrective measures is imperative.

- **Deciding on the appropriate IFS approach**

Availability of resources, such as fishponds and livestock, at the level of individual farmers is among the main concerns. Labour availability and its optimisation is an equally important concern. Setting-up the support systems, such as fodder banks, seed banks, vaccination centres etc., around the IFS for individuals is quite difficult while it is relatively easier to set-up these at the landscape level. Making women's empowerment one of the important pivots through IFS approach is crucial. IFS may be better suited for the landscape level than the household/individual (farm) level and should be carefully understood to tread forward. Demonstrating the feasibility of economics notwithstanding ecological security is going to pave the path for consolidation and further expansion. IFS should be looked at as an approach for better and optimised utilisation of resources at the landscape level for different IFS enterprises. The overall IFS needs to be looked from three the lenses: Social (addressing vulnerabilities in terms of capacity, risk mitigation, management marketing and increasing labour costs), Environmental (climate change risks recorded in food systems document) and Institutional (national missions and flagship programmes). Currently, there is no recognised standard or certification system in place for IFS-products. National awareness campaign on consumer behaviour and nutrition security and developing consumer-producer relationships needs to be on high priority for creating the desired pull for investing in the certification systems.

1.6 Case Studies

- The Indo-German development cooperation project Sustainability and Value Added in Agricultural Supply Chains | Cotton, Tea & Spices, implemented by GIZ on behalf of the German Ministry for Economic Cooperation and Development, is developing a standardised and harmonised training module on organic cotton for the farmers in India with Organic Cotton Accelerator and FiBL Switzerland.

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2

Strengthening Organic and Natural Farming in the Context of Agroecology

By National Coalition for Natural Farming¹



VISION STATEMENT

Transforming the current food systems through Agroecological Farming Principles by empowering women, smallholder farmers and consumers to ensure sustainable livelihoods, dignified life and responsible consumption.

2.1 Actionable Area

The conventional agriculture systems have attained a multifront glass ceiling from the standpoint of innovations, yield, and poverty alleviation. The actuality of agriculture as a viable livelihood opportunity is being questioned as the pay gap vis-a-vis non-agricultural occupations is rising.² This is then compounded by the other issues prevailing in the sector – such as landlessness, gender disparities, automation, rural distress, nutritional security, climate change etc. All of these are interconnected issues and require a systems transformation approach.

The transformation of the production system thus must centre around the socio-cultural context, focusing primarily on women and small, marginal and landless farmers. The shift must also acknowledge local indigenous knowledge systems and agro-ecosystem complexes.

2.2 Major Challenges

Agriculture is a resource-intensive exercise. Currently, 80% of the total freshwater consumption is reflected in the production of just three crops in India,³ additionally, marking overexploitation or severe contamination of groundwater in at least 60% of the districts of India.⁴ Agriculture also remains one of the top greenhouse gas emitters;⁵ utilising fossil-fuel-based synthetic fertilisers and pesticides to the tune of 27 mt⁶ and 60,000 t⁷ per year respectively. While all of this has led to approximately doubling the buffer stocking norms of Public Distribution System,⁸ 'the efficiency of the food system to deliver nutritious food sustainably and with little waste – has declined,⁹ causing the Paradox of Plenty/Productivity. Notably, most of the benefits of this distributed crisis are harvested by medium and large farmers, leaving the majority of small and marginal rainfed farmers at risk.

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²Ramesh, C. (2017). "Doubling Farmers' Income: Rationale, Strategy, Prospects and Action Plan". NITI Policy Paper no. 1/2017. National Institution for Transforming India, New Delhi.

³Gupta, M. D. (2021). "Govt Procurement Policy of Wheat, Rice Aggravating Water Crisis - Draft National Water Policy". ThePrint, January 23, 2021.

⁴Vijayshankar, P. S.; Kulkarni, H.; Krishnan, S. (2011). "India's Groundwater Challenge and the Way Forward". Economic and Political Weekly 46, no.2: 37-45.

⁵Jain, N. (2019). "Agriculture Is a Big Contributor to Greenhouse Gas in India. A Study Finds a Way to Fix That". Scroll.in. Available online at: <https://scroll.in/article/914085/agriculture-is-a-big-contributor-to-greenhouse-gas-in-india-a-study-finds-a-way-to-fix-that>. Last accessed: 06.09.2022.

⁶The Fertiliser Association of India (2021). "All-India Consumption of Fertiliser Nutrients". Available online at: <https://www.faidelhi.org/general/con-npk.pdf>. Last accessed: 06.09.2022.

⁷Government of India (2019). "Agricultural Statistics at a Glance". Directorate of Plant Protection, Quarantine and Storage; Department of Agriculture and Co-operation.

⁸Department of Food and Public Distribution, Govt. of India (2021). "Annual Report (2020-21)".

⁹Benton, T.; Bailey, R. (2019). "The paradox of productivity: Agricultural productivity promotes food system inefficiency". Global Sustainability, 2, E6. doi:10.1017/sus.2019.3.

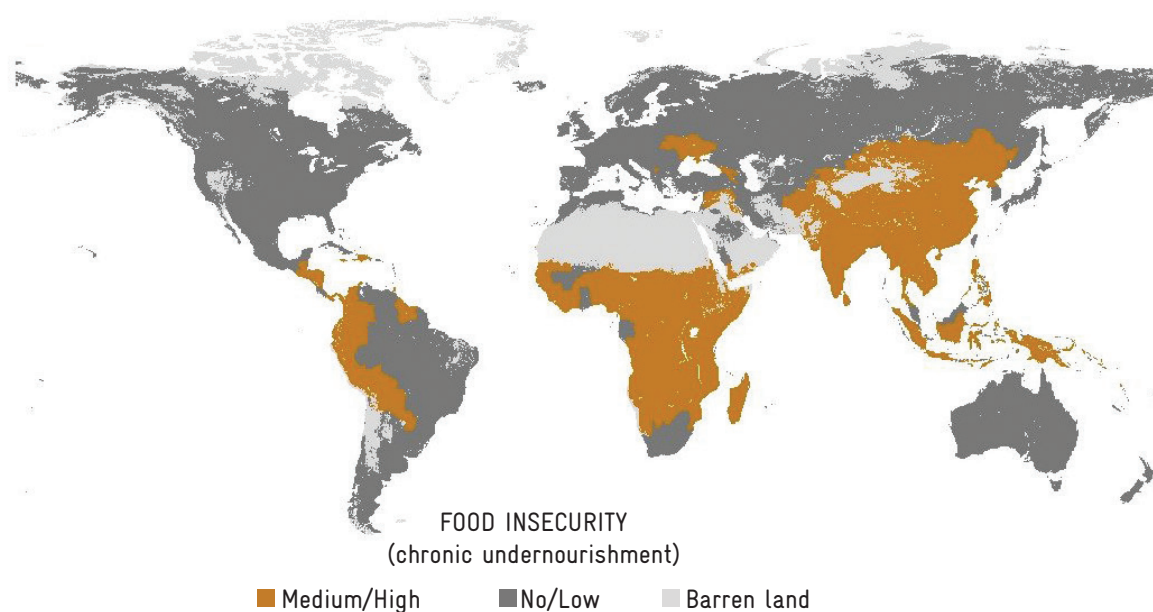


Figure 1: India ranks 103 out of 119 on the Hunger Index

Source: IPCC (2020): “Special Report on Climate Change and Land”. Available online at: <https://www.ipcc.ch/srccl/>. Last accessed: 09.09.2022.

Natural Farming is a response towards the urgency of the impending climate crisis, the vulnerability of agricultural livelihoods, undernutrition and predominance of hunger, and declining ecosystem resilience. Natural Farming is a landscape-level agroecology approach to sustainably manage natural resources of local distinct agricultural complexes with an aim to improve its overall resiliency while eliminating the usage of synthetic agrochemicals. Natural Farming, is not a mere change of agricultural practices but a system that governs the relationship between human actors, natural resources, and other environmental elements at a landscape level. This characteristic feature of Natural Farming suggests that it is not only a technological transition but a paradigmatic shift.

This paradigm shift is an absolute need of today’s world where humans exerting undue pressure on natural and social systems cannot be justified and alternatives are taking shape from the bottom up. Natural farming has the potential to solve some of the biggest challenges confronting our civilisation in the near future.

2.3 Current Status of Organic and Natural Farming

A recent report by the Council on Energy, Environment and Water on the status of Sustainable Agriculture¹⁰ in India captures the current scenario of different systems and practices in the domain. The figure below summarises their estimates in the bracket which they call sustainable agriculture systems.

One of the ongoing large-scale surveys by the National Coalition for Natural Farming suggests that currently, 164 Organisations in 88 districts of India are working with 94,000 farmers to scale Natural Farming in India. Himachal Pradesh government boasts the adoption of this farming method by 56,620 farmers and Andhra Pradesh government by six million farmers.¹¹

Formulated in 2014-15, the existing National Mission for Sustainable Agriculture (NMSA) is the Indian Government’s flagship policy, committed to promulgate sustainable

¹⁰Gupta, N.; Pradhan, S.; Jain A.; Patel, N. (2021): “Sustainable Agriculture in India 2021: What We Know and How to Scale Up”. New Delhi: Council on Energy, Environment and Water. Available online at: <https://www.ceew.in/sites/default/files/CEEW-Sustainable-Agriculture-in-India-2021-May21.pdf>. Last accessed: 21.09.2022.

¹¹Subash Palekar Natural Farming (2020): “A Glance Progress and Achievements during 2019-20”. Available online at: <http://www.spnfhp.nic.in/SPNF/en-in/achievements.aspx>. Last accessed: 06.09.2022.

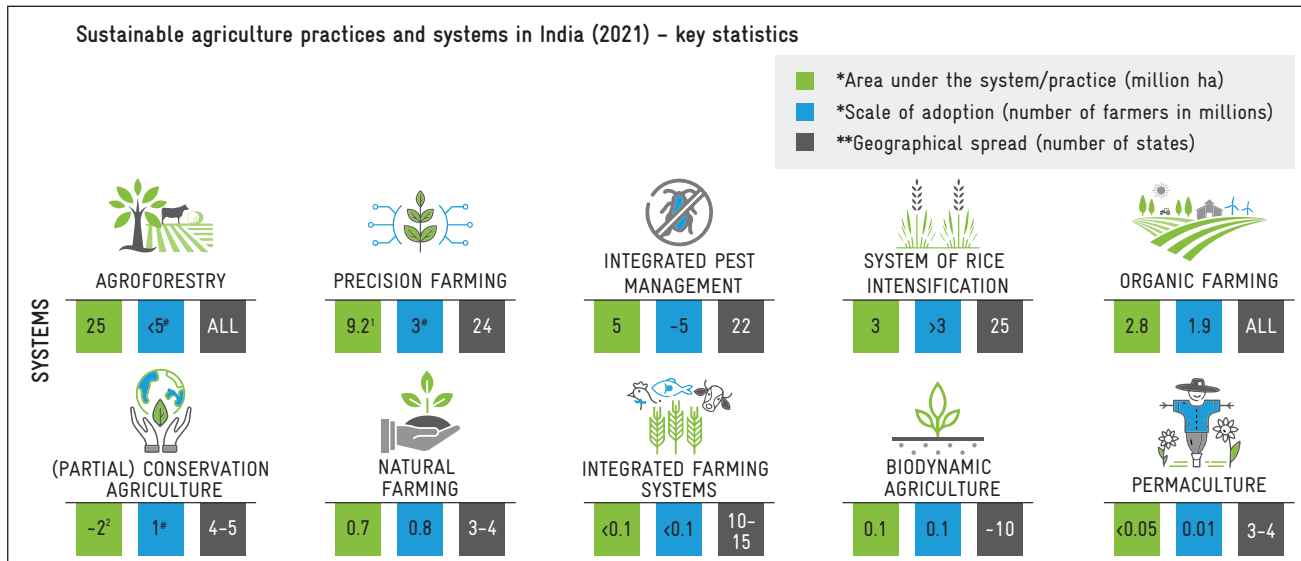


Figure 2: Sustainable agriculture practices and systems in India (2021) - key statistics

Source: Gupta, N.; Pradhan, S.; Jain A.; Patel, N. (2021): “Sustainable Agriculture in India 2021: What We Know and How to Scale Up”. New Delhi: Council on Energy, Environment and Water.

agriculture across the country. It constitutes multiple verticals centering on soil health, rainfed areas, agroforestry, and climate change. Besides NMSA, the Pradhan Mantri Krishi Sinchai Yojana focuses on improving water use efficiency and extending the cover of irrigation, and the Integrated Watershed Management Programme aids in restoring ecological balance by harnessing, conserving, and developing degraded natural resources.

In addition to the aforementioned policy interventions, numerous Civil Society Organisations (CSOs) are at the forefront of accelerating the efforts of scaling natural farming across the nation. CSOs across states like Maharashtra, Andhra Pradesh, Odisha, Rajasthan, and Madhya Pradesh are leading the natural farming movement. These CSOs are majorly working on promoting the agroecological practices, capacity building and creating awareness among farmers, support for input production and seed management, technology dissemination, and carrying out field demonstration activities.

2.4 Linkages with the Sustainable Development Goals

Since food is a common thread linking all 17 Sustainable Development Goals (SDGs), shifts in food production systems towards sustainability through the adoption of Natural Farming practices help achieve significant progress on all SDGs beyond addressing the problems of food security and hunger. Transformation of food systems envisages inclusive and equitable access to naturally-grown

nutritious food for everyone, thereby zeroing on the SDG 2 (Zero Hunger) and 3 (Good Health & Wellbeing). As Natural Farming also hinges on the carbon footprint and is known to augment soil carbon sequestration besides advocating for sustainable use of water and other resources, it enables the communities to do more with less, which is directly linked to SDG 13 (Climate Action).



Agroecological natural farming systems promote proximity between producers and consumers, help to raise awareness and reduce food wastage. Mindful use of natural resources, shortening of food supply chains, and reduction of wastage is directly linked to SDG 12 (Sustainable Consumption & Production). While the SDGs focusing on the areas at the intersections of hunger, health, and climate seem to be the apparent immediate beneficiaries of transformed and sustainable food production, there are critical linkages between the transition to agroecological practices and the less obvious SDGs – such as the ones around SDG 1 (No Poverty), SDG 5 (Gender Equality), and SDG 11 (Sustainable Cities & Communities) as well.

2.5 Vision 2030

Our vision is to ‘transform the current Food systems through agroecological Farming Principles by empowering women, smallholder farmers and consumers to ensure sustainable livelihoods, dignified life and responsible consumption at least in ten percent of the land’ in the next decade – by 2030. The task is bigger than what it seems in mere numbers. Natural Farming is a highly knowledge-intensive transition unique for each socio-technical agroecological context. This requires a coordinated comprehensive landscape-level approach that centralises the communities and existing knowledge systems and builds the social and natural capital while linking institutions to create a holistic circular bio-economy. Pathways to possibly achieve this are outlined below.

2.6 Pathways for 2030

2.6.1 Enabling Public Policies

Appropriate policy instruments are essential for scaling the transition to agroecology-based natural farming in the face of the entrenched status quo of green revolution technologies. While the NGOs and civil society organisations are playing a key role in implementing the proof of concepts and steering the agroecological movement, the promotion and adoption of these practices are still struggling with multiple bottlenecks. Several state governments have praised the efforts of civil society and are keen to adopt the implementation, however, to create a conducive ecosystem for the large-scale adoption of natural farming practices and transform food systems, policy support by the national governments is much needed.

- One of the major barriers to the adoption of natural farming practices is the lack of sufficient and timely access to bio-inputs. The promotion of bio-inputs for agricultural usage through public policies holds the potential to catalyse the adoption of natural farming practices and can support the transitioning farmers. Articulating the perimeter of the category of bio-inputs, creating a favourable environment for their production, designing and implementing bio-input promotion policies, encouraging individual and collective production of bio-inputs, improving the availability and affordability along with incentivising the application of bio-inputs, reviewing the current quality standards and regulations around bio-inputs,

educating farmers, and documenting the best practices implemented by the CSOs/farmers institutions around the production of bio-inputs are some of the potential measures that can foster a structural shift towards agroecological farming. Prospective policies linked to bio-inputs need to be flexible to empower the bio-input resource centres to remain contextual and locally relevant. In addition, stakeholders involved in natural farming may facilitate the proliferation of natural farming by building a body of evidence. One possible way of building evidence could be the creation of an interactive map of India of ‘Experts, Expertise & Experience in Natural Farming’. Besides, to ensure the timely availability of farm equipment for smallholders, Custom Hiring Centres need to be promoted and the fertiliser responsive seed breeding programme needs to be revamped to support indigenous, open-pollinated and locally resilient farmer’s varieties that are hardy and respond to systems rather than specific synthetic inputs.

- Crop diversity and dietary diversity are closely interlinked. India has witnessed a dramatic shift in the regional food systems in the last few decades, which resulted in the homogenisation of diets across the country. This shift can largely be attributed to the historic policy incentives offered by the state: input subsidies and output purchase guarantee at minimum support price for crops such as rice, wheat, and sugarcane. Consequently, acreage under the cultivation of the said crops expanded significantly, thereby eroding crop diversity and side-lining indigenous food grains like millets from our diets. Expanding and diversifying the basket of public procurement to include more crops, farmers, and regions can help to realise crop diversity, better nutrition through augmented dietary diversity and at the same time can contribute to solving the nation’s water and farm crisis.¹² Since traditional varieties respond better to multiple cropping systems in comparison to hybrid seeds, promoting these varieties besides tree-based crops, roots and tubers is the key for diversification. Despite diversification being central to food security, it doesn’t reflect in the policy initiatives and the reasons underlying this marginalisation need to be investigated. In addition, promulgation of diversification needs to be supplemented by technological innovation.
- Ecosystem services are direct and indirect benefits generated by the ecosystems that contribute to human well-being. Agricultural landscapes being an elemental

¹²Shah, M.; Vijayshankar, P. S. (2021): “Symbiosis of Water and Agricultural Transformation in India”. In: Chand, R., Joshi, P., Khadka, S. (eds) Indian Agriculture Towards 2030. India Studies in Business and Economics. Springer, Singapore. https://doi.org/10.1007/978-981-19-0763-0_5.

¹³Robertson, G. P.; Gross, K.; Hamilton, S.; Landis, D.; Schmidt, T.; Snapp, S.; Swinton, S. (2014): “Farming for Ecosystem Services: An Ecological Approach to Production Agriculture”. In: BioScience. Volume 64. Issue 5. 404–415. <https://doi.org/10.1093/biosci/biu037>.

part of the ecosystems, utilise and deliver beneficial ecosystem services to the society at large. The quality of these services is significantly impacted by the actions taken by the custodians on these landscapes. Conventionally, agriculture provides food, fibre, and fuel – “provisioning services” in ecosystem services lingo. In addition to these, agricultural ecosystems deliver “regulating services” such as climate regulation, water purification, surface water flows, groundwater level, and waste assimilation and breakdown.¹³ Although agroecosystems offer valuable ecosystem services to society at large, currently mechanisms to compensate the farmers for these services don’t exist. Payments for Ecosystem Services is one of the most reliable ways of increasing farmers’ income, an objective which can be aligned with the proposed national government’s intent of doubling farmers’ income. Evolving standard mechanisms for the valuation of ecosystem services and making use of existing frameworks like Compensatory Afforestation Fund Management and Planning Authority (CAMPA) for these payments could contribute to prompting farmers towards sustainable and natural farming. A possible policy suggestion in this vein could be a premium on the produce of those farming systems that render ecosystem services backed by a robust assessment and certification process.

2.6.2 Prioritising Research and Extension

Research is a critical supporting element in scaling up the efforts into natural farming. Despite the growing evidence for a wide array of social, economic, and ecological benefits of agroecology, there still hasn’t been a strong emphasis on the need for research, which is compounded by the lack of funding for it as compared to the research on conventional agriculture. Seeing natural farming and its principles at odds with science is a misconception that gives scope for great scepticism, which in turn is a roadblock for pushing the agenda of scaling up natural farming forward through research and extension. In principle, a reliance on traditional knowledge does not necessitate excluding modern science – in fact, agroecology consolidates scientific inquiry with traditional knowledge, as well as farmers’ and community-based innovations for shaping sustainable farming systems.¹⁴ Taking into account the range of benefits offered by natural farming systems, it is time for public authorities to prioritise mainstreaming agroecological principles

in research and extension by realigning the funding and research agenda and increasing natural farming’s evidence base through consistent monitoring and documentation. Since agroecology is a knowledge-based system, re-skilling of farmers, supplementing the indigenous systems, developing a comprehensive capacity building paradigm for different stakeholders around the agroecology based farming, revising the indicators for agriculture productivity beyond yield to move towards total system productivity as against total factor productivity, evolving systematic frameworks for advisory services across the value chain stages, employing digital technologies for effective and location specific extension services, and contextualising crop research in accordance as according to the agroecological zones are imperatives to mainstream natural farming knowledge systems.

2.6.3 Raising Consumer Awareness and Aligning Value Chains

The breakout of the COVID-19 pandemic has raised concerns about food and nutrition security worldwide. While the concern about the quantitative dimension of food is not new, studies in the last few decades in general and particularly during the pandemic have opened up a new aspect of food security i.e., micro and macronutrients. COVID-19 is closely linked to the human immune system and resilience of the body, and the disease has been more fatal with patients suffering from endemic diseases, a majority of which are comorbid disorders. There is evidence that comorbid diseases (like diabetes, heart disease, high blood pressure) are a product of highly homogenised and processed food. A paradox in highly open and liberalised markets, where food miles exceed more than thousands, the average diet is more homogenised than before.¹⁵ A paradigm shift towards natural farming is thus necessitated to overcome the perils of the status quo. Natural farming more than anything focuses on the diversity of crops and thus can cater to a heterogenised and balanced diet – sourced locally, devoid of chemicals and laden with necessary micro and macronutrients.

The vision towards this shift should not just flow down from the policy papers or should not reach the consumer via the supermarket shelves. There needs to be an effort to draw in for active consumer awareness towards natural food and products (the interplay of education, income and corporate social responsibility). The success story of consumer-driven movements for agro products – like Fair

¹⁴Parmentier, S. (2014): “Scaling-up agroecological approaches: what, why and how?” Brussels, Oxfam-Solidarité.

¹⁵Walsh, B. (2014): “Our Global Diet Is Becoming Increasingly Homogenized—and That’s Risky.” TIME. Available online at: <https://time.com/12366/global-diet-becomes-homogenized/>. Last accessed: 06.09.2022.

Trade products, certified organic products and gluten-free products, should be disseminated. Consumer awareness for such natural products will allow: (i) Better prices for farmers through direct interaction, (ii) Maintenance of retail and value addition chains, and (iii) Packet to Plate integrity.

The policy imperatives to achieve the same objectives can be as follows:

- Creating public awareness via media forums and government directives, incentivising consumption of natural farm produce.
- Portraying natural farming food as appealing and desirable via selected channels and campaigns to align the existing consumer need for better and healthy products.
- Creating an appeal for natural farm produce in the masses by rolling them out in schemes like mid-day meal, relief rations and state-subsidised food (Canteens in Tamil Nadu, Odisha, etc).
- Mandating a percentage for procurement under the Public Distribution System and rationing natural farming products to incentivise the consumer for a switch from the homogenised food.
- Amplifying the availability of natural produce and reducing the price gap between natural and conventional produce by localised production and consumption.
- Mapping consumer data not merely by calorie consumption, but also by micro and macronutrients in the food.
- Setting up stringent standards for agro-industries on the pricing of natural produce, preservatives added, shelf life and farm to shelf processes.
- Supporting and strengthening the start-ups in the organic and natural domain for broadcasting the benefits.
- Utilising digital technologies across value chains to transform the food systems.
- Building streamlined networks of farmers and consumers to shorten the supply chain.

- Devising a graded certification system to accredit farmers for their practices, input, fertility of soil etc., over the existing singular certification model.

2.6.4 Envisioning Growth that is Inclusive of Rural Women

In India, of all economically active women, 80% are employed by the agriculture sector. 85% of rural women in India are engaged in agriculture, despite only 13% owning the land.¹⁶ Nevertheless, rural women face discrimination and a range of social, cultural, and legal constraints that hinder their access to land, resources, and employment opportunities. Additionally, they are subjected to social exclusion from decision-making as well as labour markets. It is essential for policy frameworks to acknowledge women's role in food production and redistribute, recognise, represent women's productive and reproductive work.¹⁷

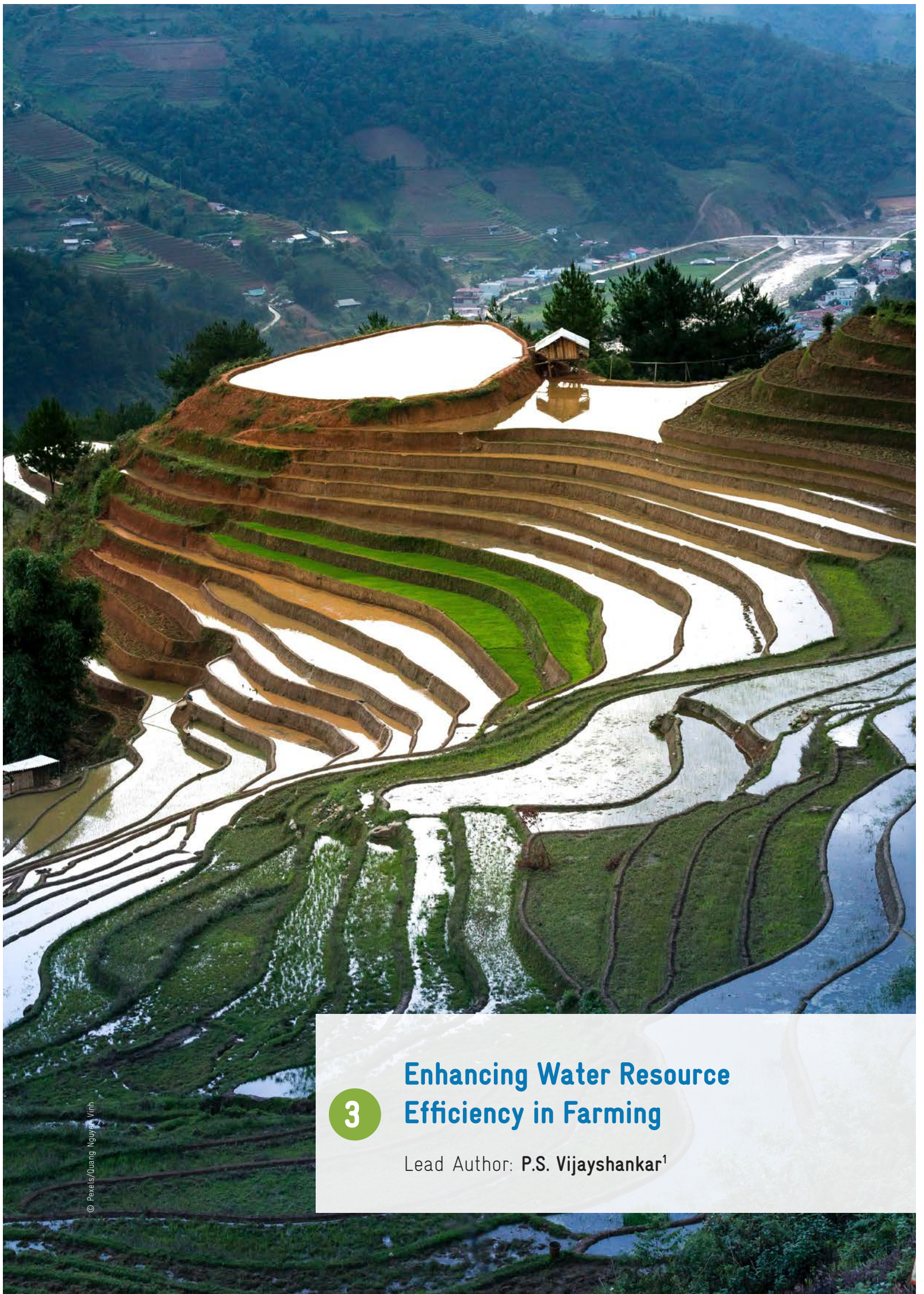
Against this backdrop, there is a need to enhance the knowledge of women farmers around the cultivation practices and involving them in decision making. Kitchen gardens are an excellent example where women have large participation and catering to the family's health and nutritional needs. In indigenous communities, women generally are the custodians of traditional seed saving practices, and this knowledge needs to be leveraged. Furthermore, partnerships between government and CSOs need to be structured in a manner that can create space for women's participation.

2.7 Case Studies

- Tribal Development Department, Gov. of Kerala (2020): "Reviving Traditional Agriculture of Attappadi". Available online at: <https://drive.google.com/file/d/1ZKqvS1Hd3v0Y0pQbsYSKdXvMU0U1yhSw/view>. Last accessed: 09.09.2022.
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¹⁶Oxfam India (2018): "Move over 'Sons of the soil': Why you need to know the female farmers that are revolutionizing agriculture in India". Available online at: <https://www.oxfamindia.org/women-empowerment-india-farmers>. Last accessed: 06.09.2022.

¹⁷Seibert, I. G.; Sayeed, A. T.; Georgieva, Z.; Guerra, A. (2019): "Without Feminism, There is No Agroecology". Global Network for the Right to Food and Nutrition. Available online at: <https://www.righttofoodandnutrition.org/without-feminism-there-no-agroecology>. Last accessed: 06.09.2022.



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3

Enhancing Water Resource Efficiency in Farming

Lead Author: P.S. Vijayshankar¹



VISION STATEMENT

Science and technology based agroecology-driven inclusive and productive water and land management for food system transformation in India.

3.1 Actionable Agenda

With an average rainfall of 1,105 mm and India's land area of 329 million hectares, the annual estimated water resources of India are about 3880 billion cubic metres (BCM). Studies by the Central Water Commission (CWC) over a period of 30 years (1985-2015) showed that the average annual water resource available is estimated at 1999.20 BCM, out of which only 1122 BCM can actually be utilised.² Several of the Indian basins like the Indus, Sabarmati, Pennar and Krishna are already becoming "closed" basins, with little opportunity for further development.³ The Water Resource Group of the World Bank characterises India's water security challenge as the problem of soaring demand, competing uses and finite availability of water.⁴ If the current pattern of demand continues, about half of the demand for water will be unmet by 2030.⁵ At least 54% of India has been identified to be highly to extremely water stressed and almost 600 million people are at higher risk of surface-water supply disruptions. Northwest India, the country's breadbasket, is facing high stress.⁶

3.2 Major Challenges

As the supply augmentation of water is severing, we need to focus our attention more on demand management of water and to finding sustainable solutions for our water problem. Agriculture is the sector with the highest water demand. A recent study by the National Bank for Agriculture and Rural Development (NABARD) and the Indian Council for Research on International Economic Relations (ICRIER) estimated that about 78% of India's annual freshwater withdrawals are used for agricultural purposes.⁷ FAO's AQUASTAT database puts this figure closer to 90%.⁸ The NABARD-ICRIER study further identified three "water guzzler" crops, rice, wheat and sugarcane, which occupy about 41% of the gross cropped area and consume more than 80% of the freshwater withdrawals for irrigation. This has meant grave inequity in the distribution of irrigation across crops and farmers and a strong mismatch between existing water endowments and the water demanded by these water-guzzling crops.

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Discussants & inputs: Surender Makhija and Anil Jain (Jain Irrigation), Aijth Radhakrishnan (2030 Water Resource Group), Mr. R.C. Kote (BAIF), Rajesh Jain (WAPSYS), Amita Bhaduri (India Water Portal), Dr. Jagdish Purohit and Rajeev Ahal (GIZ), Shri Alok Sikka (IWMI), Manish Dubey and Chandni Singh (Indian Institute of Human Settlements), R.V.Ramamohan (W L Foundation), Maya Acharya (Netherlands Embassy).

²Central Water Commission (2019): "Water and Related Statistics". New Delhi: Ministry of Jal Shakti, Government of India.

³Gulati, A.; Sharma, B.; Banerjee, P.; Mohan, G. (2019): "Getting More from Less: Story of India's Shrinking Water Resources". NABARD-ICRIER Report. Indian Council for Research on International Economic Relations (ICRIER). New Delhi.

⁴Water Resources Group (2014): "Building Partnerships for Water Security 2030". WRG Annual Report. p. 12.

⁵Shah, M. (2017): "For a Science-based Transformation of Water Policy", In: *Current Science*, Vol.112, No. 1.

⁶Bhanja, S.N.; Mukherjee, A.; Rodell, M. (2017): "Groundwater rejuvenation in parts of India influenced by water-policy change Implementation", In: *Nature: Scientific Reports*, 7, 7453. <https://doi.org/10.1038/s41598-017-07058-2>.

⁷Sharma, B.; Gulati, A.; Mohan, G.; Manchanda, S.; Ray, I.; Amarasinghe, U. (2018). "Water Productivity Mapping of Major Indian Crops". NABARD-ICRIER Report. Indian Council for Research on International Economic Relations (ICRIER). New Delhi.

⁸FAO (1994): "AQUASTAT - FAO's Global Information System on Water and Agriculture". Available online at: <https://www.fao.org/aquastat/en/>. Last accessed: 07.09.2022.

3.3 Current Status of Water Resources in India

The main reason why farmers grow such crops even in areas of patent water shortage is the structure of incentives, as they find that these crops have steady markets. Public procurement of food grains at Minimum Support Prices (MSPs) has played a big role in entrenching such water-intensive cropping patterns even in water-scarce environments. Even a small reduction in the area under these crops, in a region-specific manner, that does not endanger food security, would go a long way in addressing India's water problem.

If we were to make such a switch in cropping patterns, to reflect the agroecological diversity of India, what volume of water would we save? In a recent paper written for FAO-NITI Aayog National Consultation, Mihir Shah and myself explored the possible crop switches in both kharif and rabi seasons.⁹ The writers took the area under three most water-intensive crops (rice, wheat and sugarcane) and replaced them with less water-intensive crops like pulses and nutri-cereals. The choice of the replacement crops is governed by an analysis of the cropping pattern of the concerned state in the period before the monoculture of the Green Revolution takes firm roots there. The results showed that through seasonally appropriate agroecologically suitable crop replacements, we can save about 18-36% of the water applied in agriculture. Given that water-intensive crops currently occupy over 30% of the gross irrigated area in these states, the amount of water saved annually would be considerable.

It can be argued that these crop replacements will result in a reduction in total food grain output because of differentials in yields across crops. However, it must be borne in mind that the rapidly deteriorating water situation poses a very serious constraint to maintaining the productivity levels of water-intensive crops, especially in states like Punjab and Haryana. It would be fallacious to assume that output levels of water-intensive crops could be sustained indefinitely in these states. At the same time, aligning cropping patterns with regional agroecology would include raising the share

of Eastern India in national output and procurement of food grains. A recent study showed that the Eastern states, which are safe in their groundwater reserves, are net importers while the water-scarce regions are net exporters of water.¹⁰ This basic anomaly in water use in agriculture calls for immediate corrective action.

Price incentives play a vital role in correcting the anomalies in water resource efficiency in agriculture by promoting cropping patterns appropriate to the local agroecology. Not only the present MSP regime but market price incentives also need to change to support this movement to increased water efficiency. The price mechanism should take into account the ecological and socio-economic aspects of crop systems so that the market prices are aligned with water footprint. Marketing and branding campaigns based on the efforts put on water conservation of products could help popularise these alternative cropping systems and create a strong consumer base for them. The fundamental feature of the post-Covid food system is that it should cover a larger number of both farmers and consumers and evolve a stronger regulatory framework for agricultural markets, especially for food.

A major objection to the expansion of the scope of the Public Distribution System (PDS) is the possible implications it has for the food subsidy bill which is already over 15 billion US dollars. However, given the appalling levels of under-nutrition in India, this is a cost that we must be prepared to pay. There is also the fear that much of the enhanced subsidy would be drained away through "leakages" in the system. Recent experiences contradict this concern. PDS has been substantially reformed in many provinces, including those like Chhattisgarh and Odisha, where its coverage has been extremely low. A survey of the six poorest states in India showed that Chhattisgarh has a well-functioning, near-universal PDS which can guarantee supply of 7 kg food grains every month to the rural population along with some pulses and fortified salt.¹¹ Many other states like Tamil Nadu and Madhya Pradesh have reformed their PDS to check leakages and deliver food to those in need of it. Such experiences show that with political will, the system can be made to serve the poorest.

⁹Shah, M.; Vijayshankar, P. S. (2021) "Water in Agriculture". Theme Paper, National Dialogue on Indian Agriculture Towards 2030. Available online at: http://www.fao.org/fileadmin/user_upload/FAO-countries/India/docs/Full_Paper-6.pdf. Last accessed 07.09.2022.

¹⁰Harris, F.; Dalin, C.; Cuevas, S.; Lakshmikantha, N. R.; Adhya, T.; Joy, E.; Scheelbeek, J. M.; Kayatz, B.; Nicholas, O.; Shankar, B. (2020): "Trading water: virtual water flows through interstate cereal trade in India". In: *Environmental Research Letters*, 15 (12). p. 125005. DOI: <https://doi.org/10.1088/1748-9326/abc37a>.

¹¹Dreze, J.; Gupta, P.; Khera, R.; Pimenta, I. (2016): "Food Security Act: How are India's Poorest States Faring?", *Ideas for India*. Available online at: <https://www.ideasforindia.in/topics/governance/food-security-act-how-are-indias-poorest-states-faring.html>. Last accessed: 07.09.2022.

Along with initiatives for rationalising water use in agriculture, we also need to focus on conservation of rainwater through watershed management. Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is currently being used by many government and non-government agencies not only for provision of relief employment but also for public investment in water infrastructure.¹² Since the outbreak of Covid-19, the uptake of MGNREGA has considerably increased in different states which could be leveraged for greater water conservation and groundwater recharge with locally appropriate technologies. Another major point of action is the management of our irrigation commands. It is well-known that the gap between Irrigation Potential Created (IPC) and Utilised (IPU) has been going up due to inefficient management of the canal networks. In many parts of the command areas of irrigation structures, canals are virtually absent or are very poorly maintained. Bridging this IPC-IPU gap can in fact be a low-hanging fruit as far as water resource efficiency is concerned and greater investment needs to go into this activity.

3.4 Linkages with the Sustainable Development Goals

The themes of this paper are aligned to the Sustainable Development Goals set by the United Nations. SDG 6 is on **ensuring availability and sustainable management of water and sanitation for all**. The targets under this goal are:

Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

Similarly, SDG 2 is on ending hunger, **achieve food security and improved nutrition and promote sustainable agriculture**. The key target is given below:

Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

¹²(1) Narayanan, S. (2020): "The Continuing Relevance of MGNREGA". The India Forum. Available online at: <https://www.theindiaforum.in/article/continuing-relevance-mgnrega>. Last accessed: 07.09.2022.

(2) Shah, M. (2016): "Should India do away with the MGNREGA?". In: Indian Journal of Labour Economics, 59, 125-153. DOI: 10.1007/s41027-016-0044-1.

These goals and targets are at the core of the discussions in this paper.



3.5 Vision for 2030

The overall vision emerging for 2030 in terms of sustainable water management and food systems can be stated as follows:

Science and technology based agroecology driven inclusive and productive water and land management for food system transformation in India.

Bringing agroecology at the centre of land and water management emphasises the need to have science and technology interventions (the "economy") operate within the limits set by the ecosystem. This principle of water management necessarily implies greater water resource efficiency, environmental justice and attention to the poor and more inter-generational equity.

3.6 Pathways for 2030

3.6.1 Recommended Pathways

Six pathways of moving towards this overall vision are outlined below:

1. Realigning Cropping Pattern with Agroecology based practices to reduce the water footprint in agriculture
 - Realignment of crops and crop varieties based on the agro climatic regions. The most important step in this direction is for the government to diversify its crop procurement operations to align with local agroecology and natural resource endowments. The best way of doing this is to start procurement of crops that were prominently grown in each region before the monocultures associated with the Green Revolution set in.
 - The coverage of farmers can be enhanced by diversifying the system of public procurement at MSP outside the traditional procurement states and extending it as support to farmers growing less favoured crops in the rainfed regions. Coverage of consumers can be expanded by revamping the PDS and including nutri-cereals and pulses through it. Public distribution can be tied to the food-based entitlement programmes

- such as Integrated Child Development Services and provision of noon meals in schools. This linkage could go a long way in reducing the nutritional poverty of the most vulnerable sections of the people.
- Water budgeting; approaches based on Water and Carbon Footprint; emphasise water reuse and recycling.
 - Soil moisture as a tool for reduced water use; Irrigation scheduling based on soil moisture and measures to improve soil health, such as composting and green manuring.
 - Promotion of water saving methods and technologies such as Direct Seeding of Rice (DSR), pre-monsoon sowing etc.
 - Enhancing the area under micro-irrigation technologies such as drips and sprinklers.
2. Changing the intensive system of agriculture (diversified public procurement, expanded PDS)
- Economic incentives for farmers for moving towards less water-intensive crops. Mechanisms like MSPs should be adopted along with market-based price incentives. Marketing and branding campaigns based on the efforts put on water saving.
 - Evolving a concept where in market prices are aligned with water footprint of products. The concept of Social MSP could be adopted whereby the farmers who grow low water-requiring crops are compensated in terms of a higher price. This can be seen as a payment for the ecosystem services (ESS) rendered by them.
 - Market development for crop diversification with an enhanced role of private sector players is to be explored. Farmer Producer Organisations (FPOs) can play a big role here.
 - Financial mechanism for water use efficiency on the line of Jal Samruddhi in Maharashtra could be popularised. Haryana government also has recently initiated a programme of providing cash support via direct transfer to those farmers who shift to alternative and low water-requiring crops.
 - We should also investigate the ongoing projects, digital interventions, capacity building initiatives and draw learnings from these for upscaling and replication.
3. Increasing the irrigation efficiency in agriculture through systems like micro irrigation through public and private partnership
- Applying an area or landscape-based approach for subsidising the micro irrigation systems is an option. Conservation of water and energy alongside efficient nutrient use via smart irrigation/water management also has co-benefits of mitigation besides adaptation to climate change.
 - There are some public-private partnership (PPP) models around irrigation infrastructure taken by companies like Jain irrigation and others. However, the absence of a sustainable revenue model is the biggest constraint in such models.
 - Further research on micro-irrigation systems is needed to bring about more innovations; Governments and private players can take the lead in this. Given the wide range of private sector participation, the government needs to set-up the quality control mechanism for the MI systems and choose the suppliers carefully.
 - Improvement of irrigation efficiency also requires supportive policies in other government departments and sectors. Water policy needs to be integrated with other policies such as energy and food, given the water-energy-food nexus.
 - As mentioned, MGNREGA could be used as a tool for channelling public investment in water infrastructure. Since the outbreak of Covid-19, the uptake of MGNREGA has considerably increased in different states which could be leveraged for greater water conservation and groundwater recharge with locally appropriate technologies.
 - Irrigation management of canal commands to cover the IPC-IPU gap is an urgent initiative to be taken up. Restoring command areas of canals to health, equitable water distribution within the command and overcoming the issue of tail-ender deprivation in irrigation are critical areas that can enhance water resource efficiency in the canal-irrigated tracts of our country.
4. Implementing a landscape-based approach for efficient off-field irrigation infrastructure (watershed approach)
- Watershed development focusing on both conservation and management of small hydrological units should be the basis of water

resource planning. The rainwater use efficiency is enhanced through decentralised water harvesting, revival of traditional water harvesting structures, spring rejuvenation, recycle of wastewater and management of soil moisture.

- Village or watershed level water and energy use footprints needs to be addressed to bring the behavior change for better water use. Moving away from the conventional watershed approaches focused on surface irrigation, there needs to be clearer focus on aquifer management and storage.
 - Ecosystem services approach in water management to augment the water supply through watershed approach and demand side management should be brought together progressively at watershed, sub-basin and basin levels.
 - Formation of more river basin organisations (RVOs) and further steps for their management, governance and institutional management.
 - Panchayats need to be involved in planning the technology-based approach for creating infra for water use and storage. Sustainable agricultural practices should be part of the watershed package (Pathway 1 above).
5. Using innovative solutions for enhancing water efficiency
- Water efficient technologies available in India and outside should be piloted for large scale adaptation.
 - There is a need to examine the social barriers and enablers to changing water use behavior. Economic incentives alone do not work. Gender, local water practices, and dietary preferences, all shape what is grown and how. Value chain-based approach guarantee greater benefits to farmers.
 - Crop advisory services along with technology introduction lead to enhanced returns on farmers' investments. The private sector has a great role in this as they are the major technology provider.
 - As a part of smart irrigation scheduling, electronic sensors can be used to monitor soil-water conditions and assess plant water demand using automatic weather stations and satellite imagery. The private sector can play a big role in scaling up adoption of these technologies (already happening with farming communities in many places). For improved adoption, facilities for repair and maintenance of these systems

are critical and need investment at the local level in repair shops, replacement of damaged equipment etc.

- Climate based information and advisory to farmers; private sector may play a big role (Skymet, AccuWeather etc). Start-ups, incubators and platforms for providing agro-advisory and other services such as logistics, market access, input provision etc. could be conceptualised.
6. Using financial mechanism and incentives
- The agroecological transitions outlined would need appropriate financing mechanisms. Involving banking sector for providing affordable finance for sustainable solutions; the Umbrella Programme for Natural Resource Management (UPNRM) from GIZ & NABARD is an example (Hybrid model of loans plus capacity building)
 - Many of the private companies have come up with their own non-bank financial companies (NBFCs) to finance the products promoted by their parent organisation. However, cost of financing is still very high for farmers and FPOs.
 - There is a suggestion that micro-irrigation schemes could be made part of the infrastructure development projects. However, this would involve considerable subsidies to be provided to them, which needs a carefully worked out policy framework. Perhaps a blended approach of outcome-based financing around soil, water, climate, and GHG emission transitions together is an idea to be explored.
 - The Government may set up an irrigation management fund to finance the private sector players and other relevant stakeholders to take up irrigation reform and canal maintenance.
 - Enable smallholder farmers financially through micro-credits, which are easier for farmers to pay back but provide them with the needed financial support to e.g., implement more expensive farming but sustainable farming technologies.

3.6.2 Efficient Implementation Strategies

The pathways mentioned above would require carefully worked out implementation strategies. The feasibility of different components in these pathways is context-specific and hence, a careful analysis of the options available is critical. This should be the vast repository of knowledge with the farming communities who have an intricate understanding of the water-soil-crop-climate relationships.

The science that works on the ground is the one which can enable a dialogue with the farming communities and incorporate their traditional knowledge in the technology products developed. We could learn from several best practices and examples from different states in India.

- **The Centre of Excellence** by the Dutch Embassy provides innovative technologies from the Netherlands on the Agri-Water-Nexus. Indo-Dutch programme for enhancing water use efficiency in agriculture.
- The CIKS Chennai provides **water mapping** of rice varieties for market system orientation.
- NABARD is planning to have **an agroecology programme** for financing (GIVA). This is a scheme that would enable agroecological transitions at scale.
- A recent review¹³ of **climate change adaptation possibilities** in the water sector showed that watershed development programmes initiated in the 1970s, have evolved from infrastructure-heavy, top-down interventions to increasingly participatory resource management aimed at building water security and adaptive capacity. Interventions typically focus not

only on resource conservation but also on livelihood strengthening and community empowerment. These interventions have also been leveraged to improve local adaptive capacity to climate change. Lessons from such experiences are useful while conceiving a new generation watershed programme with a climate change adaptation focus (the new Guidelines for the **Integrated Watershed Management Programme (IWMP)** are expected to set stage for the initiation of these new generation projects soon).

- The recently initiated **Odisha Millets Mission (OMM)**, implemented in 14 districts of the East Indian state of Odisha and covering over 50,000 farmers, is an example of an initiative connecting procurement and distribution. Odisha has a high incidence of poor and undernourished population. OMM is a government-CSO collaborative programme that attempts to revive cultivation of nutri-cereals in the state and enhance its procurement at the local level. OMM then works on processing and marketing of nutri-cereals and expand consumption by linking these to the PDS. This is an example for other provinces growing neglected crops to follow.

¹³Singh, C.; Bazaz, A.; Ley, D.; Ford, J.; Revi, A. (2020): "Assessing the feasibility of climate change adaptation options in the water sector: Examples from rural and urban landscapes, Water Security". Volume 11, 2020. 100071. ISSN 2468-3124. <https://doi.org/10.1016/j.wasec.2020.100071>.



4

Innovating Farm Technologies for Transformation in Indian Food Systems

Lead Author: Sai Krishna¹

VISION STATEMENT

Transform the current food systems through agroecological farming principles at least in ten percent of the country within the next decade and adopt coordinated comprehensive landscape-level approaches that centralises the communities and existing knowledge systems.

4.1 Actionable Agenda

India is expected to surpass China in 2027 as world's most populous country. Though Indian Green Revolution has tripled the food grain production with only 30% increase in land under cultivation and was able to meet the shortages in food supplies; this growth in food production has challenged the resource base of the country, resulting in varied economic access to nutritious diets which in turn indicate high rates of stunting amongst children. The resource intensive food production systems of the past seven decades in India; the challenges of nutritional security (in spite of food grain surpluses) and degrading resource base in the country, call for transformations in food systems.

Food System, for this article, is understood to constitute production taken up by agriculture and food industry stakeholders, marketed and serviced for the consumption, nutrition and health of the consumer which contribute to the income and employment of the consumer.² A food system is never isolated in its real setting and holds a

dynamic exchange of information and material with its neighbouring systems viz., health systems, ecological & climate systems, economic & governance systems; and science & innovation systems. The article focuses on the 'people dimension' and 'farm technologies' in the transformation of food systems range between 'farm gate' and 'consumer plate'.

This article discusses the dimensions of innovating farm technologies towards overcoming the challenges of nutritional security (including food security) while overcoming the challenges of diminishing biodiversity,

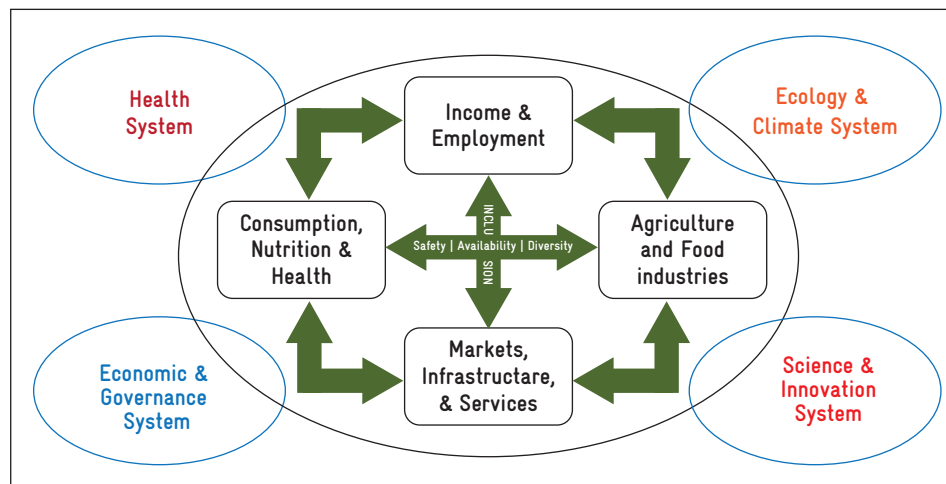


Figure 1: Interaction of various factors in the food system

Source: von Braun, J.; Afsana, K.; Fresco, L.; Hassan, M.; Maximo Torero, M. (2021): "Food system concepts and definitions for science and political action". In: *Nature Food* (2), pp. 748-750. Available online at: <https://rdcu.be/cxPxJ>. Last accessed: 20.09.2022.

¹Sai Krishan is with the National Skills Foundation of India. Further inputs were provided by GIZ colleagues from various projects.

²Source: von Braun, J.; Afsana, K.; Fresco, L.; Hassan, M.; Maximo Torero, M. (2021): "Food system concepts and definitions for science and political action". In: *Nature Food* (2), pp. 748-750. Available online at: <https://rdcu.be/cxPxJ>. Last accessed: 20.09.2022.

GHG emissions, land & water degradation and plateauing of land availability for food production. The article differentiates a technology's availability and its access, use and perceived outcome for the end user. Though the food system transformation can be discussed from the system's perspective, the article adopts a people/stakeholder perspective.

Anchored by Indian Council and Agricultural Research (ICAR) under the Ministry of Agriculture and Farmers' Welfare, technological contributions towards production and productivity enhancement have made significant strides in the last few decades. Contributions from this public system to the fields of germplasm conservation, varietal/breed improvements, good agricultural practices, pre-production – production – post harvest equipment and machinery, processed food compositions and shelf stability for diverse animal products from camels, goat, poultry, mithun, supply chain technologies, and climate smart technologies (soil, water, nutrient conservation and crop husbandry) have been multi-fold. These technologies hold huge potential to geometrical proportions if they find their way to on-farm adoption.

While the contribution from public systems has been diverse and slotted to be commercialised, several technologies in the above dimensions of food systems also were brought out by the private sector, especially farm machinery, varietal/breed development, processed foods, and logistics & supply chain, making a good head-way in securing the food and nutritional requirements of growing population.

4.2 Major Challenges

India's economic growth since independence has seen the co-existence of the 'best' and 'not so best'. While upper- to middle class components of the society have diverse and rich nutrition, the other far end of the continuum either are devoid of two square meals or deficient in diversity and quality of nutrient uptake (even if they have sufficiency in quantity). The situation – which is that more than 35.8% of children below five years are being underweight, 38.4% being stunted and 21% wasted (International Institute of Population Sciences, 2017) – speaks volumes of the nutritional security of the country. Despite of India's economic progress, persistence of regional inequalities and malnutrition exacerbated by the growing population, the country can get into a public health challenge if not addressed on immediate basis.

These nutritional deficiencies in the society are a result of various challenges that the three principle stakeholders of India's food system viz., 'producer', 'consumer' and the

'value chain player' are facing. While availability of a food is an important dimension of an effective food system, access and quality (including diversity) do constitute the important ingredients to be taken care of. On the other hand, consumer choice is a function of not just the availability but also their appeal (in terms of cost, taste, convenience and enjoyment), being familiar, mainstream and easier (possible automatic or default choice).

Challenges of Indian Food Systems constitute multiplicity of dimensions at different levels (from farm gate to the consumer choices at society level) that include:

- Deteriorating quality of natural resources viz., soil (overuse of nitrogenous fertilisers and very low use of micronutrients or other soil ameliorants), water (over use of ground water leading to their depletion) and air with a bearing on cost of food and quality of produce
- Climate change (rising temperatures, frequency & distribution of rainfall – droughts & floods)
- Poor access to land, credit, technology and infrastructure to marginalised communities in the food production systems

Challenges in the market system (gate to plate) are:

- Fragmented land holding and continued decline in land holding size – with implication on increasing extension, aggregation and agency costs – which in turn affect the way food/produce is aggregated and transported to the consumer plate. This in a way influences both the availability, access and cost implications at consumer plate
- Growing urbanisation and increasing (transactional) costs of food supply delivery
- Losses in the food supply system to the tune of 40% is humungous and implies the waste of natural and financial resources that are being invested into the food production
- Poor logistics in agriculture (input supply, produce aggregation and connection of rural-urban production-consumption centres)

Various challenges at the food basket level include:

- High emphasis on twin staples
- Calorie sufficiency focus and neglect of quality & diet diversity
- Differential dietary/nutrition requirements across socio-economic strata of the society. (under-nourished communities – diversity in daily food and inclusion of animal sources; high end of the consumption spectrum – decreasing energy intake and predominance of plant-source food

- Mismatches in demand for diversified food needs of consumers vis-a-vis production planning in rural hinterlands – leading to issues of cost, convenience and ease of default choice
- Disconnect between the production of certain nutrient rich produce on farmlands and the geographical spread of consumers who are in need of such produce – that influences the convenience and ease of access for the consumers

As India is aspiring to harvest its demographic dividend, nutritional security with an implication on the mental & physical growth of its population must be paid most attention. Furthermore, transformation for the economic and social progress of the Nation is key.

The technology development from the public systems (read as ICAR) has been very diverse and rightfully in the domains that are often ignored by the private sector for want of demand or that fall into the market inefficiencies etc., processed foods from Goat, Camel, Mithun etc. However, the food and crop production technologies by private sector perhaps made greater in-roads into the producers’ fields and consumers’ plates. This can be either due to their alignment from the market demand or may be due to the focus of private sector on felt needs while the public systems were focussing un-felt needs (with futuristic demand estimations).

4.3 Current Status of Innovating Farm Technologies in Government and Private Sector Initiatives

Several public and private sector initiatives did contribute to the food systems of the country. Apex government establishments that are supporting the food systems include Ministry of Consumer Affairs, Food & Public Distribution; Ministry of Agriculture & Farmers’ Welfare; and Ministry of Food Processing Industries. Some of the game changing interventions are stated in the following:

4.3.1 Public Distribution System (PDS) and Minimum Support Prices (MSP) in India

The PDS is a joint responsibility of both the Union and the State Governments catering to the nutritional security of country’s marginalised communities. The responsibility of Union government lies in terms of procurement, storage, transportation and bulk allocation to States, while the State government holds the responsibility of identification of eligible families, issue of ration cards and supervision of the functioning of Fair Price Shops (FPSs) etc., the central allocation to the states as in wheat, rice, sugar and kerosene. Some States also distribute pulses, edible oils, iodised salt, spices, etc.

The distribution of commodities under PDS has been largely concentrating on twin-staples and is more calorie

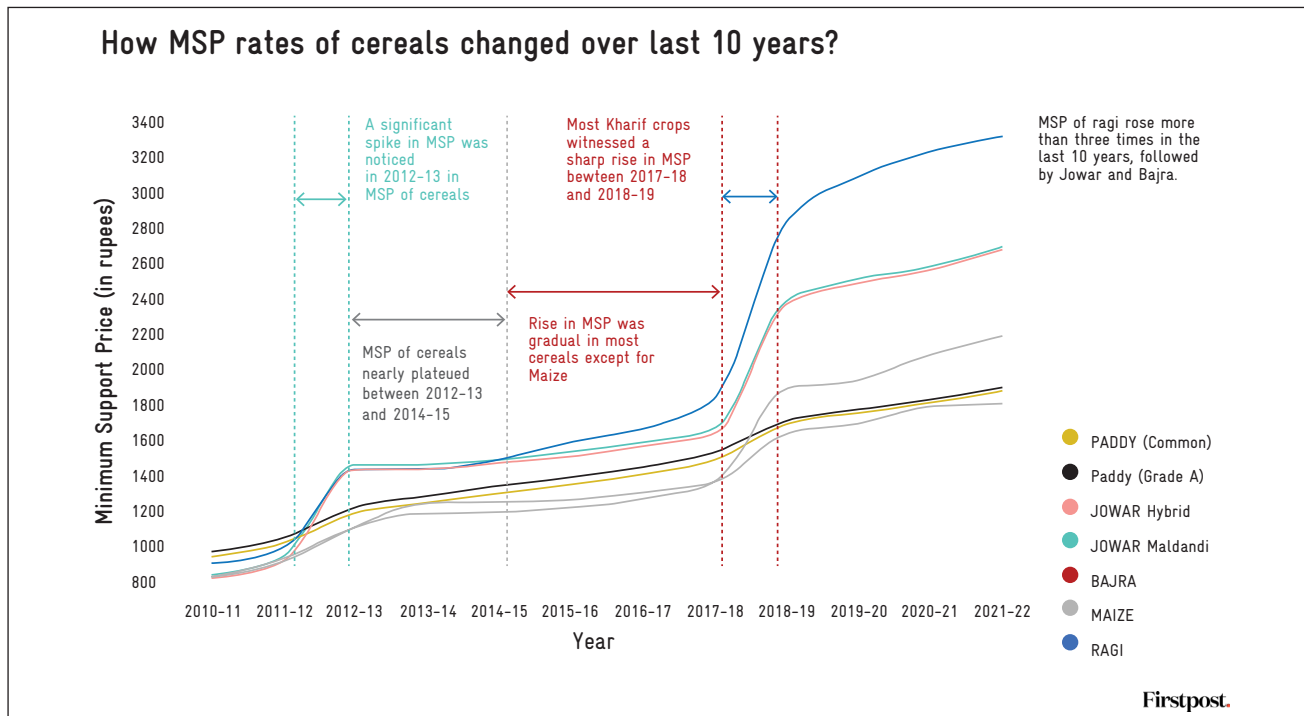


Figure 2: Change of MSP cereal rates over the last ten years

Source: Firstpost (2021): “Explained: What is MSP and how prices for Kharif crops changed in last 10 years”. Available online at: <https://www.firstpost.com/india/explained-what-is-msp-and-how-prices-for-kharif-crops-changed-in-last-10-years-9708811.html>. Last accessed: 07.09.2022.

centric, while the emerging need of the country is for nutritional quality and diversity.

The responsibility of the Union Government to procure food grains towards fulfilling the responsibility under the Ministry of Agriculture and Farmers' Welfare is taken up through the Minimum Support Process Mechanism. The skewed focus on twin-staples at the consumer end in PDS connects back to the procurement dimension too. While MSP crops (23 in number)³ cover about 90% of the cultivated area in the country, purchases of wheat, paddy and cotton constitute 37%, 44% and 30% respectively of their total market value. In case of all the remaining crops, this value is a dismal 9%.

Surprisingly, MSP of Ragi has increased more than thrice in the last ten years followed by Jowar and Bajra.⁴ In spite of such an increase, entry of these cereals into the food basket has not been very encouraging. Procurement of these cereals under the scheme of MSP and its linkage with PDS can be a potential means of transforming food systems in the country.

The Food Corporation of India (FCI), with its principal focus on wheat and rice procurement, throws open the gap in procurement of other cereals, pulses and oil seeds. With larger dependence on State Governments for MSP support and consequent last mile procurement, a national policy of diversifying the basket of PDS and its linkage with the MSP mechanism is the need of the hour. Although the MSP support is extended to five other cereals, five types of pulses and seven kinds of oil seeds and with the opportunity of their procurement, only two of the staples being distributed in the PDS calls for special attention in seizing the opportunity. Given the increasing role of e-markets in agricultural commodity trading off late; and the advent of several private players (read as start-ups) enrolling farmers with crop management and advisory services through digital means and Internet of Things (IoT) technologies further increases the feasibility of such integration.

FCI, being the largest player engaged in procurement under PDS and MSP systems, having a limited focus on the twin staples; and dependence on middlemen, commission agents, Agricultural Produce & Livestock

Market Committee officials for procurement of other staples, pulses and oilseeds calls for their integration in to the public system to ensure food security (including quality and diversity terms) of millions in India. MSP policy reach is predominantly in zones of commercial agriculture and calls for information dissemination about the MSP to farmers through multiple & professionally run extension agencies.⁵

4.2.3 Indian Council of Agricultural Research (ICAR)

Indian Council of Agricultural Research (ICAR), the apex organisation of agricultural research in India is doing yeoman service to the agriculture and food industry of the country. On the production dimension, several varieties across food grains, animal husbandry, horticultural crops are released year on year and especially varietal improvement for Indian Agriculture to stand up to the challenges of climate change is noteworthy.

With its large network of research institutes, bureaus, directorates and research centres, the contribution of ICAR has been into diversified fields of the Indian food system such as **genetic improvement, farm machinery** (viz., pea de-podding machine; poultry processing cum by-product collection unit), **value chain efficiencies** in the food system (viz., ultraviolet disinfection system, fat free flavoured makhana, adulteration testing kits for chillies, black pepper, turmeric powder, red chillies, black pepper, coriander), **food processing & products** (viz., primary makhana roasting machine, soy based composite edible film, natural dye extracted from walnut hull etc.).

While these technologies are piloted, demonstrated, and disseminated through 722 Krishi Vignan Kendra across the country; and through the social media handled of Facebook and YouTube channels; measuring the success in terms of such technologies' adoption at producer level and by the food industries (that can utilise the break-through of food processing technologies) is the need of the hour. With over Rs. 7,000 crore investment into agricultural research, the country is undoubtedly protecting the germ plasm and making progress in technologies' development, however, such large investment can only contribute to the food system when these technologies are disseminated to the end user and are adopted.

³Commission for Agricultural Costs & Prices (2022): "Organisation". Available online at: <https://cacp.dacnet.nic.in/content.aspx?pid=32>. Last accessed on 06.09.2022.

⁴Firstpost (2021): "Explained: What is MSP and how prices for Kharif crops changed in last 10 years". Available online at: <https://www.firstpost.com/india/explained-what-is-msp-and-how-prices-for-kharif-crops-changed-in-last-10-years-9708811.html>. Last accessed: 06.09.2022

⁵Deshpande, R. S.; Raveendra Naika, T. (2002): "Impact of Minimum Support Prices on Agricultural Economy: A Study in Karnataka". Agricultural Development and Rural Transformation Unit, Institute for Social and Economic Change. Available online at: <http://www.isec.ac.in/41%20Impact%20of%20MSP%20on%20Agr.%20Eco%20Kar.pdf>. Last accessed: 09.09.2022.

The Android app KISAAN-Krishi Integrated Solution for Agri Apps Navigation, which provides an integrated interface for more than 110 apps in agriculture and allied areas developed by ICAR institutions, has 10,000+ downloads. It is time ICAR takes up wider publicity of this app.

Such large institutional infrastructure commanding 2.2 lakh followers on Facebook and 50,000 YouTube subscribers – two new age dissemination vehicles of modern India is far from the desired. In the age of Google led translations and free vernacular tools available, which can aid professional agencies reach out to the partially literate at low cost, it is high time reach to the end user and technology adoption finds place in the evaluations. Similarly, to boost the technology adoption, identifying producers as a critical ingredient of the Indian food system, it is essential that the current rate of 5.81 Lakh farmers visiting Agricultural Technology Information Centres (ATICs) for obtaining solution related to their agricultural problems, would have to be improved.

On the other front, the commercialisation of ICAR technologies, establishment of a special vehicle Agri-Innovate is in the right direction. It is time the innumerable innovative technologies find their way to the farm gate and the consumer plate.

4.3.3 Digital Agriculture Directorate under Department of Agriculture and Farmers' Welfare

Establishing a directorate for digital agriculture during the times of information revolution is a welcome move from the government. The World Bank in a recent report has suggested the adoption of digital agriculture for the country; and stated that ‘The digital revolution—and the data it generates—are key to building an agriculture and food system that is efficient, environmentally sustainable, equitable, and able to link the world’s 570 million farms with 8 billion consumers’. Given the challenges discussed in the above sections, the aspirations of the Directorate to support ‘farmers in informed decisions – crop choice, varietal choice, time and practices for yield maximisation’, ‘planning by supply chain players based on timely and precise information’, ‘decision by farmers on when, where and what price to sell’ etc., are in the right direction.

The curation of National Digital Agriculture Ecosystem, that can pave the way for bringing efficiencies in the food systems of the country, is something to look forward to.

4.3.4 Evolution of Digital Agriculture and Potential Efficiencies in the Food Systems of the Country

The new trend of emerging and evolving start-ups in the country appears to be holding a great promise for transforming the food systems in the country. In the recent past, India witnessed the growth of various big data analytics/digital start-ups⁶ that can offer relevant and needed-based advisory services, ranging from nutrient advisory, crop advisory (pest and disease forecasting, detection) to weather and market advisory, to target the Small Scale Producers in the country. An illustrative list of such start-ups, which can potentially bring in efficiencies in the production and supply systems through resource use efficiencies from farm gate to consumer plate, is provided in the table below:

Table 1: Start-ups in the production and supply systems

Identification of nutritional status and advisory	Chlorophyll Meter
Pest-disease forecast, diagnosis & package of practices recommendation	Plantix, Cropin/mKrishi/Kisan Suvidha/Kisan Hub
Supply of good quality agri-inputs	Dehaat/Big Haat/Agro Star
Facilitate irrigation water use efficiency	Agsmartic/Kisan Raja/Flybird
Weather advisory	Skymet/Satsure/Yuktix
Access to warehouses with credit linkages	Ergos, Arya Collateral
Access to farm machinery	Oxen Farms/EM3/Gold Farms
Technology based financial access	KisanDhan/Arya Dhan/Origo

Various individual digital technologies, that are hitherto unable to offer services at affordable prices, are to be brought together through integration in a given geography to gain synergies and offering meaningful, relevant and integrated solutions to the small-scale producer. Such a bundle of services is expected to enhance productivity and sales realisation of small-scale producers in a viable and sustainable manner. This would need collaboration between government and private sector entities.

⁶Nishimura, T. (n.d). “Big Data Analytics Market- Future Scope in India”. siliconindia. Available online at: <https://special.siliconindia.com/viewpoint/cxinsights/big-data-analytics-market-future-scope-in-india-nwid-8846.html#:~:text=The%20Big%20Data%20Analytics%20market>. Last accessed: 07.09.2022.

Technological innovations in the supply chain have been a fundamental driver of dietary change through human history.⁷ A shift to healthy and sustainable food habits would need transformation in the land use, crop diversity and its aggregation. Additionally, it seems like there would be less supply to the end consumer. This would need big data analytics given the limitations of smaller land sizes in India and the disaggregated supply centres of crops, especially the coarse cereals and other diverse nutritional crops in the country.

An analysis of land use to deliver a healthy diet to everyone calculated that land under cereals, oil crops and sugar crops would decline by 150, 105 and 30 million hectares respectively. Land under vegetables and fruits would increase by 170 million hectares, while the trajectory for land to produce livestock would depend on the balance of plant and animal proteins in the diet.⁸

4.4 Linkages with the Sustainable Development Goals

Various Sustainable Development Goals (SDGs) that have a bearing on the sub-theme of the article i.e., ‘innovating farm technologies’ include:



4.5 Vision 2030

In the backdrop of numerous challenges on the path to sustainable food systems and the perceived need for innovating farm technologies, it is imperative to envision a path that can increase the access of producers and consumers to food and food products that too in a sustainable way.

In the words of William Gibson (1993),
‘The future is already here – it’s just not evenly distributed.’

It is envisioned that by 2030, at least 10% of the small and marginal farmers will gain access to various farm technologies through innovative digital technologies (including big data analytics and internet of things), aiding them in achieving higher, sustainable productivity (through technology driven resource use efficiency) and income, paving the way for marginalised consumers gaining access to a diverse food basket and thus helping them achieve nutritional security. Such a vision is envisioned as equitable distribution across the stakeholder groups through resource and scale neutrality.

4.6 Pathways for 2030

As discussed in the previous sections, the Indian food systems are plagued by several paradoxes:

- Certain customer segments of the society did achieve nutritional security with a diverse food basket – However, a large majority of the population is still dependent on ‘calorie’ based/quantity-based food security measures
- The country has a strong research and development system, bringing out several technologies to overcome varied challenges in the production environment and natural resource base. However, several of these technologies are yet to make their way to the end user for adoption and harvest the value such technologies have in the offering.
- India is one of the top five breeding grounds for technological innovations, especially digital technology with big data analytics and internet of things as their backbone, which offer fragile and decentralised solutions to the scenarios small and marginal land holding of producers in the country – However, the supporting ecosystem that can integrate multiple sectors (public, private and civil society) in offering real time and practical solutions to end user challenges is yet to mature and yield results.
- Minimum Support Prices of coarse cereals have tripled in the last ten years and prices of a variety of food grains such as pulses, oil seeds are protected. However, such nutritious grains and oil seeds are neither finding

⁷Herrero, M.; Thornton, P. K.; Mason-D’Croz, D.; Palmer, J.; Benton, T. G. et al. (2020): "Innovation can accelerate the transition towards a sustainable food system". *Nature Food*, 1(5), pp. 266-272. <https://doi.org/10.1038/s43016-020-0074-1>.

⁸Krishna Bahadur, K. C.; Dias, G. M.; Veeramani, A.; Swanton, C. J.; Fraser, D.; Steinke, D. et al. (2018): "When too much isn't enough: Does current food production meet global nutritional needs?". *PLoS ONE* 13(10): e0205683. <https://doi.org/10.1371/journal.pone.0205683>.

their way to the consumer plate nor is the private sector able to trigger the palate of end consumer.

- Venture capitalists and impact investors are willing to bet on the merits of various technologies in the country. However, such technologies are not able to convince the end users (producers and consumers) on the merit leading to wide scale adoption.

In this backdrop, and regarding the institutional architecture in India, the following pathways would help in achieving the envisioned sustainable production and consumption through innovating farm technologies:

- Strengthening of agricultural extension and advisory services towards technology adoption and sustainable production practices and remunerative income for producers. Mainstream use of modern media tools for information exchange and technology transfer.
- Innovate the farm technologies on the dimensions of their frugality, adoptability and relevance of market demand.
- Supporting the use of digital technologies with data analytics and internet of things
 - In achieving resource use efficiency at farm level
- In enabling supply chain efficiencies from farm gate to consumer plate
- In demand aggregation and production planning to align production with changing consumer preferences and needs.
- Popularise various processed products and technologies that are already developed for wider currency and consumer acceptance.
- Promote staple diversity through policy driven crop planning and strengthening MSP procurement mechanisms. This is to be taken up through public-private partnerships especially achieving synergies through technological interventions.
- Communication between MSP and PDS data stacks and promotion of nutritious cereals and pulses for the beneficiaries of PDS.
- Supporting outcome driven partnerships between technology agencies and public funded institutions in the ambit of Digital Agriculture. Encouraging private sector investments into technology agencies that cater to the needs of end user (producer/consumer).



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5

Empowering Farming Communities

Lead Author: Girija Srinivasan¹



VISION STATEMENT

As a country, we need to ensure that farmer-centric policies, institutions, systems and processes are in place to promote sustainable agriculture. Farmers, especially women, need to have financial security, access to information and alternative solutions to manage risks and learn new skills.

5.1 Actionable Agenda

For about 58% of India's population, agriculture is the primary source of income,² which measured on the current population size of around 1,38 billion amounts to more than 800 million people. Besides the rising world's demand for agricultural products, a steady increase in agricultural production is also demanded by the Indian population itself due to rising urban and rural income as well as a continuously increasing population. Some competitive advantages constitute the high proportion of agricultural land as well as diverse agro-climatic conditions that allow to grow a large variation of crops.³ Despite governmental support schemes, most farmers in India are small, marginal and increasingly women who cannot afford or are not informed about innovative agricultural inputs to increase their productivity and income.⁴ There are many approaches to help these farmers lift their production and living standard. Among them are the extension of adequate infrastructure, facilitation of credit access and more efficient farming methods, which are

fostered by agricultural innovation and R&D (research and development). The R&D in the agricultural sector is however insufficiently supported by the Indian government that currently only spends 0.7% of the agricultural GDP on it, which is less than half the world's average.⁵ Another component to achieve higher agricultural income and by this, gain power and control over a farmer's life, thus empowering them, are connections and cooperations. Different stakeholders in the agricultural production chain as well as farmers themselves in their communities can economically support each other by sharing knowledge, experience and tasks.⁶ Group farming can provide resource-constrained farmers an opportunity to pool land, labour and capital and lead to economic advantages under specific conditions and adapted to local contexts. For this, administrative and technical capital, socially strong neighbourhood groups, economic heterogeneity with educated members, an adequate group size and the consideration of local potential of commercial farming play an essential role in the success of farming groups.⁷

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²"Agriculture in India: Information About Indian Agriculture & Its Importance" (2022): IBEF. India Brand Equity Foundation. Available online at: <https://www.ibef.org/industry /agriculture-india>. Last accessed: 20.09.2022.

³Ibid.

⁴Kumar, V., Wankhede, K. G., & Gena, H. C. (2015). "Role of cooperatives in improving livelihood of farmers on sustainable basis". American journal of educational research, 3(10), 1258-1266. Available online at: [education-3-10-8.pdf \(scieducationalresearch.com\)](https://www.scieducationalresearch.com/education-3-10-8.pdf). Last accessed: 20.09.2022.

⁵"The enrichment of India's farming community is the key to adding US\$4.3 trillion to Indian GDP" (2016). Greater Pacific. Available online at: <https://www.greaterpacificcapital.com/ thoughtleadership/the-enrichment-of-indias-farming-community-is-the-key-to-adding-us43-trillion-to-indian-gdp>. Last accessed: 20.09.2022.

⁶"Farming communities - Our Theory of Change" (2022). Farming Communities. Available online at: <https://www.farmingcommunities.org/>. Last accessed: 20.09.2022.

⁷Agarwal, B. (2020). "Does group farming empower rural women? Lessons from India's experiments". The Journal of Peasant Studies, 47(4), pp. 841-872.

5.2 Major Challenges

Agriculture is the largest private enterprise in the country. The farming community, which includes farmers, pastoralists, forest dwellers and fishers, are facing high risks and numerous challenges (for example from prices, policies, diseases, erratic weather and climate change). An enterprise can survive only if it can grow consistently. Growth depends upon savings and investment, both of which are a function of net returns from the enterprise. The net returns determine the level of income of farmers. Accelerating the growth of agriculture is necessary to increase the incomes of those dependent on agriculture. The factors of production – land, water, human resources and finances – have to optimally perform to produce returns. Farmers need to be empowered to function as market-led commercial entrepreneurs.⁸

India derives only 15% of its Gross Domestic Product (GDP) from agriculture, though about 42% of its population remains dependent on farming. Of the 42% dependent on farming, more than 50% do not own land but work as labourers as they have no other options. According to the agricultural census, 2015-16, out of 146 million farm holdings, nearly 100 million are marginal, smaller than one hectare in size. The average size of the Indian farm has shrunk by more than half over last 45 years – from 2.28 hectares to 1.08 hectares, which has an impact on the farming potential, scale of production, adoption of technology, access to other support services, marketable surplus, credit and ultimately profitability.⁹ To optimise the usage of resources – land, water, agricultural machinery and to negotiate better terms of trade, co-operation and collectivisation among farmers is critical.

While the country is achieving a surplus in food production, the farming community is not assured of remunerative returns and income resulting in agrarian distress.¹⁰ The green revolution, white revolution and blue revolution have brought about food security; the input intensive practices have dealt a blow to the ecological sustainability. About one third of the lands have turned into problem soils,

becoming acidic, alkaline or saline.¹¹ Water, another factor of production, is under stress. Yields are plateauing. India's yield averages for most crops do not compare favourably at global level. The costs of cultivation are rising. Access to institutional finance at reasonable rates of interest still is a challenge for small and marginal farmers¹² especially in central and eastern states. Small and marginal farmers operated 47% area under cultivation (2015) but have about 9% share of credit. Climate change is stretching the farmers' ability to adopt coping and adaptation measures. The magnitude of food loss and food waste is high, with one third of production getting wasted.

Amidst declining natural resources in terms of shrinking land holding, water related issues and soil degradation, poor human resource support in terms of extension services, exploitative markets and farming communities have been vested with the moral responsibility of meeting food and nutritional security of the country on a sustainable basis.

Government policies and resources have been aimed at ensuring food security and towards enabling farmers to grow more with direct cash transfers, subsidies for fertilisers, interest subventions on loans, free irrigation and free electricity by a number of states etc. A section of farmers have benefitted from free electricity, cheap fertilisers, no income tax, assured Minimum Support Prices (MSPs) in Government mandis. However, farmers in rain fed areas have not equally benefitted. The slew of subsidy programmes and employment guarantee schemes demand more funds than productivity enhancing investments on irrigation, roads, electricity, research and development. The long-term investments for gross capital formation by governments have been on the decline in recent years, which has an impact on the private sector investment and on incomes of farmers. The composition of total investments in agriculture show that 78.2% of it stems from households (i.e. farmers themselves), while public investments constitute 19.4% share. Private corporate sector accounts for less than 2.5% of investments in the agriculture sector.

⁸Committee on Doubling Farmer's Income (2017): "Historical Analysis and Examination of India's Agricultural Production and Farmers' Income". Volume 1. Available online at: <https://farmer.gov.in/imagedefault/DFI/DFI%20Volume%201.pdf>. Last accessed: 20.09.2022.

⁹NABARD (2019): "All India Rural Financial Inclusion Survey 2018-19".

¹⁰with many farmers wishing to leave farming if they can get employment elsewhere.

¹¹According to the estimates, 37% of the land area in the country (that is, about 120.4 million hectares) is affected by various types of degradation.

¹²NAFIS survey reports that only 43% of the agricultural households reported to have availed a loan in the past one year; about 60% of them had borrowed from institutional source. As per the report on Doubling of farmers' Income, Among the various land classes, a higher percentage of investment is carried out through the informal sources of borrowings such as moneylenders, traders and input dealers by the landless (40.6%), marginal (52.1%), and small farmers (30.8%).

Farmers need measures that ensure a huge leap in productivity, better mix of farming activities to meet consumer demand with more remunerative prices, improved farm to plate marketing chains that increase farmer share of the consumer price, protection against climate change and new mechanisms for reducing risk and uncertainty. They need viable choices that will assure them adequate income.

5.3 Current Status

The farming community produced enough food, feed and fibre to Indians as the population grew from 330 million at the time of independence in 1947 to 1.38 billion in 2020. From dependence on import of food grains, India has become food secure and also a limited exporter. All this was made possible with the infusion of innovative technologies, along with supportive policies and institutions. The adoption of high-yielding varieties of wheat and rice, with intensive inputs of water, fertilisers, and pesticides, has led to surplus production. The central government guaranteed a MSP for the produce, to encourage farmers to grow more. The Food Corporation of India (FCI) was set up to procure grains at MSP and stabilise grain supply and price. India today is the second largest producer of wheat and rice in the world. India is the world's largest producer of milk, pulses, and jute, and ranks among the top producers of many other agricultural products. India has thus showcased an impressive growth trajectory from a food scarce country to a food sufficient and to a food surplus one now. All these revolutions in agricultural production, triggered by innovations, incentives and institutions, have successfully made India a net exporter of agricultural produce. A report of a working group set up by NITI Aayog, Demand and supply projections towards 2033, assessed the demand requirements of various agricultural commodities and made supply projections for the years and concluded that India will have sufficient supply of food grains milk, meat, fruits and vegetables, towards 2032/33 and beyond.

However, still about 176 million people are poor and over 194.4 million are undernourished. A very large proportion of farming households in most of the central and eastern states (23%-45%) live below the poverty line (BPL), higher than the national average (22.5%). The proportion of BPL farming households (17.5%-22.5%), even in some of the so-called agriculturally progressive states, such as Gujarat, Karnataka, Maharashtra, and Tamil Nadu, is close to the national average. Moreover, the focus has to be on rainfed areas, the eastern region, and small farmers as more than 50% of the agricultural area in India is in dry or rainfed regions.

Farmers have assured irrigation in 48% of the cropping area; 52% of the area being rain fed. The irrigated area has increased from 20 million hectares in 1950-70 million hectares in 2016. At least 60% of India's districts are either facing a problem of over-exploitation or severe contamination of groundwater. There is visible mismatch between existing water endowments and the water demanded by water-guzzling crops such as wheat, rice and sugarcane. The main reason why farmers grow such crops, even in areas of water shortage, is the structure of incentives, as they find that these crops have steady markets. The farmers who have been part of the journey of India's food self-sufficiency will now need to adopt alternative solutions and sustainable practices. Some models of natural farming are emerging, especially in rain fed areas to bring down the costs of production and also improve the judicious use of inputs and water resources, but these require a science-based approach with rigorous measurement of results including income impact on farmers.

Farmers' access to institutional finance at reasonable rates of interest has been increasing. Quantum of finance for agriculture from the formal financial institutions has been growing at decent rates for years. By end of March 2021, the outstanding agricultural credit was Rs. 12.99 lakh crores. Emergence of new institutions, methods of operation, design of new products and processes, to cater to a wide variety of financial needs have been remarkable. The credit to Gross Value Added (GVA) ratio in the agriculture sector increased from 21% in 2007-08 to almost 60% in 2019-20. The share of agriculture in credit was less than proportionate to its share in the GDP (16.5%). The allied sector has a share of 38-42% of the agricultural output, though it has only a share of 6-7% in total agri credit during the same period.

Since farming is not providing sufficient income to the farmers, governments have resorted to interest subsidy and also loan waivers. Some negative outcomes include impaired credit discipline; weakened state's finances; avoidance of agricultural finance by banks; inequitable treatment of farmers that do not have access to bank loans; reduced ability of banks to price-discriminate between good and not-so-good borrowers; and elimination of the incentive for farmers to gradually move away from crops and agricultural practices, that, at market interest rates, would be un-remunerative. According to the financial inclusion survey carried out in 2015-16 by NABARD (NAFIS), 38% of farm households surveyed depended on non-formal sources of finance, with 30% relying exclusively on informal sources. The small and marginal farms are more dependent on informal sources of finance at exorbitant rates of interest. Moreover, some states are exhibiting high agri indebtedness and loan servicing capacity of farmers are highly stretched.

While credit can address the pre- and post-harvest liquidity constraints faced by farmers, only risk management products like commodity derivatives and insurance can address the production and market risks being faced by them and reduce income volatility. Subsidised insurance products for crop, livestock and fisheries - though available, the coverage is still very low - about 30% of gross cropped area is insured, less than 5% of animals are insured; while there is a need to educate farming community on the need for insurance, their experience with the prompt claim settlement has to be vastly improved; small and marginal farmers have to be purposively included.

The agriculture sector employs 80% of all economically active women, comprising 33% of the agricultural labour force and 48% of self-employed farmers in the country as per the Ministry of Agriculture. The role of women in agriculture has become strategic; governments and other stakeholders seem to be betting on women's power to transform agriculture to be sustainable. Zero budget natural farming, a flag ship programme of the government of Andhra Pradesh, relies on women self-help groups to transform farming in the state. The women are preparing and propagating the usage of bio fertilisers and pesticides. Women are often involved in laborious work resulting in drudgery; the farm mechanisation initiative is yet to result in women friendly machines and equipment. The National Rural Livelihood Mission has mobilised women from rural areas that are largely from the farming communities into self-help groups and is taking up skilling of women farmers in sustainable agriculture. Mahila Kisan Sashaktikaran Pariyojana has trained more than 10 million women. However, the Farmer Producer Collective Initiative taken up by the government is largely gender agnostic. There is no overt emphasis either in policy or in execution for encouraging participation of women in the FPOs in this country. Women's land ownership, either singly or jointly, continues to languish at less than 15%.

The farmers' income, on the other hand, has increased but is still much lower than the incomes of other occupations. The income of agriculture labourer is one tenth of a non-farm worker and that of a cultivator is one third of non-farm worker. Farmers have received huge quantum of subsidies from the government. The subsidies on inputs like fertilisers, water, power, MSP-linked procurements have increased substantively from Rs. 12,158 crore in 1990-91 to Rs. 2,43,811 crore in 2015-16.¹³ The demand for income growth has translated into demand for the government to procure and provide suitable returns. The policy focus has now shifted from increasing production to how to increase the farmers' income.

5.4 Sharing of a Best Practice

The government of Maharashtra launched "Laxmi Mukti Yojana" in 2016 for joint ownership of house and land. MAVIM, the women empowerment organisation of the government of Maharashtra, is raising awareness among women regarding their rights to their husband's property and facilitating registering of joint ownership of the land and house in the names of husband and wife. The initiative was implemented by the three tier women owned institution structure {self- help groups, Village Level Committees (VLCs) and the federation of Self-Help Groups (SHGs), also known as Community Managed Resource Centers (CMRCs), promoted by MAVIM. SHGs had a reputation of contributing positively to the society and thus SHGs were the chosen vehicles to disseminate information on gender awareness through focused trainings. As part of these trainings, aspects such as the unequal distribution of work, access to and control over resources of women and men, the need for property in the names of women and the Government Resolution, which gives them a right to joint ownership of their husband's house and land were shared.

However, the challenge of tackling patriarchy by attacking one of its foundations – male ownership of private property – was formidable. Instead of explaining to men, the concept of joint ownership as a 'right', which would be immediately interpreted as a lack of trust in the husband and his family, male members of the village are invited to SHGs meetings and the need for joint ownership to secure their future is highlighted. This softens their approach and sensitises them to the need for women's empowerment including their wives. Key officials such as Sarpanch and Gram Sewak are made aware of the Government Resolution and its legal status through trainings and through a well-defined communication strategy of providing repeat information.

Once there is an agreement, the husband and wife jointly register as co-owners of the house and land at the village panchayats/revenue department. Total enrolment, as of June 2021, has been 52,472 members for House ownership and 45,793 are enrolled for land ownership. Out of that, 46,997 member's applications have been sanctioned for house ownership and 14,597 member's applications are sanctioned for land ownership.

Presence of women owned institutions in large numbers, and their history of successful initiatives, help gain the community's trust and make it possible to initiate the

¹³Committee on Doubling Farmer's Income (2018): "Strengthening the Institutions, Infrastructure and Markets that Govern Agricultural Growth Income". Volume 13.

dialogue on women's right to property. The success of the initiative largely depends on the credibility of SHGs.

5.5 Vision 2030

As the world faces growing populations and industrial demands, agriculture will have the potential to augment the global strength of India. However, farming and farming communities need to be sustainable. As a country, we need to ensure that “farmer centric policies, institutions, systems and processes are in place to promote sustainable agriculture. Farmers, especially women, have financial security, access to information to make informed decisions, have choices and alternative solutions to manage risks, learn new skills, have a disaster recovery plan and are active community members”.

Thus, the vision for 2030 is to “ensure farmers, rural communities specially women, become an inclusive and resilient society, transform farming systems for sustainable livelihoods, nutritional security and leading dignified life”.

5.6 Pathways for 2030

An empowered farmer is one who is able to act autonomously in her/his interest, while at the same time protecting societies' interests; on the foundation of availability of information, technical and financial resources in a policy environment that is supportive. This would mean farmers being able to produce adequate returns from the farm enterprise, ensuring appropriate use of resources that do not distort the natural resources with the policies ensuring that all farmers, crops, and activities are supported to develop to their best potential. Policy driven discrimination towards certain geographies, crops, activities, inputs and markets will be replaced by equitable support systems. This would also entail market reforms that facilitate appropriate access to financial, technical and market resources for farmers. While this view of farmer empowerment may seem utopian, this is the direction required for balanced and inclusive growth of farmers and farming.

- Empower farmers through developing state specific strategies for the next decade on improving farmers' income. Different states would need different, context specific, strategies as they are at different levels of agricultural development in terms of growth rates and the level of farmer incomes. Regional agro climate specific plans will also need to be prepared by the states. The best practices for the region have to be identified and propagated through well designed policy and operational advocacy. Models for different

climatic zones for different classes of farmers to showcase the viability of farming and farming households have to be developed participatively with farmer involvement and be widely propagated. Focus must be on small and marginal farmers and farmers in rain fed areas. The policy, as well as best practice models, have to adopt farming system approach improving soils, making available better-quality food and improving nutrition. Beyond food strategy, the policy and practices must concentrate on maximising income from farm produce –feed, fodder, bio energy etc. Central and state governments will need to align policies for sustainable income and welfare of farming communities and also work out how programmes, policies and schemes of agriculture, horticulture, tribal department etc., can converge, avoid duplication and address gaps. The political class should be sensitive to issues of sustainable access to land, water, inputs and credit. Advocacy with political class to enable to get the bigger picture will be crucial.

- The focus must be on farmer collectives as business organisations – so that they are a gateway for various services for farmers – and improving access to information, technical skills, financial services, quality inputs and markets for small holders. Apart from business entities, these collectives are best equipped to facilitate better management of water, land, production systems and persuade individuals against deviant behaviour.

Farmers' collectives will have a key role to play in extension services. As smallholders already face numerous challenges, it is essential that they have access to timely, reliable, and relevant information and advice. Farmers' collectives can institutionalise an efficient agricultural extension system, geo-tagging of farms, digitisation of agri-value chains, and artificial intelligence in agriculture. These tools are the next frontiers of knowledge to drive agriculture into a new trajectory. Extension work has to take all these technologies from pilots to farmers' fields for scaling up. Farmers' collectives can disseminate these technologies to small farmers.

A paradigm shift in water management and governance is needed, which has to co-opt farmers into the management of these resources. Multi stakeholder efforts will be needed to ensure that increasingly farmers are managing the scarce water resources. In irrigated areas, participatory irrigation management systems can pave the way for sustainable use of water. In rain fed regions, ground water

management committees can be facilitated to develop protocols for pumping of water, sequencing of water use, distance norms between wells and tubewells and strictly adhere to them. Once they understand that this is the only way they can manage to meet both their farm and domestic requirements, the process of operating and managing the systems can undergo a transformation. Farmers' collectives can play a facilitation role in the multi stakeholder effort. Farmer collectives can also facilitate convergence with Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) for creation of farm ponds for their members.

Farmers' collectives can facilitate financial services for small farmer members. If long term credit is available for agriculture, capital formation in agriculture will increase as agriculture is getting modernised and oriented towards the market. The input intensity, crop variety and technologies make farming investment intensive. Increased mechanisation, elaborate land preparation for certain crops, higher gestation periods for some crops from production to markets and shorter turnover cycles for some crops like vegetables, have to be taken into account in product design. Enabling the farmer to withhold his stock till they find a remunerative price would alone be the sufficient condition for realising higher value returns on the farm output. The highest attention should be given to warehousing (both cold and dry). Negotiable warehouse receipts and NWR-linked post-harvest loans should be given at interest subvention.

Insurance coverage needs to increase drastically both to encourage farmers to embrace new ways of farming and to protect them from the vagaries of the weather. Funding allocated to subsidising interest rates for farmers, loan waivers, etc., should be used for running a crop insurance scheme as it can provide support to farmers who do not borrow from the banking system. Insurers' experience of covering livestock has not been encouraging on account of both adverse selection and moral hazard issues. Mutual insurance with reinsurance of covariant risks can be piloted and scaled up using the network of self-help group federations and farmer collectives.

- Women to lead the transformation – An empowered woman-farmer has a much larger positive impact on the household and society. If Indian agriculture has to be transformed, policies, programmes and budgets have to a) remove discrimination against women and b) introduce affirmative actions to ensure women occupy their rightful space. The goals of nutrition

security, food safety and ecologically safe agriculture cannot be achieved without women being in the forefront. A small beginning has been made by the Department of Agriculture and Farmer's Welfare (DAC&FW) allocating specific quotas for women in the budgets of different programmes. However, women have to be given their rightful space and their access and control over various resources need to be achieved leading to their improved decision making. Women's asset ownership, technical trainings for production and value addition, access to institutional credit, access to markets, access to women friendly equipment and tools etc., are critical elements to achieve this transformation. By 2030, joint ownership of land and other agriculture assets should be aimed for. Instead of issuing ownership documents for land in male names only, states should include the names of the women who also have a legal claim to the land. Technical trainings should have at least 50% women participation.

FPOs should purposively include women producers to provide women the institutional space to improve their access to different services. Women's self-help group networks will have to play a larger role in negotiating space for women. Result oriented convergence between National Rural Livelihoods Mission (NRLM) and other ministries dealing with food production and value addition should be in place to leverage the strengths of women centric self-help group architecture.

- Integrate policy and strategic actions. There are several stakeholders and links to farmers and agriculture. Most of the time, issues relating to farming are taken up individually without adequate examination of all the linked aspects and solutions designed with a narrow focus that distort the options available and lead farmers towards choices that are sub-optimal, both from a personal and society point of view. Each time a policy change or new policy is considered, it is essential to test the same for its impact on all surrounding aspects and actors; (for example subsidies on interest on non-borrowers, power subsidy on those without an electric connection, irrigation water subsidy on those with unirrigated lands, MSP for specific crops on those that grow other crops, fertiliser subsidy on those in organic farming, etc.). While doing so, the likely impact on empowerment of farmer should also be examined. Interdisciplinary administrative units at the district and below levels as well as single window systems for promoting integrated farming just like an industrial policy should be promoted.

Section: II

**People: Building Social
Capital for Driving Food
System Transformation**



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1

Rural Consumption and Local Food Systems

Lead Author: Dr. G. V. Ramanjaneyulu¹



VISION STATEMENT

Inclusive and climate resilient local food systems to ensure economic security for producers, ecological security for ecosystem and safe nutritious food for all.

1.1 Actionable Agenda

The Covid-19 pandemic and the lockdown have exposed how a large section of our society are highly vulnerable with respect to food security, while as a sector agriculture has shown resilience. Food systems perform a central role not only in determining the quantity, quality, diversity, and nutritional content of the foods available for consumption, but also in sustaining the livelihoods of 54% of the people in the country. In addition, food systems have a major impact on human health (both positive and negative) through a variety of different channels, and on the environmental and ecosystem health of our planet. As such, how food systems function, the cost and quality of the food they deliver, and the impact they have on the health of people and our planet, directly and indirectly impacts outcomes of food security and nutrition.² Any measure taken towards this must comprehensively consider these issues in design. Unfortunately, since independence a narrow focus on few approaches without understanding over all implications, and administrative and bureaucratic failures. The situation got worsened after the 1990s with India opting for liberalisation and globalisation without strengthening its own support systems and the climate change.

1.2 Major Challenges

To understand the food and nutrition security (or sovereignty as now called), we need to understand the interplay of natural resource sustainability, economic

development, agricultural production and nutrition through the lens of a “Food Systems Approach” (FSA). Central to the vision for a robust food system is a future where nutrition-secure individuals have the capability and the opportunity to improve their health through greater access to a balanced and healthy diet. Currently, unequal growth, ecological degradation and climate change challenges threaten India’s ability to manage an economic and nutrition transformation sustainably and equitably. The main problem seems to be a lack of comprehensive and integrated approaches and the tendency to solve today’s and futuristic problems with yesterday knowledge.

Three of the important challenges to ensure food and nutrition security for all are ecological degradation, climate variability and extremes, and economic slowdowns and downturns, which are exacerbated by the underlying causes of poverty and very high and persistent levels of inequality.

Ecological Degradation: Currently, 97.85 million hectares (mha) of land have already been degraded. Of this, 3.32 mha have been added in the 15 years between 2003-05 and 2018-19, according to the Desertification and Land Degradation Atlas, 2021 released by ISRO. Almost 37 mha of the degraded land is what the report classifies as unirrigated agriculture. Water erosion is the most common reason (80%) for degradation of unirrigated farmland, followed by wind erosion (17%), salinity/alkalinity in land (2%) and water logging (1%). Loss of crop productivity, one of many negative impacts of soil erosion by water, has

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²Pingali, P.; Aiyar, A.; Abraham, M.; Rahman, A. (2019): “Transforming Food Systems for a Rising India”. Palgrave Macmillan Cham. ISBN: 978-3-030-14411-1.

serious consequences for country’s food, livelihood, and environmental security.

Impacts: Climate variability and extremes are a key driver behind the recent rise in global hunger, one of the leading causes of severe food crises, and a contributing factor to the alarming levels of malnutrition seen in recent years. Increasing climate variability and extremes, linked to climate change, are negatively affecting all dimensions of food security and nutrition. Agriculture and climate change are mutually impacted. Often the impact of climate change is underestimated, and the contribution of agriculture to climate change is ignored. As a result, much of the discussions are around particular technologies which can help farming to adapt to climate change. In reality, if farmers have to adapt to the changing climate, we need to understand this in a broader context of ecological, economical and socio-political crisis which Indian farmers are already undergoing.

The relationship between climate change and agriculture is three fold. First, climate change has a direct bearing on the biology of plant and animal growth. Second, the changes in the farm ecology such as soil conditions, soil moisture, pests and diseases etc. Third, the ability of the existing social and economic institutions, particularly in rural areas, to deal with the challenges posed by global warming. In the larger context of food security and climate change, it is also important to consider other sectors like animal husbandry and livestock, which are closely linked with agriculture.

Poverty and Inequality: Nutrition quality of diets is negatively impacted by poverty and inequality. Food insecurity and malnutrition in all its forms are made worse by high and persistent levels of inequality – in terms of income, productive assets and basic services (e.g. health, education) and, more generally, wealth. Income inequality in particular increases the likelihood of food insecurity – especially for socially excluded and marginalised

groups – and undercuts the positive effect of any economic growth on individual food security. Structural vulnerabilities, including inequalities related to gender, youth, ethnicity, indigenous peoples and people with disabilities, tend to exacerbate poverty, food insecurity and malnutrition during periods of economic slowdowns and downturns, or following conflict and climate-related disasters. Furthermore, these levels of inequality are being accelerated by the COVID-19 pandemic.

1.3 Current Status of Rural Consumption and Local Food Systems in Government and Private Sector Initiatives

In the financial year 2016-17, the government of India has set up a committee for Doubling Farmers’ Income (DFI) which stated that the objective of the government is to double farmers’ incomes in real terms by 2022 over a period of seven years (2016-17 to 2022-23). Whereas the National Banks for Agriculture and Rural Development’s (NABARD) All India Rural Financial Inclusion Survey (NAFIS) 2016-17 estimates that an average Indian farming household earned INR 8,931/month (INR 1,07, 172/year) in the agriculture year 2015-16. This is up from INR 2,115 earned in 2002-03 as per the National Sample Survey Office’s (NSSO) Situational Analysis Survey, implying a compounded annual growth rate (CAGR) of about 12% in nominal terms and 3.7% in real terms (2015-16 base). To achieve the DFI by 2022-23, the Dalwai committee points out that farmers’ real incomes need to grow at 10.4% per annum, i.e., 2.8 times the growth rate achieved historically (3.7%) and it has not achieved this. Instead, it went down to less than 3% by 2017-18 and the achievement was far lower than the targets. With less than two years left it high time to revisit the strategies.

Regional inequality in economic development is also a major challenge due to differences in initial resource

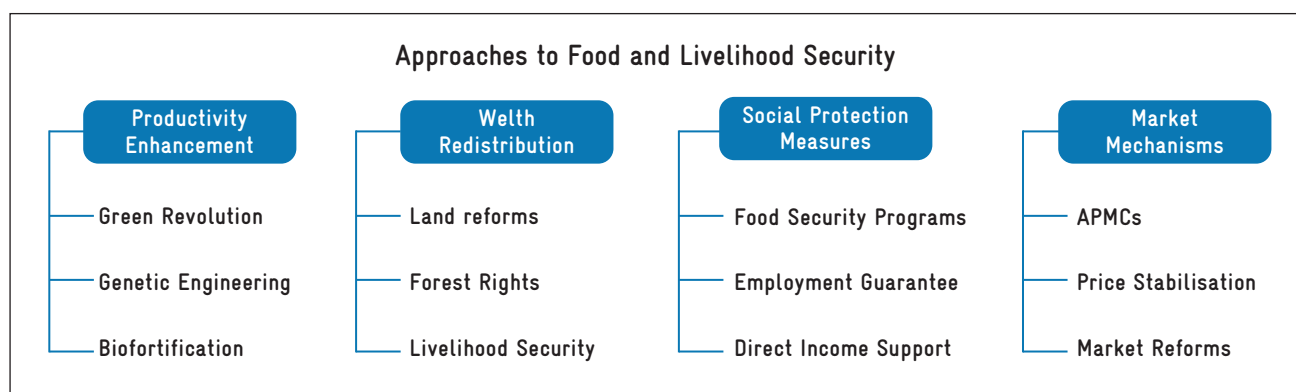


Figure 1: Approaches to Food and Livelihood Security (Figure by the author)

endowments and nationalised policies that has placed states on different structural transformation pathways.

Food security exists when all people, always, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.³ To achieve Food Security, India has taken a series of approaches, some influenced by developments across the world, some due to advocacy efforts of Civil Society Groups and political parties and some are forced by the Judicial System in India. All these initiatives can be summarised as follows.

Productivity enhancement approach: India's food and agriculture policy have historically focused on enhancing supplies by adopting technology (new seeds, agrochemicals, irrigation water). However, the narrow focus on staple grains, especially rice and wheat, have led to disappearance of wide variety of cultivated and uncultivated crops which formed the food basket of the population. While this has had considerable success in increasing the food production and reducing the incidence of hunger in the country, it led to severe malnutrition due to reduction in dietary diversity of people and had led to ecological degradation of soils and decreasing levels of groundwater. Rainfed areas were worst affected.

Distortions caused by input subsidies: The input subsidies given in India are very low compared to the subsidies given across the world, hence Indian products are unable to compete in the international market. However, same thing is happening across the country between states.

The subsidies encourage particular practices, and it becomes a vicious cycle to move out. For example, the above graph shows that chemical fertiliser and power subsidies received by states like Punjab and Haryana are nearly Rs. 30,000/ha, while many states get less than Rs. 3000/ha. This is leading to heavy use of agrochemicals and high water use. The shift is not equally supported. Similarly, the variance between states also cause distortion.

Technology driven approach: The mainstream agricultural research system failed to admit the fall out of the Green Revolution model of agriculture and continues to focus on the technology driven approach. By the 80s,

the fall outs were clearly visible. However, the focus only went from replacing one pesticide with another pesticide, one variety with another and one technology instead of another. Post 2000s, genetic engineering became the main technology driver and was tried in every crop and for every trait. However, the biosafety implications of the gene modified cotton were stark enough to put a moratorium on the technology and to explore other options.

The latest fad in this area is mandatory biofortification to address the micronutrient and vitamin deficiencies. However, there are numerous studies showing that this is not a right approach as it can lead to nutrient toxicity as well as an extensive monopoly for few corporates.⁴ This shows that still as a nation we haven't learnt from the problems we face but continue with a technology driven approach which benefits few corporations who push for such technologies.

Increasing access to productive resources: India half-heartedly attempted to address the issue of wealth accumulation. Land reforms always have been an unfinished agenda. Very token attempts were made for land distribution to landless. Attempts to legalise the tenancy and extending all benefits to the actual cultivator rather than landowner were all failed and in states like Andhra Pradesh where the tenancy is as high as 33.75%, the problem has become severe.⁵

In 2006, the government of India brought in the Forest Rights Act to ensure rights to forest dwellers to access the land and forest resources. However, the implementation is yet a serious problem. This access and suitable modifications in the Food Security Act can ensure that the tribal dwellers will have food security. This can lead to a diversification of the food base. Indigenous peoples' food systems can serve as an example of how to expand current food bases in acknowledging biodiversity, enabling diverse agri-food systems, building resilience and ensuring positive human health benefits from diversified diets. Khasi, Botia and Anwal peoples in India sustain food systems counting well beyond 100 edibles consisting of wild, semi-domesticated and domesticated species. Poverty and inequality are critical underlying structural factors that amplify the negative impact of conflict, climate variability and extremes, and economic slowdowns and downturns.⁶

³FAO (1996): "Rome Declaration on World Food Security". Available online at: <https://www.fao.org/3/w3613e/w3613e00.htm>. Last accessed 07.09.2022.

⁴Zhou, S.; Zhou, Y. (2014): "Excess vitamin intake: An unrecognized risk factor for obesity". *World J Diabetes* 5(1): 1-13. doi: 10.4239/wjd.v5.i1.1.

⁵NITI Aayog (2018): "Report of the expert committee on land leasing". Available online at: <https://documents.in/document/report-of-the-expert-committee-on-land-report-of-the-expert-committee-on-land.html?page=1>. Last accessed: 07.09.2022.

⁶Pingali, P.; Aiyar, A.; Abraham, M.; Rahman, A. (2019): "Transforming Food Systems for a Rising India". Palgrave Macmillan Cham. ISBN: 978-3-030-14411-1.

Enhancing Livelihood Opportunities: Creating livelihood opportunities for poor has been on the top priority since independence. The approach was initially through Woman Self Help Groups to create income generating opportunities at small homogenous group level through Development of Women and Children in Rural Areas (DWCRA) and later shaped as NRLM (National Rural Livelihoods Mission). The approach taken was to organise women into small homogenous groups and provide them with small investments to strengthen their livelihoods. It is designed as an empowerment tool which enables people to find a solution on their own and invest in their own future. However, many studies have shown only tokenism in these attempts and trying to increase participation in development may leave the marginalised as mere beneficiaries of programmes, without much control over the decision-making process.⁷ The entry of the private sector in this space as micro finance institutions has worsened the situation. The causes of the microfinance crisis and its consequences were therefore a blend of over-indebtedness of the clients, a lack of control in the lending process of the microfinance institutions (MFIs) themselves, and the protectionist nature of India's financial sector.⁸

Social Security Approach: Providing social security for its poor has been part of various policies and five-year plans in this country. Over a period of time, to ensure the proper implementation of these policies and schemes, successive governments have formulated Acts and provide legal right for the poor to access these schemes and programmes. Some of the important ones are:

Food Security Act (2013): The Act legally entitles up to 75% of the rural population and 50% of the urban population to receive subsidised food grains under Targeted Public Distribution System. About two thirds of the population therefore is covered under the Act to receive highly subsidised food grains. However, narrow focus on just two staple-grain-focused policies have

also created disincentives for farmers to diversify their production systems in response to rising market demand for non-staple food, such as fruit, vegetables and livestock products. Also, the imbalance in protein, vitamin and micronutrient supply in the food system is a major cause of the high incidence of malnutrition in India.⁹

To ensure its commitments under this act, the governments focussed on procuring food grains and are distributing through the public distribution system. The flaws, in the system's high centralisation have led to serious problems. While MSP is declared for more than 24 crops,¹⁰ procurement largely happens only in few crops i.e. paddy and wheat by Food Corporation of India;¹¹ pulses and oilseeds by the National Agricultural Cooperative Marketing Federation of India (NAFED);¹² cotton by Cotton Corporation of India¹³ and others by respective state agencies by MARKFED etc or sugar cane by the sugar industry and palm oil by the palm oil industry. However, the MSP system is caught with its own problems in cost estimations, price determination and delivery mechanisms. As we can see in this table, the costs have increased significantly over decades, but the prices have not increased. We can also see a variability between crops for eg. MSP of wheat was 1.47 times of cost of production (C2) while it was only 1.12 for paddy as per the reports of Commission on Agricultural Costs and Prices.

The government of India is the biggest buyer and hoarder of food grains, particularly rice and wheat. The government procures 40-50% of the marketable surplus in rice and wheat. But unfortunately, this procurement does not benefit all the farmers, as much of them are procured from very few states.

Employment Guarantee: Going by various experiences across the country to address growing unemployment, in 2005, the government of India has formulated the Mahatma Gandhi National Rural Employment Guarantee

⁷Ghosh, P. (2018): "The unintended consequences of SHGs". India Development Review. Available online at: <https://idronline.org/the-unintended-consequences-of-shgs/>. Last accessed: 07.09.2022.

⁸Gallarati, G. (2018): "Andhra Pradesh Microfinance crisis: what went wrong". Think Conference. Available online at: <http://thinkiea.com/foreign-aid-and-development/andhra-pradesh-microfinance-crisis-what-went-wrong/>. Last accessed: 07.09.2022.

⁹Pingali, P.; Aiyar, A.; Abraham, M.; Rahman, A. (2019): "Transforming Food Systems for a Rising India". Palgrave Macmillan Cham. ISBN: 978-3-030-14411-1.

¹⁰Farmer's Portal (2022): "Minimum Support Prices". Available online at: <https://farmer.gov.in/mspstatements.aspx>. Last accessed: 07.09.2022.

¹¹Food Corporation of India (2022): "Procurement Data for Current Marketing Season". Available online at: <https://farmer.gov.in/mspstatements.aspx>. Last accessed: 07.09.2022.

¹²National Agricultural Cooperative Marketing Federation of India (2021): "Annual Report 2020-2021". Available online at: <https://www.nafed-india.com/documents/AR.pdf>. Last accessed: 07.09.2022.

¹³Cotton Corporation of India (2022): "Procurement of Kapas". Available online at: <https://cotcorp.org.in/procurement.aspx?AspxAutoDetectCookieSupport=1>. Last accessed: 07.09.2022.

Act (MGNREGA). The main objective was “enhancing livelihood security in rural areas by providing at least 100 days of guaranteed wage employment in a financial year, to every household whose adult members volunteer to do unskilled manual work”. Another aim of MGNREGA is to create durable assets (such as roads, canals, ponds and wells). Employment is to be provided within 5 km of an applicant’s residence, and minimum wages are to be paid. If work is not provided within 15 days of applying, applicants are entitled to an unemployment allowance. That is, if the government fails to provide employment, it must provide certain unemployment allowances to those people. However, in the absence of comprehensive approach towards employment generation, the minimum guaranteed employment under this act has become the only source of employment for people. The ongoing crisis in agriculture also made farmers unable to pay the raising demands of farm labour for increasing the wages. As a result, farmers unions and various state governments have brought in a new demand to link MGNREGA to agriculture. However, Farm Labour Unions dismiss this as MGNREGA is a right of the labourer achieved after decades of struggle and linking it to agriculture will only dilute the spirit and become the right of the farmers to take labour whenever they need for operations and not the right of the labourer to ask for work when they cannot find any. Already the National Rural Employment Guarantee Scheme (NREGS) is being used for land development, soil preparation etc in small farmers’ lands, and additional ideas are being proposed by the national level NREGS working group itself.

As an alternative, there are different ways of providing governmental support towards labour for agriculture. A new scheme completely independent of NREGS can be initiated for labour subsidies and this ‘labour subsidy’ can be provided in addition to the NREGS guarantee, but the same NREGS delivery mechanism is used. A whole new delivery mechanism with checks and balances needs to be figured out for labour subsidy.

Market Reforms: Another approach for ensuring food security for all was strengthening markets to provide better prices to farmers and ensure that the prices for consumers remain affordable. However, always the actions of the government were to ensure cheaper food for consumers and raw materials for the industry to grow. Agriculture and agricultural markets remained as the state subjects while central governments took all the decisions. Many of these, including allowing free trade or signing global trade agreements, have caused distortions in the markets and reduced the prices for the producers and pushed transition

towards few crops like cotton. The Agricultural Produce Marketing Committee (APMC Act, 1962) was an attempt to bring in commonality on the market front. However, many of these remained only on papers and never got implemented. In this background, The New Farm Acts, 2020 were passed by Parliament in September 2020:

1. The Farmers Produce Trade and Commerce Promotion and Facilitation Act 2020
2. The Farmers Empowerment and Protection Agreement on Price Assurance and Farm Services Act 2020
3. The Essential Commodities Act (1955) Amendment Act, 2020

Some of these are much needed reforms and were pursued by several states and farmers organisations over a longer period. However, the legislations were brought in without preparedness. The process could have been more participatory as states have to implementing and farmers had apprehensions. Also introducing the legislation amidst of the lockdown also created mistrust amongst the farmers due to bad consequences experienced during demonetisation, GST rolling out and lockdown.

1.4 Linkages with the Sustainable Development Goals

The transition should focus on strengthening local food systems, shifting towards agroecological approaches in farming, improve access to productive resources, finances and services, collectivising small holders and linking to markets, reducing losses, encouraging reuse and recycle, and promoting sustainable consumption, creating social security systems and improving last mile delivery of entitlements and services. These actions will lead to a sustainable production, consumption, livelihoods systems and meet the following 17 Sustainable Development Goals.



1.5 Vision 2030

By 2030, India is going to become the first country to be home to more than 1.5 billion people, and its population is set to reach 1.7 billion by 2050 with an increase of 70%

in urban areas. Consequently, the proportion of the rural population will decline from 69% to 61% as the urban population is projected to increase more than twice the projected increase in the rural population. While the percentage decline is seen, the rural population and people depending on agriculture is going to continue when it comes to absolute numbers. The land holding is going to remain small. The transformation of urban industrial production systems towards automation etc. also may not generate major opportunities for employment. The current internal migration of 100-125 million people will stay and probably increase as the incomes in rural areas go down and opportunities in urban areas may decrease. This also calls for a significant focus on developing local employment and entrepreneurial opportunities which can be provided by strengthening local food systems. With the demand for food expected to double and the issue of climate change projected to become severe in the years to come, it is imperative to maintain biologically diverse landscapes for sustainable intensification of agriculture. In order to meet these emerging challenges and mould food and agricultural policies, it is important to focus on the role of innovations, incentives and institutions that could help to produce more, diversified and nutritious food economically, and in an environmentally and financially sustainable way.

1.6 Pathways for 2030

As we can see the existence of policies that increase productivity in agriculture at the expense of the environment, policies that increase economic growth while also increasing regional inequality and hurting small farmers, top-down policies that aim to reduce undernutrition without any discussion on how to tackle growing malnutrition or obesity. This needs to go and a comprehensive approach, which ensures access to safe and healthy food for all and sustains the natural resources while helping communities depending on agriculture become resilient to changing climate, needs to be adopted.

Towards this, first and foremost would be a shift towards ecologically sustainable models of agriculture which include practices and crops which can be grown with low water, low use of agrochemicals and low energy. This transition needs support and calls for a shift in the subsidy models.

- **Self Consumption:** Nearly 40% of the food is consumed locally. Due to transition towards paddy, cotton and other commercial crops, production of pulses, oilseeds, vegetables and fruits has gone down significantly. As a nation, we started depending on

imports of pulses and oilseeds. Many states import fruits and vegetables from other states. Villages buy from urban markets which is making them expensive and many go without consuming them, resulting in severe malnutrition. Local production and consumption should be a major goal and to achieve this, multiple cropping models, kitchen (nutri) gardens etc. can be promoted.

- **Rational Subsidies:** current subsidies distort cropping patterns and production practices
 - Shift subsidies for more ecologically sustainable models of agriculture
 - Support for ecological services.
 - Shift towards direct benefit transfers
 - Targeted approach and identifying real cultivators
- **Income Security:** As Dr. Swaminathan has mentioned in his report on farmers commission, the progress of agriculture needs to be measured in terms of growth in incomes of producers than increasing in yields. For this to happen, two steps are required:
 - Increase and invest in income diversification opportunities for small and marginal farmers
 - Strengthen direct income support measures
- **Price Distortions:** As mentioned earlier, MSP procurement operations have created a wide disparity in cropping patterns as only rice and wheat are procured by the state. Farmers are not willing to make a shift towards other crops, even if these are consuming high amounts of water, electricity and huge environmental pollution due to Methane and Nitrous Oxide emissions, stubble burning etc.

The shift needs to be into concentric circles of internalisation and self-sufficiency from district to state to national level. If MSP has to be ensured, a shift in cropping patterns is also very essential.

- **Minimum Support Price:** current price support policies are highly skewed
 - Several changes have to be brought in in assessing MSPs taking all real costs
 - The government should announce the MSPs for all the crops along with approximate quantities which may be procured. This need to be done using state wise figures and not the central figures. Let states decide how much to procure.
 - Procure through governmental agencies, use FPOs/women self help groups platforms.

- If the farmers do not get access to the MSP for any reason price compensation mechanisms can be followed.
- **Decentralised Procurement:** State level and district level planning of cropping systems to meet the food requirements is needed.
 - Food security budgets can be given to states based on proportion of targeted population and other criteria
 - A district and state level plan can be developed regarding the food produced and the foods distributed under PDS and use the existing FPOs, women self help groups, PACS and other community organisations to procure and distribute the grains under various food security schemes. The costs will go down significantly and the subsidies and benefits can be passed on directly to the producers as they are the ones in crisis.
 - Nearly 40% of food is self-consumed by the families. Some mechanism can be developed to compensate for self-consumption, otherwise it forces farmers to sell off what they produce and buy cheaper grains from PDS.
- What is not grown locally can be procured from other regions or central pool.
- **Local Institutions:** Linking urban food demand with rural prosperity, while ensuring environmental sustainability will be essential to ensure both urban and rural food security. Intersectionality of these domains and their spill overs on the economic, ecological or health systems within the country.
 - Improve last mile delivery of support services
 - Strengthen the Farmer Producer Organisations and let them procure and distribute the grain grown within their region.
 - The current identification mechanisms used for farmers based on land patta are discriminating against tenant farmers, women, Adivasi farmers and assigned landowners who may not have patta. Develop mechanisms to identify actual cultivators.

There would be regional variances in productivities, costs of cultivations, quality as well as yield variances between varieties in a crop and between crops. Fixing and guaranteeing any price will always causes distortions in cropping patterns and practices and regional imbalances. Course corrections will always be necessary.



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2

Forest-dependent Food Systems and Tribal People

Lead Author: Basanta Kumar Kar¹



VISION STATEMENT

Enabling community-led, caring, resilient, just, equitable, accountable and transformative local food systems for forest-dependent communities, including tribal communities, based on responsive, efficient, and sustainable natural ecosystems.

2.1 Actionable Agenda

India's 105 million tribal population, from about 705 distinct Scheduled Tribes (STs) representing 8.6% of total population, are hardest hit by the menace of hunger and malnutrition.² They are living with multiple forms of marginalisation, co-morbidities and struggling to survive and thrive. About 40% of under-five tribal children in India are stunted, and 16% of them are severely stunted. Mild and moderate stunting is similar in tribal and non-tribal children. But severe stunting is higher (16% vs. 9%) in tribal compared to non-tribal children. 4.7 million tribal children of India suffer from chronic nutrition deprivation, affecting their survival, growth, learning, performance in school and productivity as adults.³

The Covid-19 pandemic has upset the tribal food systems multifold by limiting their income sources and restricting food supplies from urban locations. The majority of the tribal population stay in far flung and hilly areas, this population used to be the self-dependent for their daily food intake, however, changes in food habits during the recent years have made them dependent on external supplies from the urban locations. Lockdown measures during the Covid-19 pandemic have severely impacted the food supplies to

these locations. Now we have an opportunity to rebuild a caring, resilient, inclusive, transparent local food systems for the tribals. This is going to be particularly true in emergency contexts where perishables are difficult to deliver and store and the life and livelihoods of the tribals are pushed to margin.

2.2 Major Challenges

Almost 85% of children at their most critical age of 6-23 months do not receive a minimum acceptable diet that includes minimum four or more food groups.⁴ These food groups are cereals and millets, pulses, milk and milk products, roots and tubers, green leafy vegetables, other vegetables, fruits, sugar, fat/oil and meat, fish, and eggs. Only 9.8% tribal children consume iron rich food. The consumption of iron rich food is coming down. As per the National Family Health Survey (NFHS)-IV (2015-16), 18.9% of children were consuming iron rich food. A little more than 50% of children between 6-23 months do not consume enough Vitamin A rich food.

The consumption of micronutrient rich food by the tribal women in reproductive age (age 15-49) is abysmally low. Only 50% consume milk or curd, 32.2% consume fruits,

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²Bang, A. (2020): "Malnutrition among tribal people". India Seminar. Available online at: https://www.india-seminar.com/2020/730/730_abhay_bang.htm. Last accessed: 07.09.2022.

³UNICEF (2018): "Tribal Nutrition". Available online at: <https://www.unicef.org/india/what-we-do/tribal-nutrition>. Last accessed: 07.09.2022.

⁴UNICEF (2018): "Tribal Nutrition". Available online at: <https://www.unicef.org/india/what-we-do/tribal-nutrition>. Last accessed: 07.09.2022.

Table 1: Types of Meals in the National Food Security Act-2013

Category	Type of meal	Calorie (kcl.)	Protein (g)
Children 6 months to 3 years	Take home ration	500	12-15
Children 3-6 years	Morning snacks and hot cooked meal	500	12-15
Children 6 months to 6 years – who are malnourished	Take home ration	800	20-25
Lower Primary classes	Hot cooked meal	450	12
Upper primary classes	Hot cooked meal	700	20
Pregnant women and lactating mothers	Take home ration	600	18-20

42% consume eggs, 34.3% consume fish, 33.2% consume chicken or meat and 43.1% of tribal women consume fish or chicken or meat. There is an invasion of fried foods and aerated drinks into the tribal food system. 40% women consume fried food, and 17.7% women consume aerated drinks.⁵

India’s target driven POSHAN Abhiyaan (National Nutrition Mission) signals a new era in nutrition history. The programme provided opportunity to transform the nutrition landscape.

Pandemic measures: During the pandemic, the national and state governments in India decided to provide free food grains along with subsidised food grains, supplementary nutrition benefiting the children, pregnant and lactating women, and mid-day meals to school children, financial support to the more vulnerable people and monthly allowances to daily wage laborers utilising the Direct Benefit Transfers (DBT) method etc. Special hunger relief camps and community kitchens were made operational for the distressed communities so that there is scope to provide cooked meals and other essentials. The Ministry of Tribal Affairs (MoTA) revised the Minimum Support Price (MSP) of 49 Minor Forest Produces (MFP) under MSP for MFP scheme on 1st May 2020 besides including 23 new MFPs in MSP list. The government of India reiterating its commitment to good nutrition during the current budget envisaged Mission Poshan 2.0 that focuses on health-wellbeing and nutrition to fight malnutrition.

Agricultural and food policies in India have focused on increasing food production and meeting calorie and energy inadequacy. Our food system has grossly neglected the process of marginalisation, negative externalities on nutrition, natural and human capital, and biodiversity. The consequence is alarming – double burden and all forms of malnutrition.

The tribals in India suffer from all forms of malnutrition – undernutrition, overweight/obesity, and micronutrient malnutrition, popularly known as hidden hunger. The malnutrition outcomes are deeply unfair. The social, geographical, economic and policy level exclusions make the tribals hardest hit. More than 50% of the child mortality is attributed to malnutrition. As per NFHS-IV, under-five mortality rate for scheduled tribes (57 deaths per 1,000 live births) is considerably higher than for those who are from scheduled castes or other backward classes (39 deaths per 1,000 live births). More than half (53%) of preschoolers and more than one-third of school-age children and adolescents (38% each) belonging to scheduled tribes were anaemic.⁶

In India, 22.9% of women are having low Body Mass Index (BMI). For tribal women, the low BMI is 31.7%. Additionally, 20.6% of women are overweight or obese. For scheduled tribe women, the overweight and obesity is 10%.⁷ Although the rate is not significantly higher, it provides an early warning sign on the slow onset of a disaster due to a broken food system. As per NFHS-IV,

⁵Ministry of Health and Family Welfare, Gov. of India (2016): "National Family Health Survey (NFHS-4)". Available online at: <https://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>. Last accessed: 07.09.2022.

⁶Ministry of Health and Family Welfare, Gov. of India (2019): "Comprehensive National Nutrition Survey 2016-2018". Available online at: <https://nhm.gov.in/WriteReadData/l892s/1405796031571201348.pdf>. Last accessed: 20.09.2022.

⁷Ministry of Health and Family Welfare, Gov. of India (2016): "National Family Health Survey (NFHS-4)". Available online at: <https://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>. Last accessed: 07.09.2022.

the prevalence of stunting among children under five in India was 38.4%. However, for the tribal children it was 44%. Stunting, or low height-for-age, is a sign of chronic undernutrition that reflects failure to receive adequate nutrition over a long period. Stunting can also be affected by recurrent and chronic illness. The reported deaths of the children specifically the tribal children due to malnutrition or underlying causes of malnutrition has been haunting the country since independence. These are severely affected malnourished and the children with wasting. Wasting may result from inadequate food intake or from a recent episode of illness causing weight loss.

2.3 Current Status of Forest-dependent Food Systems in Government Initiatives

Since independence, the tribals have been fighting for Jal (water), Jangal (forest) and Jameen (land). The tribal

food system is dependent upon the forest, land-common property, water resources, and the biodiversity (so called catch and collect). The Panchayat (Extension to the Scheduled Areas) Act (1996) that was meant to expand local self-governance and tribal self-rule, is yet to be fully implemented. 40% of states have not formulated necessary rules yet. The Forest Rights Act (FRA) (2006), that recognises the rights of forest dwelling for tribal communities, is embroiled with unnecessary bureaucracy and many other implementation hurdles.

The National Food Security Act (NFSA) from 2013, that controls three food and nutrition entitlements, like Targeted Public Distribution System (TPDS), Integrated Child Development Service (ICDS) and Mid-Day Meal (MDM), has numerous governance and programme delivery issues. The Schedule II of the NFSA-2013 only has provision of food that are supplemental in nature and prescribes calorie and protein only.

Embracing Heritage Food

The Wild Food Plants: A special category in tribal food system

The wild food plants are neither cultivated nor domesticated. It constitutes a special category of the tribal food system. These food plants grow wild in forests, common property resources and in farmlands and are harvested by local people as sources of food. For forest dependent and dwelling poor, the forests remain the main source of food, nutrition, and livelihoods. Indigenous knowledge and the use of plants, however, are in danger of being lost. The food subsidies in rice and wheat, the environmental and cultural transformations have led to changes in eating habits and practices.

However, there is a growing interest on nutri-cereals, specifically millets. In the year 2018, the government of India declared 2018 as the Year of Millets and launched a campaign to promote nutri-cereals. In the year 2020, the Prime Minister dedicated 17 biofortified varieties of eight crops, including nutri-cereals like the maize hybrid varieties 1, 2 and 3 are enriched with lysine and tryptophan, the finger varieties of millet CFMV 1 and 2 are rich in calcium, iron, and zinc. The CCLMV1 variety of small millet is rich in iron and zinc. In the same year (2020), the Prime Minister endorsed the year 2023 to be observed as International Year of Millets. The UN/FAO agreed to the proposal. Several states are now encouraging nutri-cereals specifically millet by linking its production with MGNRGA. The state of Odisha has established the Millet Mission and Andhra Pradesh has established Millets Board to promote millets.

Nutri-Cereals: A special category in tribal food system

India was host to multi variety millets, a popular staple. Until the Green Revolution in the 1960s, millets made up around 40% of all cultivated grains. The crop millet lost popularity during the green revolution by relegating its status to a 'coarse grain' for the poor. In 1951, the share of the coarse grain was 36% to total cereal production. Just after the green revolution, the share declined to 26% in 1975. In the year 2020, the share of coarse grain to total cereal production is only 17% whereas the share of rice production is 42% and wheat production 39%. This macro and micronutrient rich food was key diet of the tribals.



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2.4 Vision 2030

Malnutrition is a silent emergency which is emerging at a fast pace. The food and nutrition systems are interlinked. Investment in nutrition will lead to enhanced productivity. Common property resources are shrinking, which used to be the main source of food for tribal. There are serious issues of the tribal diets, these can be on the accounts of availability, affordability, or governance issues. There are number of Government initiatives and regulations to enable the food safety and nutritional security. However still these are not in position to achieve the desire outcomes.

The vision and strategic directions must align with the vision of Poshan Abhiyaan and UN Sustainable Development Goal (SDG) 2. SDG 2 emphasises agriculture, food security and nutrition together.



2.5 Pathways for 2030

With a prioritised action on the first 1000 days of life, the new food system for tribal will address all forms of hunger and malnutrition. It will have an integrated strategy to address hunger and all forms malnutrition and co-morbidities. Better WASH, strategies for tackling deworming, co-infections and other diseases like malaria, sickle cell anaemia, TB and HIV etc. must be included in the intervention programme.

The details have been mentioned below.

2.5.1 Essential Agriculture, Food and Nutrition Interventions

Addressing calorie hunger and undernutrition: This can happen by effective implementation of National Food Security Act (NFSA) from 2013 and bringing out a new legislation on food and nutrition. It can address calorie inadequacy. While doing so, crops which were traditionally consumed by the tribals and high in nutrition (millets, pulses etc.) should be promoted.

Addressing protein hunger: It calls for expanding food programmes and income safety net programmes, diversifying both the production and farming system to include poultry, fishery, dairy etc., investing in women small holder farmers and working with India’s Jal Jeevan Mission to promote water as source of nutrient.

Addressing micronutrient malnutrition-hidden hunger: It would require increasing dietary diversity, engaging on food fortification and bio-fortification programmes and streamlining the existing supplementation programmes.

Addressing impending obesity and overweight: It would require work on addressing local food systems to improve access to safe and nutritious diets with reduced salt, sugar and fat and working with India’s food regulator, FSSAI, food MSMEs and Farmer’s Cooperatives on improving access to safe and nutritious diets by the poor.

Table 2: Poshan Abhiyaan Targets and Sustainable Development Goals (SDG)

Poshan Abhiyaan Targets To improve maternal, infant, and young child nutrition	Sustainable Development Goals II End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	
Prevent & reduce stunting children (0-6 years) at 2% per annum	SDG 2.1	By 2030 end hunger and ensure access by all people the poor and people in vulnerable situations including infants, to safe, nutritious, and sufficient food all year round
Prevent & reduce under-nutrition children (0-6 years) at 2% per annum		
Reduce low birth weight at 2% per annum	SDG 2.1	By 2030, end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons
Reduce anaemia among young children (6-59 months)-women & adolescent girls (15 to 49 years) at 3% per annum		
Global targets for non-communicable diseases (NCD)		
		Salt/sodium intake: A 30% relative reduction in mean population intake of salt/sodium
		Raised blood pressure: A 25% relative reductive in prevalence of raised blood pressure or contain the prevalence of raised blood pressured, according to national circumstances
		Diabetes and obesity: Halt the rise in diabetes and obesity

2.5.2 Specific Recommendations Programme

Recommendation I

Structural Reforms: Increasing Rights and Entitlement

Policy Level

Effective implementation of the provisions under the Forest Rights Act (2006) and PESA Act will go a long way in increasing entitlements and the size of land holding of the tribal farmers.

A New National Food and Nutrition Security Act

The present National Food Security Act (2013) is grossly inadequate to address the hidden hunger and malnutrition. The widespread hunger and malnutrition, including micronutrient deficiencies and obesity, indicates that the marginalised population in India, specifically tribals, need a new legislation on food and nutrition, which can take care of a) Sustainable food and nutrition security, b) Food safety including management of food and nutrition value chain, preventing wastage of food and c) Preserving bio safety and biodiversity.

To stimulate an Agri-nutrition programme, NITI Aayog's model 'Agricultural Land Leasing Act' (2016) needs to be enforced and implemented. This act can recognise tenancy and safeguard the interest of marginalised tribal women and small holder farmers.

Programme Delivery and Implementation Level

Right over revenue land and right over forest land is the key: The government should introduce reforms on women land leasing. It is necessary to develop a comprehensive framework for inducing awareness and behavioural change amongst both landowners and forest-based communities.

Private sector investments need to go into both timber and food-based forest systems.

It is important that the Indian Government minimises the need for displacement, as it has direct impact on the tribal food security. Through MGNREGA, the agro forestry and nutri-garden need to be promoted. Without disruptions, the people should access and control food and nutrition entitlements programmes provisioned under the Targeted Public Distribution System (TPDS), the Midday Meal Scheme (MMS) and the Integrated Child Development Services (ICDS).

Recommendation II

Policy Level

Recognising Atmanirbhar POSHAN (Nutritional Self Reliance)

A Leadership Agenda of Action: Investments in tribal nutrition can spur growth, productivity and can contribute to the demographic dividend. It needs the highest level of policy and political will to deliver and transform. The pandemic has taught us that Atmanirbhar POSHAN (Nutritional Self Reliance) at the district/local level is key. It is necessary to invest in tribal nutrition that promotes a life cycle approach and revitalises local food systems. Each district must be self-sufficient at least in six food groups – this can bring food and nutritional self-sufficiency at district level.

Programme Delivery and Implementation Level

Conducting a micronutrient and nutritional status survey in each district, mapping flora and fauna, and planning at the local level for minimum district self-sufficiency in six food groups needed by children, adolescents and adults will be critical to this effort. Additionally, tribal-specific data collection-work with experts and the Department of Tribal Welfare for baseline data collection specific to the tribal population, with a focus on nutrition behaviour and food habits must be conducted. Using data analytics, identifying problems and issues faced by the communities is also crucial.

Another aspect is the introduction of biofortified varieties of crops and other innovative solutions to address the nutritional needs of the tribal communities. Other measures include strengthening local production systems so that the tribals improve access to diversified diets at the local level; Reviving of traditional knowledge and wisdom-promotion of millets to ensure nutrition security highlighted in white paper of millets; and integrating forest land, common land, pasture wetlands and pasture lands, as this will enable both livelihoods and food systems and help to build the self sufficiency.

Recommendation III

Promoting and Protecting Livelihoods – Farm plus Non-Farm plus Natural Resource Management

Policy Level

Promotion of women small holder farmer led climate smart, and nutrition sensitive agriculture will be key and critical for tribal people. Shifting towards dryland

agriculture, that incentivises nutri-cereals (millet varieties) and doubling the minimum support price of millets to that of rice, will be a major policy shift. Like the government of Odisha, the states need to encourage the establishment of the millet missions and introduce the millet and wild foods (after research and a quality control mechanism) in the public funded food programmes – ICDS, PDS and MDM. It is necessary to provide the tribal cultivators the basic technology and research knowhow on the food groups they can grow and consume.

Programme Delivery and Implementation Level

India’s “Stand Up India Scheme” is available to promote entrepreneurship among scheduled caste and scheduled tribe population. This scheme can be harnessed to promote food and nutrition related micro-small and medium enterprises (MSMSEs). India’s flagship Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) can be linked for physical capital strengthening, nutri-garden, diversifying production and farming system.

Local and household level non-farm enterprise promotions may be encouraged. Amul models of cooperative system and integrated processing centres can be replicated. The capacity building, skilling of human resources and mentoring will be key to success. Capacity building and training of producers around food safety and market standards to avoid exploitation and fetch better prices add to that.

Market interventions operation to restructure the commodity trading at mandi level and strengthening post-harvest and market systems for commodities produced in forest areas while ensuring their sustainable production and harvesting without harming the nature can benefit income and employment opportunities. The restoration of forest (especially biodiverse forest) may lead to minimum 30 days of employment to the forest dwellers along with the additional income.

Since the majority of the farm sizes/land holdings are small and marginal, in such a case, local bodies/customary institutions should be motivated to move towards community/collective farming.

A watershed approach and creating employment opportunities, linking MGNREGA with forest restoration, can generate employment.

Recommendation IV

Improve Affordability of Nutrient-Dense Foods

The factors that determine the affordability of nutrient adequate diet are income-wages, consumer preference, access, and, on a more macro level, availability of nutritious food items in the region. To this end, a policy reform may be considered to develop a ‘least-cost’ recommended diet metric to monitor dietary costs and affordability on a regular basis and to consider the cost of recommended diet as an alternative nutrition-sensitive poverty line. More specifically, the states need to reassess the cost-effectiveness of their current food baskets offering, accounting for the nutrient adequacy recommended by the National Institute of Nutrition and recommend timely policy measures. On agriculture-livestock-nutrition, access is not just access to nutrient adequate food from a consumer perspective, but access to resources and inputs by the farmer to improve productivity, diversify crops, sustainably engage in livestock farming and achieve economies of scale.

The tribal population, specifically women and children, must be able to afford foods from other food groups and consume fruits, vegetables, legumes, meat, fish, and eggs which are significantly lower today. Conventionally, the cost of accessing 2100-2200 calories has determined the poverty line in India, and ensuring food security and addressing hunger has been the goal. Given the gains made under renewed prioritisation of nutrition-specific interventions, this policy recommends shifting the goal post from food security to nutrition security.

Recommendation V

Just and Equitable Governance – Increase Transparency and Accountability

Policy Level

The targeted food and nutrition programmes for Particularly Vulnerable Tribal Groups (PVTGs) and aboriginal extinctive primitive tribals in India will address inequality. So far, 75 tribal communities have been identified as PVTGs in different Indian States. Their nutritional needs must be prioritised for their sustainable development. Local government bodies through micro level planning, social audits and community-based monitoring mechanisms can contribute towards this agenda.

Programme Delivery and Implementation Level

IT enabled technologies can improve transparency. Apps may be developed to generate awareness. Technology

can be a key driver-quality of production, estimates groundwater, weather data-compensation can be very transparent. Drone and AI can be used to it in a scientific manner. Even the drought management and insurance can be better managed by using UAVs (drones) and analytics associated with it.

The Community Nutrition Report card, which may capture situation indicators as well as status of resources and time bound plan of action may be introduced.

Addressing multiple exclusions, revitalising gramshabhas and activating district grievances authorities and social audits as provisioned under NFSA-2013 can enhance accountability.

Skilling 3.5 million grassroot functionaries like Accredited Social Health Activists (ASHAs), Anganwadi Workers (AWWs), Auxiliary Nurse Midwives will be important to increase entitlements and better access. SHGs can be a very good platform to be engaged for improved access.

Recommendation VI

Policy Level

A ZERO Mortality Mission – Survive and Thrive a Top Investment Agenda

Providing a safe and dignified place for the children with a mission on ZERO mortality every tribal household aspires today. Seasonality occupies an important element in tribal livelihoods and nutrition and therefore must be taken into consideration. Each state needs to establish a Child Task Force and invest on children who are wasted and severely affected malnourished. The rising wasting is a concern. Safe and nutritious foods during antenatal period can prevent high incidence of low-birth-weight children and other forms of undernutrition. The government may include pulses, edible oil and other fortified foods approved by Food Safety and Standards Authority of India (FSSAI) in the public funded food programmes-ICDS, MDM and TPDS.

Programme Delivery and Implementation Level

The inter-generational cycle of malnutrition needs to be addressed to reach to zero mortality mission – maternal and Infant child feeding will be critical to reduce IMR/MMR.

Opportunities may be explored to address micronutrient malnutrition, popularly known as hidden hunger. Along with dietary diversity and supplementation, the fortified diets may be provided through public funded programmes.

There are reports of commercial interests and children in their first one thousand days of life are consuming breast milk substitutes. Strong regulatory and enforcement measures may be taken to prevent commercial interest in nutrition.

A community level creche programme needs to be mainstreamed.

Universalisation of Maternity Entitlements expansion of Pradhan Mantri Matru Vandana Yojana (PMMVY), especially in tribal community is necessary. It will ensure reduction in maternal malnutrition, maternal mortality, low birth weight babies and neo natal mortality as well as increase in early initiation of breast feeding and exclusive breastfeeding.

Recommendation VII

Policy Level

Convergence to Transform

The convergence and coordination among key sectors and stakeholders from the community level to the district can be optimally provided through the state. The convergence with the Department of Health and Family Welfare, Women and Child Development, Rural Development, MSME, Tribal Affairs and Jal Jeevan Mission would be key to success. The data driven management and robust evidence from the ground can be a key driver for better convergence. The village level platform like VHNSD – village health nutrition sanitation day – needs to function excellently with support from the community, local government, health and ICDS (Integrated Child Development Services) department. Anganwadi Centres, with the support from local government and gram sabhas (village parliament) can be a Centre of Excellence with convergence of all other services.

Programme Delivery and Implementation Level

- Engagements with the Millet Mission-Collaborate to explore what kind of millets can be grown in the specific areas.
- Work closely with the Tribal Welfare and Forest Departments to ensure the implementation of Forest Right Act.
- Establish convergence between DWCD and SRLM to promote livelihood opportunities for women from the community. Livelihood opportunities like preparing mid-day meals, or millet-based snacks or entrepreneurial activities which promote nutrition,

which can be done by the SHG women and handled by the line departments will lead to the women's empowerment and upliftment.

- Work with MWCD and MoH&FW and Ministry of Ayush for key health and nutrition supplies and services.
- Discussions with district officials on knowledge gaps and needs of tribal populations.
- Conduct regular information trainings with AWW and ANMs. Include Asha workers also in the nutrition awareness dissemination. VHNDs can be a useful place for information exchange.

Recommendation VIII

Policy Level

Food Safety and Nutrient-Dense Foods

Strengthen Quality Assurance and Quality Control Mechanisms: Food safety is pivotal to food system. For decades, the deaths and illness of the adults and children due to spurious liquor, wild roots, tubers and fruits, mango kernel and unhygienic food dominate the public discourse. Also, the tribals need skilling on food safety and food hygiene so that their products meet safety standards. It is more important during the pandemic to strengthen food safety value chains and hand hygiene. The state needs to place institutional mechanism for proper quality assurance and quality control measures and regulatory enforcement. This will enable them to access and consume safe and nutritious food.

The Food Safety and Standards Authority of India (FSSAI), in coordinate with the Ministry of Agriculture and Farmer's Welfare (MoA&FW), the Ministry of Fisheries and Aquaculture Development (MoF&AD) and the Ministry of Food Processing Industries (MoFPI), needs to ensure food safety. With a greater push towards convergence for improved availability and access, the policy envisions a deeper collaboration between FSSAI, the National Institute of Nutrition (NIN) to ensure food safety of nutrient-dense foods, which are susceptible to shorter shelf-lives and run the risk of food wastage.

Water contamination, specifically heavy metal contamination in the water, impacts health and nutrition as well as the food value chain. The tribal ministry may work with the Jal Jeevan Mission on improved access to safe water, water testing at the village level and look for opportunity on drinking water iron policy in some regions in the country.

Programme Delivery and Implementation Level

From the perspective of bio-diversity conservation, at least in the rural areas, all villages should have bio-diversity park and fruit plantation to be managed by the SHGs and Community Groups.

Introduction of traceability programmes by FPOs could be a big step towards reaching harmonised quality standards by FPOs without increasing costs.

The government of India is promoting AYUSH medicines and the Ministry of Ayush has issued advisory on Kuposhan Mukh Bharat. The advisory has also redefined bio enhancers as fortificants (vitamins and minerals). In partnership with the Ministry of Ayush, the herbal plants and medicines may be promoted for a mission 'Malnutrition Free India'.

Recommendation IX

Policy Level

Social behaviour changes through cultural endowments: The tribal food and nutrition system is marred with myths and misconceptions and some cultural taboos. Simultaneously, tribal tradition and its cultural social capital provide opportunity for a healthy behaviour change. The appropriate complementary feeding for 6-24 months is abysmally low. Through social behaviour change and communication strategies based on tribal culture and tradition, there can be substantial increase in feeding behaviour, hygiene practice and food safety.

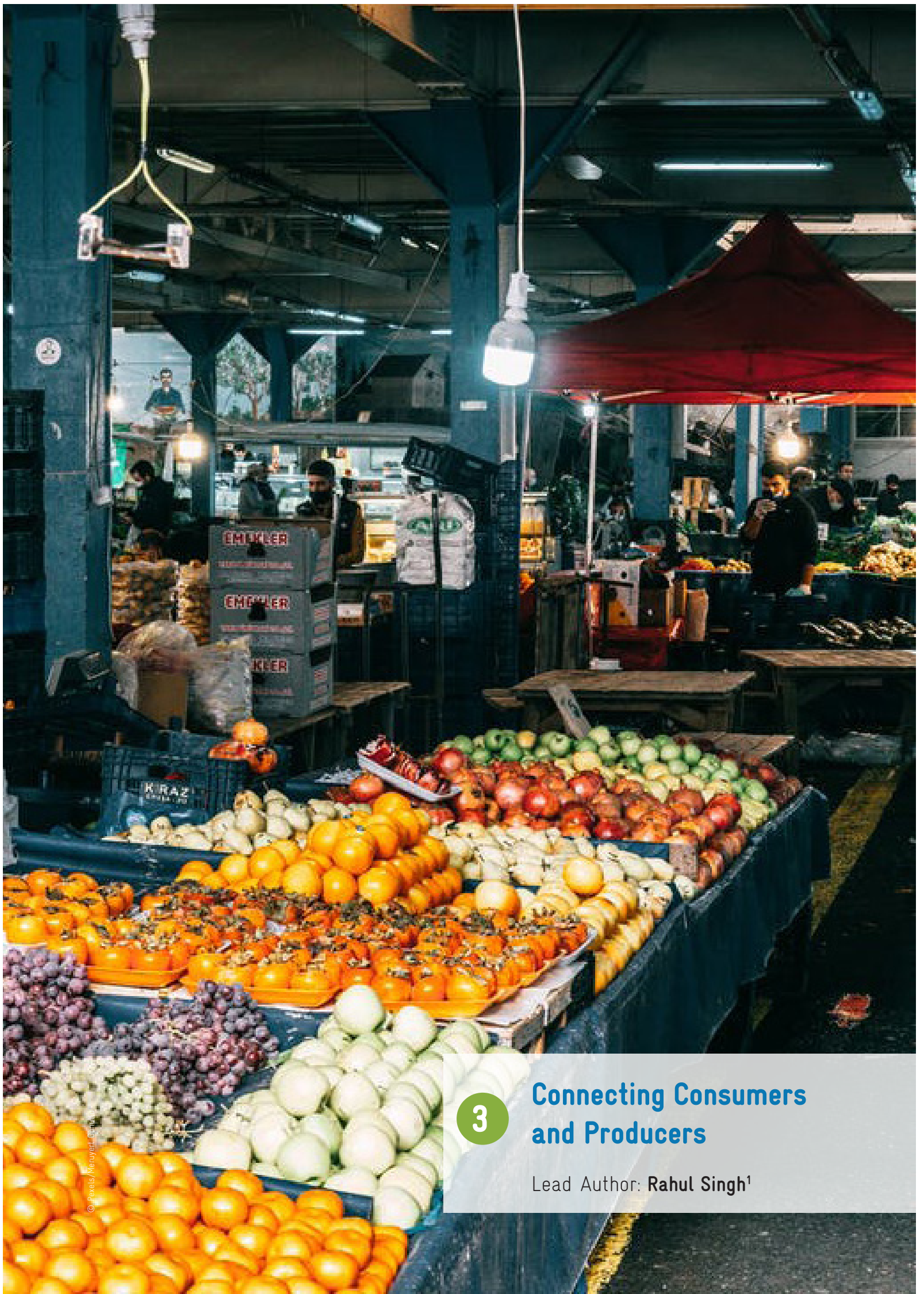
Programme Delivery and Implementation Level

- Understanding food habits and promoting local foods – use the data collected to study food habits. This evidence-based study will help understand how many food groups are being consumed and what are the possible barriers.
- Organise food and cooking workshops that promote healthy, traditional/local recipes as well as inclusion of new nutrient-rich foods.
- Behaviour changes at local level need to be promoted with a focus on inter-personal counselling, keeping the cultural and social aspects in mind, can be promoted.
- There is a need to invest on research and technological innovations on traditional and alternative foods, diets, medicine, and behavioural practices. This will augment the livelihoods opportunity.

- Promote and protect the income through strengthening value chain. India's premier research and academic institutions like the Indian Council of Medical Research (ICMR), Indian Institutes of Technology (IITs), the Central Food Technological Research Institute (CFTRI), the Indian Agricultural Research Institute (IARI) etc. can significantly contribute to understanding the tribal immunity and traditional food, diet, and health practices to develop innovative solutions.
- Consumer demand for healthy food arriving from sustainable production systems is to be promoted.
- Promote millet recipes by a famous Indian chef.
- NUTRITION education sessions with all the family members for improving the knowledge, attitude, and behaviour of the tribal community are necessary. Organise recipe workshops with the community members to show them how best to utilise these grains.

The Way Forward

COVID-19 provides an opportunity for a new world order. It is a critical wakeup call to redesign, our food systems that delivers nutritious and affordable diet for all. Policy makers, researchers and the agriculture sector need to come together to systematically to solve the food and nutrition divide for a sustainable food system and sustainable planet.



3

Connecting Consumers and Producers

Lead Author: Rahul Singh¹

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VISION STATEMENT

Self-sufficient, inclusive, integrated, fair, sustainable and technology-led global value chain ecosystem delivering food and health assurance by producer-consumer partnership.

3.1 Actionable Agenda

India's population has touched 1.38 billion, which is about 17.7% of the world's population.² It will surpass China by 2030 and will become the most populated country of the planet, i.e. consumers are increasing fast. India accounts for 2.4% of the global land, farmers in half the Indian states are marginal (land less than 1 ha) and the remaining are small farmers (land holdings of 1-2 ha). About 58% of the total workforce in the country is still engaged in agricultural and allied sector activities, which accounts for approximately 17.8% of the country's Gross Value Added (GVA) for the year 2019-20.³ The shares of crops and livestock contribute about 85% of the overall agriculture output.

Total food grain production in India is at record 297 million tonnes in 2019-20, which is higher by 11.5 million tonnes than the previous year. Agricultural and allied exports amounted to approx. USD 34 billion in 2019-20, with major export destinations as USA, Saudi Arabia, Iran, Nepal and Bangladesh and top agriculture and related products exports were marine products, rice, meat, spices, cotton raw, oil, sugar, and tea.

In the last 50 years, India has moved from a food scarce to a food sufficiency state, there are several reforms by governments, milestones and successes are drawn.

The private sector has also participated in produce and connecting with farmers in the value chain, improving the efficiency and economies of scale. The composite average growth rate (CAGR) in the last 30 years has been satisfactory, however producers and consumers face several constraints, including input supply, technical expertise, credit availability, storage support, transport, output quality, and most importantly organic market connect.

The Producer Support Estimate (PSE) for India was negative 11.2% of the value of farm receipts between 2000-01 to 2019-20, while Consumer Support Estimate (CSE) was one of the highest in the world at 28.8%.⁴ This section focuses on how social capital helps bridging the producer-consumer integration with technology and digital intervention as enabler in the value chain, benefitting both the producer and the consumer and making the food system stronger on food production, quality and commercial sustainability.

3.2 Major Challenges

India is not only dealing with market connect of producers and consumers, but also suffering in value chain loss in form of both the 'food loss' and 'food waste'. Food loss takes place from the farm up to the retail-level, while food wastage is loss of food at the retail, food service,

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²The World Bank (2020): "Total Global Population". Available online at: <https://data.worldbank.org/indicator/SP.POP.TOTL>. Last accessed: 07.09.2022.

³Ministry of Finance, Gov. of India (2021): "Economic Survey 2020-2021". Available online at: <https://www.indiabudget.gov.in/budget2021-22/economicsurvey/index.php>. Last accessed: 07.09.2022.

⁴OECD (2021): "Agricultural Support". Available online at: <https://data.oecd.org/agrpolity/agricultural-support.htm>. Last accessed: 07.09.2022.

and household level. The lack of cold chain and proper storage for produce, transportation to market, adequate processing facilities, marketing partners and information centres has led to the failure leading to food wastage affecting producer and consumer connect.

Thus, concerns of unpredictability of agricultural production and the demand, risk in supply chain and value chain, absence of the organised social networks of producers and volatility in aggregation of platforms are critical challenges in sustainable food system.

Production planning modelling

As per the Press Information Bureau report,⁵ India lost around USD 12.5 billion in terms of rejection at farm gate and loss during distribution. It also observes that there is about 5–18% waste in the fruits and vegetables sector, 4–6% waste in farm produce and poultry and fish food loss between 6–12%. The reasons for post-harvest loss (PHL) are inadequate storage infrastructure, lack of knowledge on storing practices, inadequate timely market access and small farm holdings to scale up, which account for 80% of the farm holdings. Smart yield management systems are critical. Addressing the produce, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Collaboration with MICROSOFT developed smart yield management for farmers in Andhra Pradesh, which improved the productivity by 30%, mainly by superior forecast of weather, market timing, input requirements and consumption pattern.

Market linkage and fair price

The traditional agricultural value chain has been long with many intermediaries,⁶ which has created low return for producers and high prices for consumers. An organic relationship between the producers and consumers was never established, given the volatile behaviour of the market intermediaries. The technology support reach to producers and offer of a fair price or minimum support price ensures the confidence in the system by both end stakeholders.

Quality, capacity building and social network

Quality of the produce, adulteration at source and in transit, information asymmetry about the produce and in the

supply chain as well as lack of transparency are concerns of the producer, while customer order-to-fulfilment lead-time (CLT), supplier order-to-fulfilment lead-time (SLT), the complete cycle time (CT), and the delivery-to-customer lead-time (DTC) are real-time concerns. Systems addressing these issues are modelled starting at micro level with clusters at regional level and finally connected with the organised sector like Metro Cash and Carry and reliance retail chains. Direct government initiatives like Rythu Bazar in Andhra Pradesh and Telangana have supported producers in selling the produce directly in the market yard allocated, shortening the chain and creating an efficient consumer reach system.

Non-technical super and sub systems

In the overall food system, the non-technical sub systems such as governance, institutions, policy and regulations, and social norms are influential institutions. The base characteristic of this ecosystem is usually historically rooted, socially dynamic, cross regional and works at cross-scale interactions among many processes and actors, and culturally sensitive in multi-cultural settings. Thus, it is systemic in an emergent rather than a planned sense. Social capital becomes an important carrier of the whole ecosystem. A friction in the regional frame can develop national level hazard or evolution/revolution in absence of right treatment of the issue.

3.3 Current Status of Connecting Consumers and Producers in Government and Private Sector Initiatives

Towards making the systems robust and more efficient, market integration activities are getting designed for better outcomes. Developing a unified market for agricultural commodities, India launched the Electronic National Agriculture Market (eNAM) in 2016 by networking existing Agriculture Produce Marketing Committees (APMCs), primarily to increase the choice of the farmers' produce for sale in Mandi. The immediate future looks at 22,000 Mandis and about 7,500 APMCs connected with eNMA,⁷ which expands the ecosystem of the producer network. This has brought in the unorganised produce community on a platform offering efficiency and scale. At the policy environment, the introduction of the Farmers' Produce

⁵Ministry of Food Processing Industries, Gov. of India (2016): "Steps taken to Reduce Post Harvest Food Losses". Available online at: <https://pib.gov.in/newsite/printrelease.aspx?relid=136922>. Last accessed: 08.09.2022.

⁶Committee of State Ministers, In-charge of Agriculture Marketing to Promote Reforms (2013): "Final Report". Available online at: <https://dmi.gov.in/Documents/stminprreform.pdf>. Last accessed: 08.09.2022.

⁷India Brand Equity Foundation (2020): "Indian Agriculture Industry Analysis. Industry Report". Available online at: <https://www.ibef.org/archives/industry/agriculture-reports/agriculture-presentation-december-2019>. Last accessed: 08.09.2022.

Trade and Commerce (Promotion and Facilitation) Act, 2020 and the Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Act, 2020, The Essential Commodities (Amendment) Bill, 2020 and Farmer Service Bill 2020 argue to favour farmers directly for their produce and reduce the value chain benefits transferring partial advantages to consumers.

Market actors and stakeholders, such as input suppliers, farmers and other producers like FPOs and cooperatives, intermediaries, food processors, traders, consumers and others in forward and backward integration are experimenting new business models. The collaborative models of cooperatives/FPOs with corporate chains, small farmers clustering to Haats, technology led facilitation and end-to-end solution to producers by companies are success cases, but the scale is too big to manage India.

3.4 Linkages with the Sustainable Development Goals

Improving performance is welcome but should follow a sustainable approach. The National Programme SNAD policy of India and the sustainable development goals (SDGs) guide to agriculture related missions under its framework with

- SDG 2 - “End hunger, achieve food security and improved nutrition and promote sustainable agriculture” recognising the inter linkages among supporting sustainable agriculture, empowering small farmers, promoting gender equality, ending rural poverty, and ensuring healthy lifestyles.
- SDG 2.3 - By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.
- Government of India VISION 2030
Agenda 1 - To build physical as well as social infrastructure for a ten trillion dollar economy; and Agenda 8 - Self-sufficiency in food production and producing food in the most organic way.
- ICAR 2030, Focus 1 - Promote innovations and improve human resource capacity by involving all stakeholders in the food-supply chain.

Increasing urbanisation, higher population growth, inequitable rural economic growth and high information asymmetry at ground level all have skewed the growth in favour of the system influencers. The social networks like self-help groups (SHGs), farmer producing organisations (FPOs), cooperatives and other such social groups make a significant influence in developing economic opportunities for themselves and making the ecosystem more sustainable.



3.5 Vision 2030

The most critical space is the market institution and its capacity to deliver. The producer structure, expertise, network, partnerships, and alliances optimising the management cost, screening cost and transfer cost would make an efficient producer – consumer relationship and be commercially beneficial.

In India, system thinking and transformation will demand high execution capabilities, especially in an unorganised structure like agriculture and food systems. A Food System Execution Council (FSEC) should be created to plan, execute and monitor the sector requirement. This can be attempted with the help of technology to avoid delivery asymmetry. At functional level, technology-led integrative value chain designs suiting to the regional context can become the base of transformation to the new Food Systems design of India. Major recommendations are presented to achieve VISION 2030.

Recommendation I: Smart yield management

- **Consumption-linked** production i.e. understanding food consumption patterns of both domestic and exports markets and taking it to the producers
- Categorise food system’s produce, create and implement the food safety and regulations issues at regional, national and global level
- Federation of FPOs, cooperatives and SHGs as the new set of institutions to address the market and yield related challenges
- Netting the demand side by active engagement with consumers associations, hotel associations, industry bodies like the Confederation of Indian Industry (CII), the Federation of Indian Chambers of Commerce & Industry (FICCI), and the Progress Harmony Development (PHD) chamber of commerce
- Mapping the consumer behaviour for the food sector; taste, preferences and accordingly develop the market systems

- Developing the vertical and horizontal dynamic data management system to share information at every stage of the value chain to manage yield
- Dialogues and discussions at the farmers' end and orienting them around the market systems, assured market for farmers and risks associated
- Informality of both the consumer and the producer make application of systemic thinking very difficult, designing the pull factor so that both sides see added benefits
- Develop self-governing bodies at different levels and break silos by stakeholder dialogue

Recommendation II: Value chain traceability

- Developing a 'Tracing the Produce Model', the value distribution in value chains, partnership value acquisition and automation of data collection and analytics for policy
- Developing the designs of traceability and modelling the engagement of produce and supply chain stakeholders i.e. farmers, FPOs, cooperatives, cold chains, retailers etc
- Designing a traceability model to better consumer health for plant-based production
- Developing scalable best practices and dissemination to replication
- Developing quality standards and marks for safe and traceable farms and food
- Developing local, regional, national and global models of traceability in food systems
- Creating capacity building programmes to achieve the goals and actions in the Traceability Agenda i.e. reduced cost of cultivation, improved productivity and product quality, and food safety and certification norms

Recommendation III: Integration of finance and insurance services to the value chain

- Developing new financing institutions and models for affordable financing to smallholders, FPO and cooperatives
- Integrating multilateral and bilateral agencies in developing the models at affordable interest rates to smallholder farmers, especially around the safe and agro ecology-based production systems like the Umbrella Programme for Natural Resource Management

- Bringing innovative financial and insurance products at different levels of the value chain, assuring risk coverage and return to the most vulnerable groups in the value chain
- Developing opportunities of impact funds, sustainable farming bonds and green food credit systems (GFCS) for value chain financing
- Developing special financing vehicles to cooperatives, FPCs and micro level farmers
- Developing the Multi-Stakeholder Infrastructure Fund (MSIF) to support local infrastructure ecosystem required for production
- Developing programmes and schemes of incentivisation to produce safe, natural and organic foods
- Developing a contract farming financing model by the buyer to the farmer.
- Developing products of crop assured insurance, weather insurance, market risk insurance with a smart claims management system
- Developing minimum revenue plans with incentives for smallholders, FPOs and cooperatives to support high produce and financial health

Recommendation IV: Digital enabled market place

- Creating a comprehensive digital and data system at Gram Panchayat level, since the digital ecosystem is being laid down for two way commination towards support and connect
- Implementing digital systems to bring traceability and transparency in the value chain
- Designing systems of capturing and modelling data for evidence-based policy and support the financing and insurance verification
- Designing local level network (LLN) initiatives to connect producers and consumers, such as RWAs and FPOs connect
- Rationalising the logistics cost of farmers to leverage the digital marketplace
- Digital marketplace is still a challenge for FPOs as good number of farmers are still not connected with internet and smartphones
- Developing a micro farm market with smart phone technology, connect and offer packaging, branding, logistics support to produce high end products
- Developing dual transaction systems i.e. farmers as consumers for commodities, input supplies, and services like finance, insurance and logistics

Recommendation V: Capacity building, environment and sustainability

- Developing and designing capacity building programmes for all stakeholders in new food systems including policy makers, intermediaries, financial institutions, FPOs and smallholders.
- Framing the inclusive system connecting PDS, CBOs and private players
- Enhancing multilateral and bilateral agencies' role in building social capital and social infrastructure like World Bank, Japan International Cooperation Agency (JICA)
- Developing commodity specific systems of measurement of food waste at each level of the supply- and value chain and bringing the circular economy principles in practice
- Developing responsible consumer education programmes for deeper engagement
- Developing standards, quality marks, aspirational marks for next level markets
- Developing landscapes approach farming with fair value distribution in the value chain towards food aspiration and economic balance for a healthy food system

3.6 Pathways for 2030

Networks and partnerships with underlying trust and common goals, which are supported by public policy systems will deliver superior performance in 2030. Social resources that people rely on when pursuing their livelihoods, i.e. social capital, will help building the local value chains at micro levels, regional or national level and green value chains at global level to deliver to consumers.

Actionable Agenda

- Promote and develop a connected infrastructure pool for agriculture with ten years tax exemption to investors
- Design and boost scalable producer–industry partnerships through various models

- Promoting effective, efficient and decentralised governance and self-governance with best management practices
- Prepare a multi-stakeholder, multi-institutional participatory and consortia-based action plan
- Launch 'National agriculture technology mission' and 'National agriculture sustainable value chain mission' programmes
- Develop 'agriculture supply chain corridor' to deliver value in time
- Create 'Agriculture technology and innovation fund'
- Create 100 Agriculture cities in India with a comprehensive value chain plan
- Develop 'Agriculture & farming equipment hubs by companies' working on lease model
- Create 'Agriculture cloud and data authority' to facilitate all stakeholder market support
- Create a 'National food system chamber of commerce' with committed agenda
- Develop 'Agriculture malls in mega cities' to promote brand and image to food system
- Develop 'National food processing export zones' for high quality and exports
- Create a 'Agriculture stock exchange' to develop asset allocation system in domain
- Create 'Consortia of financing and venture capital institutions' supporting the complete ecosystem of the food system with special focus investment on producers
- Create world class knowledge systems, universities, and start-ups with special privileges

The aggregation of important stakeholders like government, policy agencies, companies, financial institutions and producers and consumers will stabilise the food system space. The successful models and best practices will guide to create newer models and present replicability, hence VISION 2030 is achievable.



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4

Workforce Nutrition

Lead Author: Tarun Vij¹



VISION STATEMENT

Reimagining nutrition security for a healthy and productive Indian workforce; Delivering healthy diets to strengthen nutrition security for a healthy and productive Indian workforce; Ensuring wellbeing through nutrition security for a healthy and productive Indian workforce.

4.1 Actionable Agenda

India's demographic dividend provides a window of opportunity to become one of the largest economies globally in the medium term, with the short-term realisation of Prime Minister Modi's vision of achieving a \$5 trillion GDP. With 66.8%² of the population under working age, India has a huge potential to achieve economic growth much faster than the largest global economies. For this to happen, India must focus on building a strong human capital that can act as a driving force to move away from low-skilled jobs to a knowledge-based economy. This requires ensuring nutrition security for the present generation of the working population as well as our children who will enter the workforce in future.

4.2 Major Challenges

Malnutrition has consequences beyond an individual's health and wellbeing. A study in 19 countries estimated that \$8–38 billion per year are lost from reduced worker productivity due to employees being underweight, and \$4–27 billion per year due to obesity.³ Further, child malnutrition alone is responsible for approximately 15% of the total disease burden in India, which costs India around

3% of its gross domestic product (GDP) every year, i.e., around \$46 billion, and up to 8% of its productivity.⁴

A balanced diet, including micronutrients such as zinc, iron, and vitamins, is important to build body immune systems and fight diseases and pandemics. During the recent Covid-19 pandemic, people with poor immune systems have suffered the most. Poor and vulnerable sections of the population, including daily wage earners working in both formal and informal sectors, have minimal access to diverse foods and are more negatively impacted during public health crises.

Businesses can play a catalytic role in sustaining a healthy and thriving workforce. Given that most of the working-age population will eat at least one meal a day at work; access to nutritious food in work settings is often inadequate – a missed opportunity given the strong connection between health, nutrition, and productivity.

Improving investments in human capital through improved workforce nutrition interventions is one way to influence both national economies and global public health. 'Workforce Nutrition', as defined by the Global Alliance for Improved Nutrition (GAIN), refers to a set of

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²OECD (2021). "Working Age Population". Available online at: <https://data.oecd.org/pop/working-age-population.htm>. Last accessed: 07.09.2022.

³Wellesley, J.; Eis, J.; Marijs, C.; Vexler, C.; Waites, F.; Benton, T. G. (2020). "The Business Case for Investment in Nutrition". Chatham House Report. Available online at: <https://www.chathamhouse.org/sites/default/files/07-08-business-case-investment-nutrition-wellesley-et-al.pdf>. Last accessed: 07.09.2022.

⁴Huddinnott, J. (n.a.). "The Economic Cost of Malnutrition". Available online at: https://www.nutri-facts.org/content/dam/nutrifacts/media/media-books/RTGN_chapter_05.pdf. Last accessed: 07.09.2022

interventions that work through the existing structures of the workplace to address fundamental aspects of nutrition amongst employees and/or supply chain workers. These programmes aim to create improved access to, and demand for safe and nutritious food. Breastfeeding support programmes are included in this definition”.⁵

There is a strong business case for corporates, employers, and governments to introduce effective workforce nutrition programmes. A recent World Bank analysis estimates that every \$1 invested in interventions to meet the World Health Assembly nutrition targets would yield an economic return between \$4 and \$35.⁶ A simple workforce nutrition initiative of providing healthy and varied food choices at work can reduce the risk of non-communicable diseases and provide enough energy and nutrients to perform tasks: this, in turn, has the potential to reduce rates of accidents and absenteeism, increases productivity, and decreases mistakes. Besides contributing to enhanced productivity and revenue; workforce nutrition programmes also help attract customers, retain talent, improve brand reputation, increase employee loyalty, fulfil sustainability commitments, and strengthen the sustainability approach.⁷

4.3 Current Status and Government Initiatives Towards a Workforce in Nutrition

The nutrition policies and programmes of the government of India are targeted at the population in general and not specifically at the working age. The national initiatives on maternal and child nutrition, such as the Integrated Child Development Services (ICDS), Mid-Day Meal, and the recent flagship programme POSHAN Abhiyaan (Nutrition Mission) have had moderate success in decreasing the number of children who are stunted, wasted, and anaemic, but there is substantial scope to improve upon these indicators in line with global benchmarks. While these interventions are critical to developing a nutritionally secure workforce for tomorrow; the current working adults have largely been left out of the existing governmental interventions. This is particularly true for workers in the unorganised sector, who constitute more than 90% of the 450 million strong workforces in India. The existing laws

and regulations for workers that include the Factories Act, Mines Act, the Building and Construction Worker’s Act, and the Plantation Labour Act provide for occupational health and safety, labour welfare, and conditions of work. Nutrition is overlooked in these policies.

The introduction of the National Food Security Act (NFSA) is an important event in India’s development discourse. The NFSA has facilitated guaranteed access to staple foods at very subsidised rates for millions of vulnerable worker households through the network of Public Distribution System (PDS) fair price shops. However, the affordability of other important sources of nutrition such as fresh fruits, vegetables, dairy products, and other important food groups is still a challenge for many. Therefore, most of them are unable to consume the recommended diet and continue to remain nutritionally vulnerable.

For the past 40 years, food policies have largely focused on providing calorie-dense diets and reducing absolute hunger; however, concentrated efforts to reduce hidden hunger or micronutrient deficiency need to be additionally prioritised with urgency. Micro-nutrient malnutrition is one of the leading causes of chronic diseases. Chronic diseases are on the rise in India, and mostly impact the working-age population and the elderly. As per the recent World Bank data on India, deaths due to chronic diseases (non-communicable diseases) such as heart diseases, diabetes, stroke, and others has accounted for 65.9% of all deaths in 2019.⁸ This results in an overall reduction of the work capacity of individuals due to decreased productivity and increased absenteeism. The country’s public health advocacy to date has concentrated mainly on infectious diseases, and therefore there is a need to address the challenges of chronic diseases with equal energy.

A very recent development towards workforce nutrition in the private sector is the corporate wellness programmes. Although focusing on the overall health and well-being of the employees; nutrition-related services such as diet counselling, weight management, and physical exercises are part of these wellness initiatives. There are a few

⁵Scaling Up Nutrition (2019): “Addressing Workforce Nutrition Commitments”. Available online at: https://2fe0ur3bixo1clgx344dzo3-wpengine.netdna-ssl.com/wp-content/uploads/2019/09/SUN_Workforce_Nut_black_white_pr7_screenfriendly_largefile.pdf. Last accessed: 07.09.2022.

⁶Wellesley, J.; Eis, J.; Marijs, C.; Vexler, C.; Waites, F.; Benton, T. G. (2020): “The Business Case for Investment in Nutrition”. Chatham House Report. Available online at: <https://www.chathamhouse.org/sites/default/files/07-08-business-case-investment-nutrition-wellesley-et-al.pdf>. Last accessed: 07.09.2022.

⁷Global Alliance for Improved Nutrition (2019): “Better Nutrition for a Healthier Workforce. A Summary Report of a Workshop”. Available online at: <https://www.gainhealth.org/sites/default/files/publications/documents/gain-convening-paper-series-1-better-nutrition-for-a-healthier-workforce-july-2019.pdf>. Last accessed: 07.09.2022.

⁸The World Bank (2020): “Cause of death, by non-communicable diseases (% of total) - India”. Available online at: <https://data.worldbank.org/indicator/SH.DTH.NCOM.ZS?locations=IN>. Last accessed at: 07.09.2022.

Indian businesses that have introduced these wellness programmes. These interventions are not only contributing to the health and well-being of the employees but are also helping businesses to retain talent. Notwithstanding their importance, there is scope for many more Indian businesses to start making investments in employee wellness. There is limited capacity and know-know on designing and implementing such programmes. Moreover, the current corporate wellness programmes only benefit about 10 % of employees who are primarily employed in the formal sector.

Traditionally, governments have been responsible for addressing health and nutrition of the population, but it is increasingly realised that governments alone cannot tackle the huge burden of malnutrition. Many policymakers and business leaders now believe that the private sector can play a key role to contribute to the nutritional outcomes of the workforce.

4.4 Linkages with the Sustainable Development Goals

Sustainable Development Goals are multifaceted targets that require actions at multiple levels, ranging from households to community to nation. One important area, which is often overlooked, is the importance of healthy diets for everyone. Poor diets are associated with hidden hunger, the prevalence of non-communicable diseases, sub-optimal cognitive development, and reduced productivity. Businesses can introduce workforce nutrition programmes, which will not only help reach a large portion of the population through workplaces and daily work environments, addressing a variety of nutrition and health-related problems, but also contribute towards attainment of the Sustainable Development Goals. Workforce nutrition programmes promoting healthy diets can directly contribute towards SDG 2, which relates to ending hunger, achieving food security and improved nutrition, and SDG 8, relating to full and productive employment and decent work for all. Additionally, WFN programmes also support SDG 1 – ending poverty in all forms, SDG 3 - health and wellbeing, SDG 4 - cognitive development and learning, and SDG 5 - reduced inequality. Investment in WFN programmes is a win-win for businesses and workers, as these programmes not only help businesses and corporates to increase productivity and revenue, but also to attain global goals of the country.



4.5 Vision 2030

India needs to seize the opportunity to achieve economic growth through a healthy workforce. The vision for workforce nutrition in India for 2030 is to reimagine nutrition security for a healthy and productive Indian workforce through the involvement of both public and private sector stakeholders. Government and businesses need to realise the importance of nutrition for the workforce as key for better economic growth and development.

4.5 Pathways for 2030

Despite various challenges, India needs to explore innovative ways to introduce nutrition policies and programmes for its workforce. Businesses, corporates, and other stakeholders need to join the governmental efforts and make nutrition a part of their business strategy. Below are four key areas of priority in which workforce nutrition interventions can play a catalytic role.

■ Enhance demand and access to nutritious foods

Affordability and accessibility play an important role in the consumption of diverse types of food, but lack of awareness about nutrition and healthy food choices, knowledge about chronic diseases, and motivation to change behaviour play an equally critical role in one's dietary habits. Working adults spend one-third of their day at work; therefore, employers can influence their behaviour by providing a supportive environment and leveraging existing infrastructure to bridge the knowledge gap on nutrition and improve access to nutritious diets for by the workforce. Workplaces can be leveraged as an optimal point of nutrition intervention.

It is recommended to introduce **nutrition education** programmes for the workers. Driven by the top leadership of companies; these programmes can focus on improving knowledge on nutrition and will help in (i) changing attitudes towards specific behaviours, (ii) addressing normative beliefs, (iii) modifying beliefs with self-control. A holistic approach to creating a corporate-enabled effective health and nutrition communication plan to generate health awareness, sustain motivation and reach out to not just employees but workers in the value chain, as well as the community at large is required. Businesses and corporates can use consumer behaviour insights to develop targeted communication to bring about behavioural changes to improve demand for nutritious food by own employees and other workers in the value chain.

Businesses and employers can also introduce **healthy food at work** by focusing on increasing employees'

access to healthy and safe foods at work. Employers may provide healthy food for free, with a subsidy, or at full cost to the employee. These programmes change the food environment through healthier, innovative, and affordable canteen meals (some include promotions alongside options), healthy snack offerings, vending machine options, more balanced portion sizes. Usually, corporate canteens are outsourced to a food vendor, and they must be onboarded for this initiative. Health and wellbeing committees can be formed at workplaces to work together with the food vendors to develop nutritious food menus and to monitor and evaluate the impact of the programme.

■ Improve maternal and child health

Women have a crucial role in promoting nutrition. They breastfeed the new-born and prepare meals for the family. Women also make up an important and critical part of the workforce in India, thus making it important for scaling up nutritional efforts for women. Over the last three decades, the participation of women in the workforce has been declining due to several reasons – increased care responsibilities being one of them. It is important to introduce better health policies and make concerted efforts to create healthy and safe working spaces for women. A study from as early as 2000 has shown that improvement in women's status through providing work opportunities is associated with positive impacts on their nutritional status. This study also estimates that improvement in women's status account for 11.61% of global reductions in the proportion of underweight children, and improvements in women's education through secondary school enrolments accounts for 43.01% of global reductions in the proportion of underweight children. Taken together, the two indicators accounted for over half of the reductions in children underweight.⁹

India has recently passed a regulation that provides six months of paid maternity leave to working women. This is a very encouraging development to further build upon. It is important to **introduce the concept of care in the workplace**, which can be initiated through introducing family-friendly policies. **Breastfeeding support** is a crucial part of these family-friendly policies apart from paternity and maternity leave. Breastfeeding support programmes enable working mothers to exclusively breastfeed their children for six months and up to two years. This requires an appropriate place and time to pump/express milk during work hours, refrigeration facilities to store milk,

and provisioning facilities to mothers such as childcare at the workplace with flexible work schedules. A workplace breastfeeding support practice/programme improves productivity and reduces absenteeism in working mothers in addition to the benefits to the infants. Additionally, support can also be provided to working mothers through creches and lactation stations in both organised and unorganised sectors. Human rights audits and recruitment of more female workforce in leadership positions can benefit the employers to ensure the development of a supportive environment for women. This also helps in catering to the larger agenda of Sustainable Development Goal 2 by increasing rates of exclusive breastfeeding among working mothers.

■ Contribute towards the fight to control non-communicable diseases

As globalisation and urbanisation converge in India, lifestyle-related diseases, especially non-communicable diseases, are emerging as a major threat. According to the World Health Organisation (WHO), seven out of ten deaths in lower-middle-income countries were due to non-communicable diseases (chronic diseases) such as ischaemic heart disease, stroke, neonatal conditions, diabetes, kidney diseases, and cancer which are also triggered by chronic malnutrition. In India, the share of chronic diseases is becoming a great threat for workers. Businesses need to step up their workforce nutrition interventions to tackle this increasing disease burden along with the government.

Businesses and employers are uniquely placed to take positive action on fighting lifestyle-related diseases by introducing **nutrition-focused health check-ups** as part of the workforce nutrition intervention. Nutrition-focused health check-ups at the workplace, if coupled with counselling, can help in preventing non-communicable diseases such as diabetes and heart diseases. They can also help in providing information to the employees about their health, making them understand the nutritional risk factors and lifestyle changes that are needed to mitigate risks. Additionally, they can support the employees in tracking progress on nutrition-related goals, increasing their knowledge about health and nutrition, which further translates into a lower likelihood of sick days and an overall boost to employee morale.¹⁰ Nutrition health check-ups also help in reinforcing positive changes in the nutrition-related behaviour of individuals.

⁹Scaling Up Nutrition (2016): "Empowering Women and Girls to Improve Nutrition: Building a Sisterhood of Success. Available online at: <https://scalingupnutrition.org/wp-content/uploads/2016/05/IN-PRACTICE-BRIEF-6-EMPOWERING-WOMEN-AND-GIRLS-TO-IMPROVE-NUTRITION-BUILDING-A-SISTERHOOD-OF-SUCCESS.pdf>. Last accessed on 07.09.2022.

¹⁰Global Alliance for Improved Nutrition (2019): "Nutrition-focused health checks". Available online at: <https://www.gainhealth.org/sites/default/files/publications/documents/evidence-brief-3-nutrition-focused-health-checks-2019.pdf>. Last accessed: 07.09.2022.

■ Provide nutrition for supply chain workers

Investments by the government in nutrition programmes must be augmented by a much stronger commitment and involvement of the private sector, especially from the bigger brands, to meet the nutritional deficits in India's workforce. The unique needs and challenges of the most marginalised worker need to be understood while designing workforce nutrition interventions in the private sector. The workers and employees engaged in the formal sector can benefit from nutrition interventions in the workplace setting. By contrast, most of the workforce in India is from the unorganised sector who continue to work as self-employed workers and contributing family workers. Therefore, traditional workplace setting nutritional interventions may not work in all these contexts, and businesses may need to go the extra mile to target the workforce in the unorganised sector.

Corporate social responsibility is one way in which corporates can channelise their funds to build a healthy

and prosperous workforce beyond their immediate staff members, but this may not be sufficient. Workforce nutrition needs to be an integral part of a company's policy. For instance, many global and national businesses operate in sectors that employ many workers in their value chains. These include the high-value agriculture and horticulture value chains such as coffee, tea, sugarcane, cashew, and spices. Similarly, the construction, textile, and mining industries employ many workers as does the services sector. Workforce nutrition policies and programmes for the supply chain workers can be an integral part of the sustainable business practices of such companies. Various nutrition-sensitive programmes, such as nutrition education and counseling, health checkups, breastfeeding support, and providing access to nutritious, safe, and affordable food can be introduced in partnership with development partners. These will potentially benefit many workers in the unorganised sector, if not all. The private sector can evaluate and monitor such nutritional programmes to measure their financial impact on their businesses.

Section: III

**Planet: Solutions for
Nature-Positive Food
Systems**



1

Enhancing Soil Health

Lead Author: **Amita Bhaduri**¹



VISION STATEMENT

By 2030, farmers/farming systems will move from exploitation of soils towards recycling of nutrients and organic material leading to enhancing productive and adaptive capacities for sustainable ecological and food systems.

1.1 Actionable Agenda

Food systems are severely affected by environmental shocks and resource depletion and there is an increasing “need to address production constraints and environmental risks, including low agricultural productivity growth, climate change, increased soil and land degradation, and loss of biodiversity”.² Soil, a finite, fragile resource is fundamental to food systems and “an estimated 95% of our food is directly or indirectly produced on our soils”. The threat to soils “are not only detrimental for global food security, but also negatively impacts our climate, our water systems and our biodiversity”.³

Soils supply the “essential nutrients, water, oxygen and root support that our food-producing plants need to grow and flourish”.⁴ Microbes in the soil are responsible for the soil health, fertility and carbon reserve. “Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests,

form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive effects for soil water and nutrient holding capacity, and ultimately improve crop production”.⁵ Food systems resilience needs to begin from the farms and specifically with the soil. “They are the key to any production, as they store water, cycle nutrients, help to resist disease and ultimately grow healthy crops”.⁶

While the last few decades in India have been marked by impressive gains in food production, food security and rural poverty reduction, the heightened intensification in agriculture after the green revolution has led to deteriorating health of soils in India.⁷ Many of today’s soil and crop management systems have now become unsustainable and are degrading the ecosystem. There is a deterioration in soil quality i.e., its “continued capacity to function as a vital living system”⁸ and soils are increasingly facing salinisation and acidification due to inadequate agricultural practices.

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²von Braun, J. (2018): “Global institutions: Governance reform for food, nutrition, and agriculture”. In: 2018 Global food policy report. Chapter 8. pp. 62–71. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/9780896292970_08.

³FAO (2015): “Healthy soils are the basis for healthy food production”. Available online at: <https://www.fao.org/soils-2015/news/news-detail/en/c/277682/#:~:text=Healthy%20soils%20produce%20healthy%20crops,need%20to%20grow%20and%20flourish>. Last accessed: 08.09.2022.

⁴Ibid.

⁵Ibid.

⁶Smukler, S. (2021): “Building a Resilient Food System Starts with the Soil”. The University of British Columbia. Available online at: <https://www.landfood.ubc.ca/building-a-resilient-food-system-starts-with-the-soil/>. Last accessed: 08.09.2022.

⁷National Commission on Agriculture (1976): “Report of the National Commission on Agriculture, 1976”. Available online at: <https://www.worldcat.org/title/report-of-the-national-commission-on-agriculture-1976/oclc/4491358>. Last accessed: 08.09.2022.

⁸Patra, A.; Lenka, N. K.; Biswas, A. (2015). “Soil Health Assessment and Management: Issues and Strategies”. Indian Journal of Fertilisers. 11. 16–25.

1.2 Major Challenges

Large parts of India are faced with deterioration of soil health over time due to a combination of factors such as unsustainable resource use; loss of soil fertility due to nitrogen deposition, low nitrogen uptake efficiency, and low fertiliser response ratio resulting from injudicious use of fertiliser.⁹ Major concerns include contamination of surface and groundwater resources, soil and water acidification,¹⁰ micronutrient deficiency, low organic carbon,¹¹ accumulation of heavy metals and metalloids through various forms of emissions, residue burning and increased emissions of potent greenhouse gases. The overuse of pesticides has “destroyed beneficial insect populations that act as natural enemies of pests and reduced the nutritional value of food”.¹²

Soil Health: Status in India

- Land degradation: About 29% or about 96.4 million hectares are considered degraded; 37% of land area (120.4 mha) of soil suffer from varying degrees of degradation.
- Physical constraints: 89.5 mha
- Annual soil loss: 5,334 million tonnes of soil
- Annual nutrient loss: 5.37 to 8.4 million tonnes of nutrients
- About 50% of canal-irrigated area is affected by salinisation and/or alkalinisation due to poor drainage.
- Annual loss in output of main crops in India because of soil erosion: 7.2 million tonnes i.e. 4 to 6.3% of annual agricultural production of the country and ranges to a loss in terms of replacement cost from 1 to 1.7% of the GDP.
- Rise in fertiliser consumption: At an all-India level, it has risen (in terms of N, P and K5) from 2.17 kg per hectare in 1961/62 to 134 kg per hectare in 2018/19.
- NPK ratio in India in 2015 was 6.7:2.4:1 as against an ideal ratio of 4:2:1 as recommended by the Fertiliser Association of India.

- Imbalanced use of fertilisers created widespread deficiency of secondary and micro nutrients and 49% of soils in India are potentially deficient in Zn, 12% in Fe, 5% in Mn, 3% in copper (Cu), 33% in boron (B) and 11% in molybdenum (Mo).

This soil degradation threatens sustainability and has led to a decline in the inherent capacity of soils to supply plant nutrients. A fact finding committee constituted by the Government of India in 1997 reported a decline in the organic-carbon content of the soils due to continuous cultivation of cereal-based cropping systems, for instance rice–wheat, rice–rice and rice–maize, etc.¹³ Also, unsustainable forest management is increasingly leading to carbon losses from forest biomass and soils. Soils are a key enabler for achieving healthy and sustainable food systems apart from other objectives such as climate neutrality, biodiversity restoration, zero pollution, and a resilient environment. Soil health has a direct impact on several SDG’s, most notable being SDG 2: Zero Hunger, SDG 13: Climate Action, SDG 6: Clean Water & Sanitation and SDG 15: Life on Land. SDG 15.3 in particular has soil and land at its core “combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world by 2030”.



1.3 Current Status of Soil Health in Government Initiatives

Soil health enhancement has been a concern for the government which has over the years made huge investment through various developmental schemes such as the Integrated Watershed Management Programme (IWMP); National Watershed Development Project for Rainfed Areas; Drought Prone Areas Programme (DPAP); Desert Development Programme (DDP) etc.¹⁴

The National Mission for Sustainable Agriculture (NMSA), a recent initiative, has soil health management as

⁹Gulati, A.; Ferroni, M.; Zhou, Y. (2018): “Supporting Indian Farms. The Smart Way”. Academic Foundation. ICRIER. ISBN 13: 978-93-327-0472-5.

¹⁰Bhattacharyya, R.; Ghosh, B.N.; Mishra, P.K.; Mandal, B.; Rao, C.S.; Sarkar, D.; Das, K.; Anil, K.S.; Lalitha, M.; Hati, K.M.; Franzluebbers, A.J. (2015): “Soil Degradation in India: Challenges and Potential Solutions”. In: Sustainability 2015, 7, 3528–3570. <https://doi.org/10.3390/su7043528>.

¹¹Bhattacharyya, T.; Pal, D. K.; Mandal, C.; Velayutham, M. (2000): “Organic carbon stock in Indian soils and their geographical distribution”. In: Current Science, 79(5), pp. 655–660. <http://www.jstor.org/stable/2410508>.

¹²United Nations (2020): “Special Rapporteur on the right to food”. Available online at: <https://www.ohchr.org/en/special-procedures/sr-food>. Last accessed: 08.09.2022.

¹³Chand, S.; (2010): “Challenges of soil quality of Indian soils vis-à-vis food security”. In: Current Science 99 (3). Available online at: <http://indiaenvironmentportal.org.in/files/Challenges%20of%20soil%20quality%20of%20Indian%20soils.pdf>. Last accessed: 08.09.2022.

¹⁴National Project on Organic Farming (NPOF); National Project on Management of Soil Health and Fertility (NPMSHF); Paramparagat Krishi Vikas Yojana (PKVY) – a scheme on organic farming; National Rainfed Area Authority (NRAA) by the Planning Commission; National Biogas and Manure Management Program; Nutrient Based Subsidy (NBS) Policy Initiatives; Pradhan Mantri Krishi Sinchai Yojana; Mission Organic Value Chain Development for North Eastern Region; Policy mandating urea manufacturers to produce neem-coated fertiliser; Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

a sub-scheme for promoting soil test-based balanced and integrated nutrient management. More recently (in 2015), a National Mission on Soil Health Card¹⁵ has been launched to provide soil test-based fertiliser recommendations to all farmers in the country at an interval of three years to enable the farmers to apply recommended doses of nutrients based on soil test.

Soil Health: Key Milestones in India

- Soil conservation a state subject as per the constitution
- Policies that address concerns related to soil degradation/soil health: National Agricultural Policy 2000; Forest (Conservation) Act 1980; Environment (Protection) Act 1986; National Environmental Policy 2006; National Policy for Farmers 2007; National Agroforestry Policy 2014; National Water Policy 2012; National Forest Policy 1988 etc.
- Guidelines for implementation of Soil Health Management (SHM) component under National Mission for Sustainable Agriculture (NMSA)
- Strengthening of Soil Testing Laboratories (STLs) (3887 Nos.) with an aggregate analysing capacity of 15 million samples per annum; Inclusion of mini labs developed with ICAR technology for soil testing/fertiliser recommendation
- Farm Science Centers (KVK) 700 Nos. with portable soil testing kits
- Fertiliser plants – 172 nos
- Bio-fertiliser production units – 400 Nos with a capacity of 100,000 tons per annum
- Continuation/strengthening of Central Fertiliser Quality Control & Training Institute, Faridabad and its Regional Laboratories – 82 nos
- Promoting use of integrated nutrient management
- Several Research Institutions: Indian Institute of Soil Science; National Bureau of Soil Survey & Land Use Planning; Central Soil Salinity Research Institute; Indian Institute of Soil and Water Conservation
- Key Research Initiatives: Ail India Coordinated Research Projects – Soil Test Crop Response; Micro- and Secondary Nutrients and Pollutant Elements in Soils and Plants; Long Term Fertiliser Experiments; Salt Affected Soils Network Projects; Soil Biodiversity-Biofertilisers; Organic Farming Consortia Research Project; Conservation Agriculture

Source: *Gol websites; 5K Choudhori, Soil health mc 'cvernment Indian perspective*

1.4 Vision 2030

While India is on track to achieve its national commitment of land degradation neutrality and is also working to restore 26 million hectares of degraded land by 2030, as per the Prime Minister's speech to the UN 'High-Level Dialogue on Desertification, Land Degradation and Drought' in June 2021,¹⁶ the risks of soil health degradation are on the rise.

The country is faced with the challenge of increasing its food grain production by 2030 while its land-use is getting more intensive and per capita arable land area is declining. "Thus, the need for identifying processes, practices and policies that govern sustainable management of soil resources is more critical now than ever before".¹⁷

India needs to take steps towards reducing soil erosion, protecting soil fertility, increasing soil organic matter, restoring degraded soils and improving the monitoring of soil quality by 2030. A joint report by the United Nations Environment Programme (UNEP) and the United Nations Conference on Trade and Development (UNCTAD) states the need to "move away from industrial agricultural models of the twentieth century" and calls for "a wide range of creative, sustainable agricultural systems which not only provide food, but also factor in the economic value of nature-based services of forests, wetlands and soil organisms that underpin agricultural services."

1.5 Pathways for 2030

What should policymakers do?

- Soil health has been overlooked in government policies in the recent decades and there is a need to better mainstream/integrate issues related to soil health improvement and agronomic crop production by focussing on low hanging initiatives at first and thereafter move on to the more complex practices.
- Nature-based agroecological solutions, such as land carbon sinks, will deliver multiple co-benefits and thus need to be supported and made a part of policy and programmes. There is a need to set targets for soil carbon¹⁸ sequestration to reduce carbon footprint and global warming. Policy makers/researchers need

¹⁵Coverage: 10.74 crore farmers in 1st cycle (2015-17) and 11.75 crore farmers in 2nd cycle (2017-19); the 2nd cycle is focusing on job creation and entrepreneurship development through local entrepreneurship models.

¹⁶Roche, E. (2021): "India on track to achieve national commitment of land degradation neutrality: PM". mint. Available online at: <https://www.livemint.com/news/india/india-on-track-to-achieve-national-commitment-of-land-degradation-neutrality-pm-11623685061876.html>. Last accessed: 08.09.2022.

¹⁷LaI, R. (2009): "Laws of Sustainable Soil Management". In: *Agronomy for Sustainable Development* 29 (1). http://dx.doi.org/10.1051/agro:2008060.29.10.1007/978-90-481-2666-8_2.

¹⁸There may be limitations to soil organic carbon enhancement in dry and semi-arid regions.

to acknowledge the bio-dynamic nature of soils and “recognise farmers’ knowledge and location-specific understanding of soils and their knowledge in practice”.¹⁹

- Over the years, there has been an increased focus on water conservation and on development of infrastructure for water harvesting; there is a need for a greater push and investment on soil conservation as it is the best way to conserve soil. Thus, government policies should integrate both.
- There is a need to manage land degradation neutrality. Soil management policies should be integrated with land use policies so that we do not end up losing good quality soil to non-agriculture uses.
- Yield enhancement has been the major paradigm over the decades and there is a need to shift from resource use efficiency to sustainable, location & resource specific policy measures. Policy formulation, legislation and incentives that prohibit extractive farming practices/subsidised agrochemicals/synthetic pesticides and instead promote circular management schemes/sustainable agriculture practices such as green mulch, compost or phosphorus recycling are needed. To preserve and improve soil quality (soil health and biodiversity) and fertility, the five different forms of sustainable agricultural farming practices encouraged by FAO – agroecology, agroforestry, zero tillage, conservation agriculture and organic farming need to be adopted. Targets should be set to increase the area under these practices and for hotspot areas (saline, acidic, contaminated soils). Such areas can be treated with a degree of urgency.
- The pesticide regulatory framework needs to be aligned with food safety laws and India should adhere to pesticide use reduction targets. Furthermore, a campaign is needed by government to raise awareness on how unhealthy soils make food systems fragile.
- The policy framework should support the creation of a favourable ecosystem around soil health management by bringing various stakeholders and different government initiatives on a single platform. Innovative policies and investments are needed to develop a mechanism to maintain the soil biodiversity. Enhanced knowledge and awareness programme(s) around soil related issues and probable solutions are needed. This could be in the form of a lab to farm initiative by bringing together various ministries and other platforms. The Swachh Bharat Mission has a focus on garbage collection and compost making, which can be interlinked with soil management initiatives through both rural and urban waste management. There is also a need to promote infrastructure/assets to reduce soil and water erosion.
- It is crucial to rationalise the pricing of agricultural inputs (fertilisers, pesticides) and outputs to ensure food security, nutritional balance, and enhance soil health.
- There is a need to move from mitigation to adaptation-based solutions to climate change.
- Burning of crop residues has serious implications on soil health and therefore, there is a need to undertake measures to promote the incorporation of residues into soil.
- The government is encouraging the production and usage of nano fertilisers in the country with an aim to address the imbalanced and excessive use of conventional urea. This should be further extended.
- The efficacy of on-going soil reclamation programmes (including the soil health scheme) needs to be assessed to give successful policy prescriptions. So, the costs of soil health degradation should be assessed at national/regional scale. The government may release a ‘State of the Soil Health Report’ every five years on the lines of the ‘State of the Forest’ report. This report should deal with issues such as improvement in soil organic carbon, soil erosion, soil degradation etc.
- Soils in rainfed areas, particularly the drylands, need support for locally validated strategies and substantial investment to improve their health. Cost of losses due to inaction is quite high in comparison to cost of action to promote soil health measures. It is crucial to invest in the addition of organic matter to rejuvenate soils and improve their capacity to hold water, improve soil structure, support soil life and as well supply nutrients to plants”.²⁰

¹⁸There may be limitations to soil organic carbon enhancement in dry and semi-arid regions.

¹⁹Indian Institute of Technology (2017): “India’s Soils: Science - Policy - Practice Interfaces for Sustainable Futures”. Available online at: <https://hss.iitd.ac.in/sites/default/files/field/newspdf/Concept%20Note%20-%20Conference%20on%20India%27s%20Soils.pdf>. Last accessed: 08.09.2022.

²⁰Network of Rural & Agrarian Studies (2020): “State of Rural and Agrarian India Report 2020. Rethinking Productivity and Populism Through Alternative Approaches”. Available online at: <http://www.ruralagrarianstudies.org/wp-content/uploads/2020/11/State-of-Rural-and-Agrarian-India-Report-2020.pdf>. Last accessed: 08.09.2022.

- There is need for a policy thrust to support the creation of soil testing infrastructure at local level by encouraging local entrepreneurs.
- The government should promote IT based solutions to assess, inform, educate and implement soil issues. There is a need for an improved access to digital technologies and other media platforms to inform the farmers and practitioners.
- All soil health management and food sustainability initiatives should take gendered preferences and constraints into consideration.

What should researchers do?

- Soil health should become an important element of India's research programme and there should be increased science-policy-practitioner interface. There is a need to establish science-based evidence around agroecology/natural farming-based practices, as currently much of the evidence is anecdotal. Quantification of outputs from natural farming-based practices may also lead to establishing science-based evidence.
- Research institutions/agricultural colleges should initiate courses in sustainable farming practices. There is a "need to build on a science-based vision on soils with clear policy objectives and supportive instruments such as advisories, incentives etc." (RRA Network, 2021). They need to engage the farming communities including marginal, small and medium farmers, pastoralists and decision-makers in an active dialogue.
- There is a need to have better monitoring of land degradation for conservation of soil resource and improving soil health - using new participatory tools and techniques for soil testing. At farm level, soil test-based site specific balanced and integrated nutrient management (soil health card) should be strengthened. There is a need to develop the broader parameters for collecting data around soil health monitoring. To assess the problem, there is a need to have clear estimates (and mapping) of the areas with degraded soils.²¹ the priority indicators for monitoring soil health are soil organic matter content, nutrient

balance, yield gap, land use intensity and diversity, and land cover. 'State of Rural and Agrarian India Report 2020',²² comprehensive soil and water quality indices need to be devised to evaluate the need for changing practices linked to the use of agrochemicals in farming and other allied sectors.

- Researchers need to develop evidence-based knowledge documents on the linkage between soil health and human health for wider circulation among farming communities and consumers. There are multiple documents and knowledge products already available with research institutions which can be made available to the farmers and other stakeholders in a simpler language.
- There is a need to document the carbon footprint of current systems and agroecology based systems as also the impact of circularity on the farm.
- Property specific benchmark can be established for soil health to better monitor the progress.
- Research can also be done on how to manage the functional (quality) aspects of the food along with managing the yields. Better managed soils with good number of micronutrients leads to healthy produce.

What should government departments/ extension systems do?

- Extension systems need to be strengthened and farmers should be trained on sustainable agricultural methods, especially on farming systems approach to close knowledge gaps. The approach is based on local and renewable resources, which integrates animal and crop production on each farm or farms in close proximity, including crop rotation, use of cover crops and a better recycling of biomass and nutrients.
 - Efficient nutrient management should be facilitated towards improving the soil health.²³ There is a need to "systematise compost making in every gram panchayat by allocating land".²⁴ The healthy soils would not only have excellent water holding capacity but also will not contaminate water systems through the soil and groundwater.

²¹FAO (2015): "Healthy soils are the basis for healthy food production". Available online at: <https://www.fao.org/soils-2015/news/news-detail/en/c/277682/#:~:text=Healthy%20soils%20produce%20healthy%20crops,need%20to%20grow%20and%20flourish>. Last accessed: 08.09.2022.

²²Network of Rural & Agrarian Studies (2020): "State of Rural and Agrarian India Report 2020. Rethinking Productivity and Populism Through Alternative Approaches". Available online at: <http://www.ruralagrarianstudies.org/wp-content/uploads/2020/11/State-of-Rural-and-Agrarian-India-Report-2020.pdf>. Last accessed: 08.09.2022.

²³Jat, M. I.; Jat, H. S.; McDonald, A.; Sikka, A. K. (2015): "National Dialogue on Efficient Nutrient Management for Improving Soil Health". Available online at: https://www.researchgate.net/publication/349643301_National_Dialogue_on_Efficient_Nutrient_Management_for_Improving_Soil_Health. Last accessed: 08.09.2022.

²⁴Revitalizing Rainfed Agriculture Network (2015): "Invest for 'Life in Soil'. 10 ways to make 'Living Soils' possible". Available online at: <https://discuss.farmnest.com/uploads/default/original/1X/2c283c8ea40f1047b588bfd2916f1a8cc864aba2.pdf>. Last accessed: 08.09.2022.

- With declining soil fertility rates, there is a need to have in place strategies that improve the availability of microelements and macrominerals in soils to help meet targets for health and nutritional needs.
- Farming practices, such as conservation agriculture or regenerative farming, have a huge potential to reduce CO₂ emissions and turn them into a new sink through sequestration. Conservation tillage that leaves at least 30% of the soil surface covered with crop residue after planting to reduce soil erosion and limit carbon losses should be encouraged.
- Farmers need to be encouraged to manage crop residues better and bring about changes in cropping pattern by providing them incentives/price/procurement support/increased public funding.
- Leveraging watershed programmes and the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) to work on soil and water conservation, water harvesting; drought proofing including afforestation; land development etc., can provide a vehicle to achieve soil health enhancement. If properly designed, this can provide co-benefits in terms of strengthening soil health, improving soil nutritional balance and ensuring food security of local communities. Landscape-based treatment of catchments and extending tree cover outside forests through agroforestry can help reduce soil erosion.
- Disseminate information and communicate benefits to farmers through national newspapers, radio programmes, and modern information and communication technologies, such as cellular phones and the internet.
- The government needs to incentivise the creation of local soil testing infrastructure to encourage testing by farmers. Further, the use of Geographical Information Systems (GIS), Remote Sensing, Internet of Things (IoT), Artificial Intelligence and Machine Learning could be game changers in the coming years for ensuring soil health by providing information and enabling the adoption of local level remedial measures.
- There is a need to strengthen local Non-government Organisations (NGOs) with technical know-how and right information. Farmer Producer Organisations (FPOs) may play a critical role in soil health management as they have a big role in promoting natural farming. The government should develop a trained cadre of community resource persons through Green Colleges to support soil health/nature-based solutions/agroecology/Zero Budget Natural Farming (ZBNF)/biochar etc. Promoting peer to peer learning and extension models such as farmer field schools is critical. While designing the extension approaches, it is important to understand the combination of factors (economic, environmental etc.) that govern a farmer's decision.
- The government should recognise the role of the private sector and develop partnerships that can draw in investment, innovations in technology and knowledge exchange around sustainable agricultural practices that support soil health.
- Soil health data is already available with the government and can be put in public domain.
- Local site v/s market-based approaches that are scalable and transferable are needed for bio-inputs, as their availability leads to the higher usage by the farmers. The government may lower the hurdles to practices that promote soil health and set-up a regulation around this.

What should India do in relation to international initiatives?

- India should actively support the Global Soil Partnership (GSP), which was launched by FAO in 2011 to bring together international, regional and national organisations that are working in the area of soil protection and sustainable management. The GSP aims to implement the provisions of the 1982 World Soil Charter, principles and guidelines of the revised World Soil Charter and the voluntary guidelines for sustainable soil management, while also raising awareness and motivating action by decision-makers on the importance of soils for food security and climate change adaptation and mitigation.
- India is a member of the international initiative “4 per 1000”, accepted by the Global Climate Action Plan (GCAA) and adopted by the UNFCCC at COP 22, which aims to demonstrate that agriculture, and in particular agricultural soils can play a crucial role where food security and climate change are concerned. Though not a normative target for each country, the initiative states that an annual growth rate of 0.4% in the soil carbon stocks, or 4% per year, in the first 30-40 cm of soil, would significantly reduce the CO₂ concentration in the atmosphere related to human activities. Even a small increase in the soil carbon stock (agricultural soils, notably grasslands and pastures, and forest soils) is crucial to improve soil fertility and agricultural production and to contribute to achieving the long-term objective of limiting the temperature increase to the +2°C threshold prescribed by Intergovernmental Panel on Climate Change (IPCC).

Recommendations

- There is a need to increase the area under healthy soils (physical, chemical and biological health) that can provide essential services for healthy food, people, nature and climate. Targets should be set for improving nutrient use efficiencies and fertiliser response ratio.
- In light of the COVID-19 crisis, there is a need to restore soil ecosystems and explore their microbiome as the “transformation of natural ecosystems to human use-dominated ecosystems increases the risk of human exposure to novel diseases and can lead to global pandemics”.²⁵
- India needs to improve soil carbon stock for improving food security and deal with climate change. It is a member of the international initiative “4 per 1000”, accepted by the Global Climate Action Plan (GCAA) adopted by the United Nations Framework Convention on Climate Change (UNFCCC) at COP 22, which aims to demonstrate that agriculture, and in particular agricultural soils, can play a crucial role

where food security and climate change are concerned. Supported by solid scientific documentation, this initiative invites all partners to state or implement some practical actions on soil carbon storage and the type of practices to achieve this (e.g. agroecology, agroforestry, conservation agriculture, landscape management, organic farming). The idea is to help transition towards a productive, highly resilient agriculture, based on the appropriate management of lands and soils, creating jobs and incomes, hence ensuring sustainable development. Though not a normative target for each country, the initiative states that an annual growth rate of 0.4% in the soil carbon stocks, or 4% per year, in the first 30-40 cm of soil, would significantly reduce the CO₂ concentration in the atmosphere related to human activities. Even a small increase in the soil carbon stock (agricultural soils, notably grasslands and pastures, and forest soils) is crucial to improve soil fertility and agricultural production and to contribute to achieving the long-term objective of limiting the temperature increase to the +2°C threshold prescribed by Intergovernmental Panel on Climate Change (IPCC).

Best Practice from the Global Programme for Soil Protection and Rehabilitation for Food Security (ProSoil) in India

The global programme ‘Soil Protection and Rehabilitation for Food Security’ (ProSoil) works in India and six African countries – Benin, Burkina Faso, Ethiopia, Kenya, Madagascar and Tunisia. It is part of the ONEWORLD – No Hunger initiative by the German Federal Ministry of Economic Cooperation and Development (BMZ) and receives co-funding by the EU through its DeSIRA initiative and by the Bill and Melinda Gates Foundation. ProSoil supports partner countries to promote approaches for climate-smart agriculture and sustainable land management for various stakeholders, particularly smallholders. Besides small farming businesses and the relevant state institutions, other players from the academic and research communities, the private sector and civil society, are involved in these measures. The programme aims to improve the political and institutional framework to establish incentives for better soil management and agroecological transition pathways. There is a strong focus on sharing knowledge, experiences and learnings across partner countries.

In India, the project is implemented by Deutsche Gesellschaft für internationale Zusammenarbeit GIZ together with the National Bank for Agriculture and Rural Development (NABARD). Non-governmental organizations are working at the grassroot-level with about 54,351 smallholders (of which 48% are women) and farmer producer organizations in seven districts in Maharashtra and Madhya Pradesh. By developing their capacities and providing (digital) expert advisories on agroecological practices and climate-smart farming the project aims to protect or rehabilitate 153,000 ha of land by 2023. To achieve this, ProSoil embraced a landscape-based planning approach as well as digitisation. A digital platform called Network for Information on Climate Exchange and Sustainable Soil Management (NiceSSM) will enable over 340,000 farmers to access timely and localized expert advice and knowledge on farming practices to improve soil health. ProSoil is developing and testing innovative approaches to enhance soil organic carbon for climate adaptation and mitigation. In Maharashtra urban organic waste is being recycled into quality compost and Terra Preta applied by farmers as organic fertilizers. A national network for biochar and bioresources is coordinating experimental pilots, research, and policy recommendations on biochar for carbon sequestration. ProSoil is advancing co-creation and participation for knowledge capture and sharing with formats such as farmers conferences, farmer-made videos, South-South exchanges, and participatory action research.

More information: <https://www.giz.de/en/worldwide/32181.html>



²⁵IPBES (2020): “Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services”. Daszak, P.; Amuasi, J.; das Neves, C. G.; Hayman, D.; Kuiken, T.; Roche, B.; Zambrana-Torrel, C.; Buss, P.; Dundarova, H.; Feferholtz, Y.; Földvári, G.; Igbino, E.; Junglen, S.; Liu, Q.; Suzan, G.; Uhart, M.; Wannous, C.; Woolaston, K.; Mosig Reidl, P.; O’Brien, K.; Pascual, U.; Stoett, P.; Li, H.; Ngo, H. T. IPBES secretariat, Bonn, Germany, DOI:10.5281/zenodo.4147317.



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2

Reducing the Ecological Footprint of our Public Food System

Lead Author: Ravindra Adusumilli¹



VISION STATEMENT

Establish a public food system which integrates the principles of decentralisation and diversity and promotes the remunerative and resilient agroecology-based practices for food and nutrition security and natural resources conservation at household and national level.

2.1 Actionable Agenda

India's public food system played an important role in the historical evolution of its agriculture, the support systems around it and the food grain consumption patterns across the country. Analysing the ecological and economic footprints of the public food system in India, this paper argues that realigning the system to the principles of decentralisation, diversification and to agroecology will reduce its negative ecological and economic footprints and can potentially induce economic growth with diversity.

The architecture of public spending on ensuring 'food and nutrition security' in India is comprehensive. It starts from the time of 'conception' followed by a series of nutrition intervention programmes – starting from pregnant and lactating women, children up to the age of five years, mid-day-meals in schools, the targeted public distribution system and Antyodaya Anna Yojana programme for the poor, among others, and covers the entire life cycle of people.² These programmes are delivered through a well distributed network of Anganwadi Centres, managed by the Women and Child Development Department and fair price shops. The basic rice/wheat required for such programmes is supplied through an elaborate mechanism

of procurement at Minimum Support Prices and handling of the grains by the Food Corporation of India and Civil Supplies Departments at various levels. Large warehouse infrastructure was created for the purpose.

The Ministry of Consumer Affairs, Food and Public Distribution is centrally responsible for managing the food security programmes. The government of India spends Rs. 1,15,240 crores (2019-20), about 4% of its annual budget, on the 'food security' programmes; this has increased from 63,844 crore rupees spent in 2010-11. Food subsidy is the largest component of expenditure of the Food and Public Distribution Department, accounting for 95% of this budget. The subsidy also covers storage cost incurred by the Food Corporation of India (FCI) in maintaining buffer stocks. The subsidy is given to the FCI and to the states for procuring food grains from farmers at government notified prices and selling them at lower subsidised prices (known as Central Issue Prices) under the National Food Security Act (NFSA), 2013. The NFSA mandates coverage of 75% of the population in rural areas and 50% in urban areas; currently 81 crore people in the country i.e. 59% of the population are covered.³

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²Department of Food & Public Distribution (2021): "Annual Report 2020-21". Available online at: <https://dfpd.gov.in/E-Book/examples/pdf/AnnualReport.html?PTH=/1sGb02W68mUlunCgKmpnLF5WHm/pdf/Ar2020-21English.pdf#book/2>. Last accessed: 08.09.2022.

³Ibid.

2.2 Major Challenges

2.2.1 Displacement of Rainfed Food Systems

As can be seen in Figure 1, over 60% of the food grains procured at Minimum Support Price (MSP) comprises of paddy and wheat. Millets, renamed recently as nutri-cereals, constitute 0.38% of the annual allocation of food grains for various food, nutrition and relief schemes by the Government of India.

India maintains a large pool of buffer stocks. The stock of food grains in the central pool, as on 1st January 2021, was 532.79 lakh MT – which comprises of 342.9 lakh MT of wheat, 186.69 lakh MT of rice and 3.2 lakh MT of nutri-cereals; the food grain stock has steadily increased from 273.66 lakh tons on 1st Jan 2017 i.e. increased by 48% over four years.⁴ This is against the Central Pool (buffer) stocking norm of 214.10 lakh MT; the stocks are double the quantity prescribed by the norms. The central pool stocks constitute about 19% of the estimated production of the three food grains during the year.

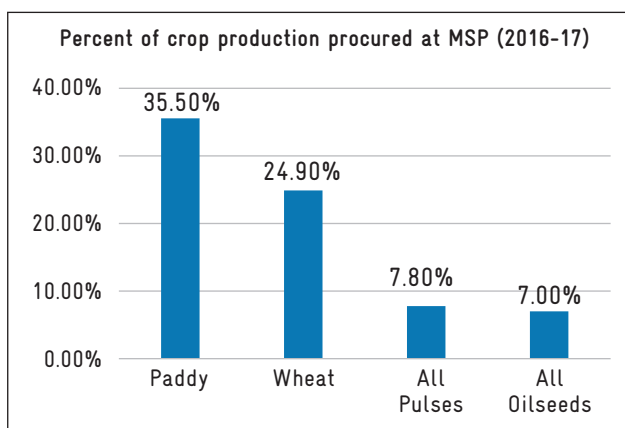


Figure 1: Percentage of crop production procured at MSP (2016-17) (Figure by the author)

About 48% and 33% of the annual production of rice and wheat respectively were allocated for various food distribution programmes in contrast to a meagre allocation of 0.74% for millets. The nutrition rich millets did not find any place in the state nutrition programmes – in spite of the serious mal-nutrition across several areas in the country and in spite of their availability in the central pool.

Even if the states would like to introduce millets into the nutrition programmes, they have to bear the entire cost of the grains as the central pool millets allocation was meagre and replete with several administrative hiccups.⁵

The Public Food Systems architecture – brilliantly conceived to meet specific policy objectives, which has altered the ‘food-landscape’ of the country – shifted the food-geography from rainfed areas to irrigated areas and created an eternal dependency on irrigation, chemicals, energy, the Minimal Support Price and subsidies. This also has altered the ‘food-economy’, skewing the benefits of public investments/expenditure and markets heavily in favour of irrigated areas, leaving the rainfed areas to misery, poverty and distress, arising out of climate vulnerabilities. While at the same time the nation is struggling with entrenched poverty and nutrition security in some areas, obesity, diabetes, lack of immunity, pesticide induced cancer in urban and irrigated areas.

2.2.2 Changing Food Habits and Shrinking Food Diversity

A most devastating impact of the dominant preoccupation with the policy of ‘national food security’ is on the changes in food habits and crop systems. Even while the country was facing food shortages in the 1960s, every village used to produce food, embedded in a diverse crop-systems mix that includes cereals, millets, pulses and oilseeds adapted to the local agroecology. Negating such widespread and diverse food production as subsistence farming, few districts well-endowed with irrigation and good soils were chosen for intensive production of rice and wheat, using chemicals and high yielding varieties. The rest of the country’s contribution to food production was ignored and left to depend on food grains distributed under the Public Distribution System (PDS).

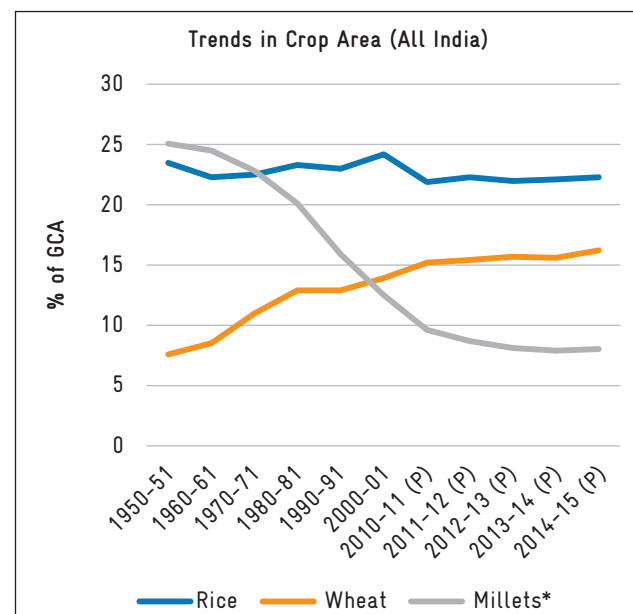


Figure 2: Trends in Crop area (All India) (Figure by the author)

⁴Department of Food & Public Distribution (2021): “Annual Report 2020-21”. Available online at: <https://dfpd.gov.in/E-Book/examples/pdf/AnnualReport.html?PTH=/1sGb02W68mUlunCgKmpnLF5WHm/pdf/Ar2020-21English.pdf#book/2>. Last accessed: 08.09.2022.

⁵From the experience in one of the programmes supported by Niti Aayog in Telangana to introduce millets into ICDS facilitated by WASSAN.

Undermining the capacity of each village to produce its own diverse food, the policy preoccupation with ‘national food security’ created the celebrated islands of ‘food bowls’ – the sacred agriculture places that are to “feed” the country assisted by the ‘temples of modern India’, the large dams. These food bowls are devastated at present with acute groundwater scarcity, pesticide poisoning and low net returns, even after propping up with all subsidies. Additionally, the large diversity in food consumption in rest of the country got narrowed down to rice and wheat wherever irrigation is available. This phenomenon induced drastic decline in the crop area under millets (see Figure 2). Within one generation, people in the large part of the rainfed areas even forgot about their millet traditions. Concentrated production in few areas, procurement, transport, milling, storage and distribution through the PDS has a very large ecological footprint.

2.2.3 Monocropping through Reduced Agrobiodiversity

Agrobiodiversity is another major casualty. The diverse crop systems in the drylands changed to monocrops. The varietal diversity in food systems also collapsed with the public seed systems established to ensure proliferation of few high yielding varieties. Thousands of landraces, even in rice, are now replaced by very few dominant derivatives of successful High Yielding Varieties (HYVs).

The multi-crop systems that used to cover soil for longer periods are replaced by single crop systems that leaves soil barren from October-November itself; exposing soil to high temperatures and desiccation of whatever soil organic matter left! Anantapur district of Andhra Pradesh is a good example (see Figure 3)

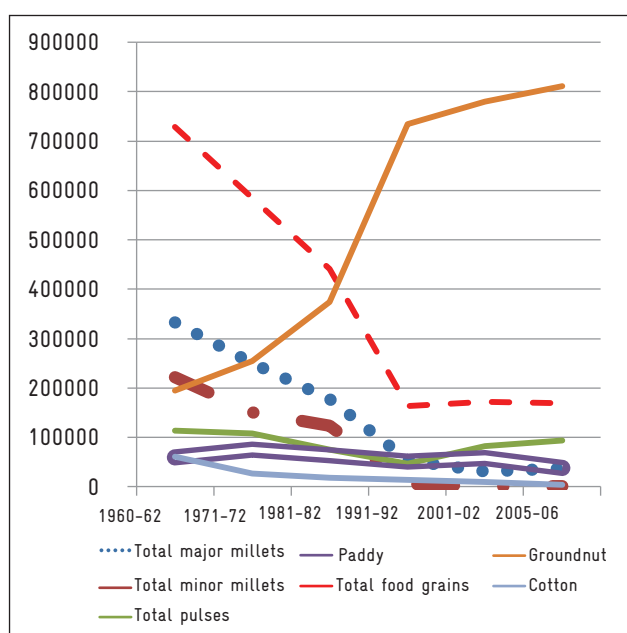


Figure 3: Food grain production in Anantapur, AP (Figure by the author)

Food grain production drastically declined over time yielding to monocrop of groundnut. The decline was much faster after 2 Rs. per kg subsidised rice was introduced around 1980s.

2.2.4 Rice and Wheat as Main Subsidy Consumers

The fact that paddy and wheat dominate the public food system needs no further explanation. The TPDS (Targeted PDS) centred public food distribution consumes a bulk of the food subsidy and is also a measure of economic support to paddy and wheat cultivation. Perhaps, unlike others, these are the two crops for which MSP is consistently announced and backed up by procurement. Even when the off take is slow, the food grains procured are allowed to stockpile in the central pool in excess of the buffer stock norms.

Table 1: Fertiliser usage by Crops (2003/4)

Crop	Gross cropped area (million ha)	Share in fertiliser consumption (%)	Total Fertiliser use (Kg/ha)
Paddy	44.7	31.8	119.1
Irrigated	24	22.2	155
Rainfed	20.7	9.6	77.6
Wheat	25.7	21	136.7
Irrigated	22.8	19.7	144.9
Rainfed	2.9	1.3	75.9
All crops	187	100	89.8
Irrigated	75.1	68.5	153.1
Rainfed	111.9	31.5	47.3

Rice and wheat consume about 53% of the total fertiliser consumption in India; of this these crops under irrigation consume 42%. Fertiliser consumption of irrigated crops is over three times the consumption of rainfed crops on per ha basis. Apportioning the large fertiliser subsidy accordingly, the discrimination of rainfed areas in terms of support to crop nutrition is visible.

The two crops are great guzzlers of subsidies (see above table). Together with food subsidies, they consume 72% to 85% of the total subsidies in agriculture.

The food and fertiliser subsidies have been consistently increasing at an exponential rate. These were started as an incentive to promote usage of chemicals.

The price signals through fertiliser subsidies and MSP for rice and wheat distorted the structure of input use against organic manures and crop area in favour of rice and wheat.

2.2.5 Investment in Irrigation and Electricity Subsidies

Another important prop of our 'Public Food System' is irrigation. The net sown area in the country is more or less stabilised at 141 million hectares with 68.12 and 95.77 million ha under net and gross irrigated area respectively (2017). Groundwater based irrigation using tubewells surpassed the percentage of irrigation by gravity (canals). Electricity for groundwater extraction is subsidised in several states.

Rice and wheat have a combined share of 38.5% (22.3% and 16.2%) of the gross cropped area of the country; but share 87% of the gross irrigated area under food grains. Crop wise, while over 90% of the area under wheat is irrigated, only about 60% of rice is irrigated; about 40% of rice is still rainfed. The irrigated areas under millets and other crops were meagre.

Investments in expanding irrigation largely benefitted wheat and rice. Much of the produce of these crops goes into public procurement for distribution under food security programmes. We have already seen that food and fertiliser subsidies are largely usurped by the two crops.

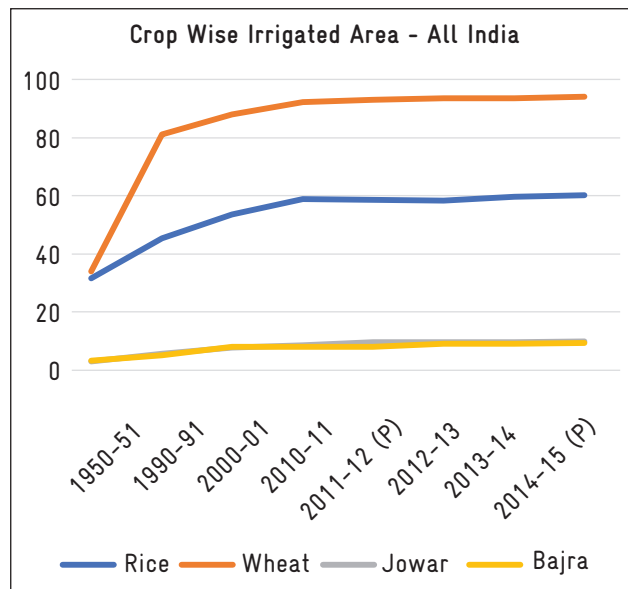


Figure 4: Crop-wise irrigated Area - All India (Figure by the author)

The subsidies propping up rice and wheat cultivation are a sensitive issue in Indian politics and cannot be easily restructured. Indian agriculture economy has embarked on a 'ride on the tiger', so to say.

2.2.6 Subsidisation of Soil Pollution

The per hectare use of fertilisers increased from 1.99 kg in 1960 to 135.33 kg in 2009–10 and furthermore in later years. The average crop response to fertiliser use declined drastically from 25 kg grain per kg NPK during 1960s to only 6 kg grain per kg NPK fertiliser during the 11th Plan (2007–2012) as the diminishing returns set in. The efficiency of fertiliser nitrogen is only 30 to 40%.⁶ Imbalanced fertiliser use with low organic manure and the poor organic carbon status of soils in many of the regions in the country were closely linked to the emerging deficiencies of other nutrients (P, K, S, B and Zn).⁷ The poor and declining trends in soil carbon across the key food-ecosystems in the country are worrisome. 'Experts call the flood of excess nitrogen one of the most severe pollution threats facing humanity today'.⁸

Considering that only about one third of fertilisers used are actually used by crops, the country is incentivising pollution of groundwater and soils with nitrogen compounds by spending Rs. 44,649 crores annually (2021). This amount is almost at par with 40 years of government expenditure on watershed development in India till 2017-18 which stands at Rs. 47,229 crores.⁹

2.2.7 Failing Aquifers

Distorting the structure of food grains production and consumption the PDS system with focus on rice-wheat also made the food-system in the country 'water intensive' spinning off several crises in the water and energy sectors; the constitution of food from rainfed systems (millets etc.) drastically reduced.

Groundwater as a source of irrigation provided by deep tube wells has become the single largest source of irrigation. It is estimated that over the last four decades, around 84% of total addition to the net irrigated area has come from groundwater; with this trend, the energy footprint

⁶NAAS (2006): "Low and Declining Crop Response to Fertilizers". Policy Paper No. 35, National Academy of Agricultural Sciences, New Delhi. pp 8.

⁷Indoria, A. K.; Sharma, K. L.; Reddy, K. S.; Srinivasaro, C.; Srinivas, K.; Balloli, S. S.; Osman, M.; Pratibha, G.; Raju, N. S. (2018): "Alternative sources of soil organic amendments for sustaining soil health and crop productivity in India - impacts, potential availability, constraints and future strategies". In: Current Science 115(11). pp. 2052-2062. 10.18520/cs/v115/11/2052-2062.

⁸UNEP (2020): "Fertilizers: challenges and solutions". Available online at: <https://www.unep.org/news-and-stories/story/fertilizers-challenges-and-solutions>. Last accessed: 08.09.2022.

⁹Rath, B. (2019): "Analysis of Investment in Irrigated areas vis.-a-vis. Rainfed areas". National Rainfed Area Authority (NNRA). Presentation shown at a joint workshop on land degradation neutrality by NNRA, RRA and GIZ.

of irrigation has expanded substantially. There is growing evidence of steady decline in water Tables and water quality. At least 60% of India's districts are either facing a problem of over-exploitation or severe contamination of groundwater.¹⁰ Ironically, much of the rice and wheat produced with such ecological footprint is languishing in the FCI godowns with stocks many folds higher than the required buffer stocks.

The real water and energy footprint of the 'public food system' is anybody's guess. Ironically, the country is incentivising such an ecological nightmare through the public food systems.

2.2.8 Climate Footprints

The centralised food-system with its intensity on water and energy also has a large climate footprint. The public distribution supply chain requires the transportation of 40 million metric tonnes of food grains from the Food Corporation of India (FCI) stock point to the different states. 85% of this is done by rail, covering an estimated 1,500 km each year and the rest by road and ferries; the transport requirements of the centralised procurement till the stock reaches FCI stock points are additional. The hidden environmental costs of this long and voluminous supply chain have not yet been calculated.

The current footprints of GHG emissions of food grain at 1212, 15.65 and 45.51 million metric tons of CO₂, N₂O and CH₄ are projected to increase by 1.8%, 23.92% and 2.35% respectively if production increases in the current structure to meet the NFSA requirements.¹¹

2.3 Vision 2030

We come back to our central thesis – 'the thinking that has created the problem in the first place, cannot provide a solution'.

The large and increasing negative fiscal, economic, social and environmental impacts of the centralised food-system are only symptoms of the mammoth problem. Any amount of tinkering with the symptoms of the large problem created by the food-systems policy narrative – such as improving fertiliser and water use efficiency, developing better climate resilient varieties of paddy or

wheat, improved targeting of PDS etc., may have only marginal impact. The challenges are many and humongous that cannot be solved continuing with the current policy paradigm.

2.3.1 Core Principles

Decentralisation, diversity and agroecology can be the three principal pillars of the new vision of the food systems 2030. These three principles are consistent with each other and together, can potentially usher in a new public food system with reduced negative footprints.

From FCI warehouses to Anganwadis – substantial institutional, infrastructure and human capacities in the delivery food and nutrition programmes are established in the country with good outreach; the new vision needs to leverage and build upon this capital base for a transformation of the Public Food Systems.

One fundamental policy change is to decentralise choices and decision making on the food-menus in all the state nutrition programmes, including PDS with norms of compliance with nutritional standards laid out. The policy goal should then be '*achieving local food security*' as against or in addition to the 'national food security'; local – as much as possible – most preferably at the present last-mile Stock Points from where the stocks are supplied to various food and nutrition programmes. Such policy decision may even consider renaming PDS as **"Public Nutrition System"** to emphasise on the intent of the policy. The nutritional quality of the food distributed then, will also become an administrative responsibility. This small policy decision will necessitate a larger institutional overhaul.

The current public food system, however, can continue with its mandate, albeit reduced, on ensuring 'national food security', serving the purpose of backstopping the 'localised' PDS in terms of a) buffering against natural calamities b) facilitating exchange of grains across districts when they are in demand but are not produced locally c) meeting the urban demand for food grains.

The following could be the strategic elements of the new vision once the 'decentralisation' in choice of foods and related decisions are instituted.

¹⁰Vijayshankar, P. S.; Kulkarni, H.; Krishnan, S. (2011): "India's ground water challenge and the way forward." In: Economic and Political Weekly 156(2), pp. 37–45. Available online at: <https://casi.sas.upenn.edu/sites/default/files/iit/EPW%20-%20Shankar%2C%20Kulkarni%2C%20Krishnan.pdf>. Last accessed: 20.09.2022.

¹¹Sengupta, P.; Mukhopadhyay, K. (2016): "Economic and Environmental Impact of National Food Security Act of India". In: Agric Econ 4(5). <https://doi.org/10.1186/s40100-016-0048-7>.

2.3.2 Major Advantages of the 'Closing the Loop of Decentralisation' Policy

- Food miles are saved in terms of transport of grains from procurement centres to processing plants – to warehouses – to stock points.
- Handling raw grains is much simpler – the pest infestations are low, reducing the use of chemicals in storage; this would of immense advantage in the case of Millets where the shelf-life reduces drastically once the grains are processed.
- Smaller, decentralised processing facilities will help in decentralisation of the agro-industry. These facilities can also be used by the farmers' organisations for their value-added marketing, paying service charges. Such facility may also be run by Farmer Producer Organisations (FPOs) or local entrepreneurs.
- Economic cost of food grains over and above the MSP can be significantly brought down with decentralisation. The requirement for central pool buffer stocks can also be properly estimated and much of it can be maintained locally or within the state.
- Taken up at a scale with intensive campaign on agroecology and insistence on non-chemical produce may significantly reduce the fertiliser and pesticide consumption and related subsidies.
- The shift in policy focus to nutrition and agroecology can potentially stimulate 'nutrition sensitive agriculture' and increase nutritional density of production for household consumption.
- Inclusion of millets into food-systems will reduce the 'water footprint' of the public food systems and can even reduce electricity subsidies (see Table 2 below).
- 'Water (and energy) balance' in the food grain basket i.e. the ratio between rainfed and irrigated grains, is as much important as the 'nutrition balance' at the national level for ecological security.
- Reduction in energy, water and carbon footprints of the public food systems will drastically reduce.
- Decentralisation will stimulate local circular economies with their multiplier effects and the investments can even come from the private sector.
- More than anything, such radical shift will democratise the food system and lends itself amenable to citizen control and vigil.

Table 2: Water footprint of rice replacement

% Rice replacement of annual requirement	Requirement (m.tons)	Area required 10 q/ha productivity (ha)
PDS annual requirement (m.tons)	39,84,996	403,339
10%	398,499	605,009
15%	597,749	10,08,349
25%	996,249	

The promise of providing non-chemical and nutritive grains of people's choice at the decentralised level can be a politically very attractive proposition.

The 'new thinking', if executed, can leverage the existing public food system architecture to spin off multiplier effects in the local economies well distributed across the country, embedded into local food cultures and agroecology. However, political incentives need to be sufficiently large to take on the battle against the deep-rooted vested interests in the current system.

2.4 Pathways for 2030

2.4.1 Strategic Elements of Operationalising the New Vision

- Embed food-menus into local agroecology, food cultures and traditions. The synergy between what foods are used/promoted locally and with the local agroecosystem ensures 'healthy souls and healthy soils'.¹² This needs to be an intense community engagement to build their capacities on human nutrition and its embeddedness in the local crop-systems and agroecology. This needs to be a structured campaign with food festivals, recipe competitions and such others; these have proven to be successful in the campaigns in the Watershed Support Services and Activities Network's (WASSAN) experience in Odisha Millets Mission and Comprehensive Revival of Millets programmes in Andhra Pradesh. This strategy must be backed up by adequate public investments allocated for the 'transition'.
- Set up systems, processes and redefined (decentralised) hierarchies to institute the 'decentralisation decisions' on the composition of PDS supplies (and others).

¹²Thanks to Sri. Rajeev Ahal, for this name.

Anganwadis within a ‘Stock Point’/District/Block to have their own menus with local foods duly meeting the nutritional requirements of the target groups under various programmes. This will help active involvement of community and rediscovering their local food cultures. Anganwadis can potentially induce nutritive and ecologically sensitive food cultures among the new generation.

- Estimate demand for various commodities based on the chosen food menus required for various state nutrition programmes at the last leg of decentralisation i.e. ‘Stock Points’ or Blocks.
- Arrive at appropriate pricing mechanisms indexed to central MSP. Right price signals for local nutritional grains induce expansion in their production; backed up by intense campaigns to generate demand, price signals can catalyse balancing crop systems, agroecology and human nutrition. Backing up the price signals with MSP and real procurement for diverse commodities will enhance credibility of the government’s commitment to achieve the twin objectives.
- Mandate the Department of Agriculture to promote adequate area under chosen crop-systems to meet the estimates on procurement.
- Insistence and incentivising production of grains to be procured with organic or non-chemical methods, following good agriculture practices such as water use efficiency etc., can promote de-chemicalisation of the food system.
- Link-up with the FPOs for local production and supply of the chosen commodities; organise procurement around the last-mile stock points from

where the supplies to fair price shops, Anganwadis and others are presently organised. The catchment of these stock points can be the lowest planning unit. It does not entail any major changes in the organisation of the present system.

- Plan district and state level procurement for the central pool stocks required to buffer the food system for the three purposes mentioned earlier.
- Introduce ‘processing at the last mile’ – this can be at the stock point, if it is the last mile policy planning unit or the policy may even consider giving raw/unprocessed (cleaned and graded) grains to households and transferring the processing charges to the user through Direct Benefit Transfer. This policy potentially closes the loop of decentralisation. Required processing facilities can be developed at the level of the stock points or the units of planning. The state may even encourage private investments on processing facilities as the demand is assured. Produce can be stocked in raw form and milled as per the requirements with the local facility.



Dam Tungabhadra River, Hospet, Karnataka, India



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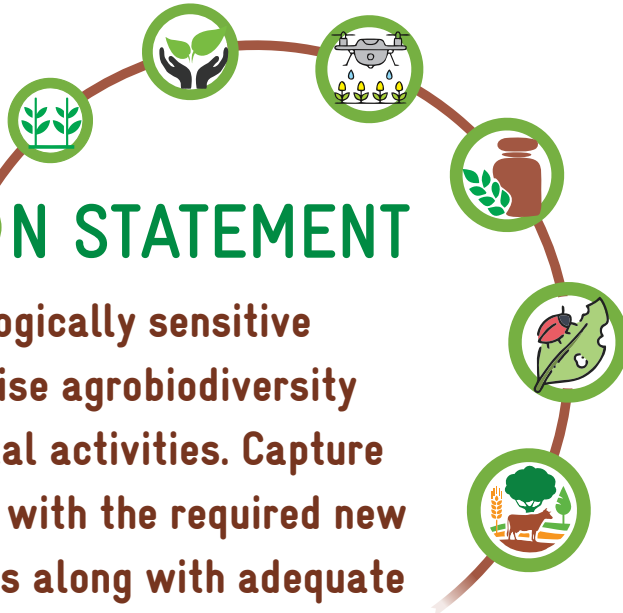
3

Agrobiodiversity and Nutritional Security

Lead Author: Seema Bhatt¹

VISION STATEMENT

Demonstrate and promote ecologically sensitive agricultural practices. Internalise agrobiodiversity concerns in routine departmental activities. Capture agrobiodiversity data routinely with the required new tools and appropriate indicators along with adequate capacity building for recording the same. Create consumer awareness for nutritious and healthy diets.



3.1 Actionable Agenda

Agricultural biodiversity (or agrobiodiversity for short) is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems (or agro-ecosystems): the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes.²

India is characterised by 20 fairly distinct agro-ecosystems, based on soil type, rainfall amount and distribution, and altitude. Producers have over centuries domesticated and selected plant and animal populations that have resulted in crop and livestock diversity as we see it today. Agrobiodiversity is critical to the lives and livelihoods of small farmers, rural communities and indigenous peoples and an inherent part of their culture and tradition. They have a wealth of knowledge on the same.

Not too long ago, several hundred crop species were being grown and consumed globally. However, today, 80% to 90% of the world's calories come from only 10 to 20

crops. It is suggested that this simplification of diets has led to a decline in diversity and nutritional quality of food consumed. The change in agricultural systems from varied cropping systems to monocultural cereal systems seems to be contributing to micronutrient deficiencies.³ Agrobiodiversity can counter these trends. Besides providing a rich dietary diversity, it could be a source of nutrients, help combat hunger. Further, strengthening local food systems could help provide environmental stability and resilience to climate change.

Agrobiodiversity is critical in achieving the goal of Zero Hunger and realising the targets under the Sustainable Development Goals (SDGs) 2 and 12.



Some Trends and Figures related to Agrobiodiversity

Globally, there are approximately 3,82,000 species of vascular plants, of which more than 6,000 plant species have been cultivated for food, fewer than 200 make substantial contributions to global food output, with only nine (sugar cane, maize, rice, wheat, potatoes, soybeans, oil-palm fruit, sugar beet and cassava) accounting for 66% of total crop production (in 2014).

¹Seema Bhatt is the National Biodiversity Expert with FAO India.

²Convention on Biological Diversity (2008): "What is Agricultural Biodiversity?". available online at: <https://www.cbd.int/agro/whatis.shtml>. Last accessed: 08.09.2022.

³Welch, R. M. (2008): "Linkages Between Trace Elements in Food Crops and Human Health". In: Alloway, B.J. (eds) Micronutrient Deficiencies in Global Crop Production. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6860-7_12.

Some Trends and Figures related to Agrobiodiversity

The world's livestock production is based on about 40 animal species, with only a handful providing most of the global output of meat, milk and eggs. As of 2018, 7,745 out of 8,803 reported livestock breeds are classed as local (i.e. reported to occur in one country only); 594 of these breeds are extinct. Among extant local breeds, 26% are classed as being at risk of extinction, 7% as not at risk and 67% as being of unknown risk status.

Countries report the farming of 694 aquatic species and other taxonomic groups. In 2016, global capture fisheries harvested over 1,800 species of aquatic animal and plants. Within these thousands of species there are numerous genetically distinct stocks and phenotypes. As of 2015, 33% of fish stocks were estimated to be overfished, 60% to be maximally sustainably fished and 7% to be underfished.

Source: FAO. 2019. The State of the World's Biodiversity for Food and Agriculture (FAO Commission on Genetic Resources for Food and Agriculture).

3.2 Current Status

India is committed to the conservation and utilisation of biodiversity in general and agrobiodiversity in particular, integrating both *in situ* and *ex situ* approaches. This includes improving opportunities for mainstreaming agrobiodiversity conservation and sustainable use through the policies and collaborative actions of all relevant ministries and government departments, particularly the Ministry of Environment, Forests and Climate Change (MoEF&CC) and the Ministry of Agriculture and Farmers Welfare (MoA&FW). Biodiversity forms the cornerstone of ecosystem functions and services that support millions of livelihoods in the country and traditionally India has always been focused on endeavors to conserve its vital biodiversity and ecosystems. The Convention on Biological Diversity (CBD) was adopted by the United Nations in June 1992. Subsequently, Contracting Parties were required to integrate the three objectives of the Convention (i.e. conservation of biological diversity; sustainable use of its components and; fair and equitable sharing of benefits arising out of utilisation of genetic resources) into relevant legal procedures, programmes and policies. As a party to the CBD, India honors and strives to meet all its obligations and commitments. This includes efforts to address all three objectives of the Convention for both wild and domesticated biodiversity. The enactment of the Biological Diversity Act in 2002 provides the adequate legal mechanism required for biodiversity conservation in the country. This progressive legislation addresses

several aspects of biodiversity conservation, including agrobiodiversity.

The CBD mandates each party to prepare a National Biodiversity Strategy and Action Plan (NBSAP) or an equivalent instrument, and to ensure that this strategy is mainstreamed into relevant sectoral or cross-sectoral plans, programmes and policies. India prepared its National Biodiversity Action Plan (NBAP) in 2008 through a comprehensive inter-ministerial process. This NBAP was later revised by integrating the 12 NBTs and brought out as the Addendum NBAP 2014. The National Biodiversity Target 7 specifically highlights that, by 2020, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimising genetic erosion and safeguarding their genetic diversity“.

In the context of agriculture and allied sectors, India has made significant strides in agriculture to integrate and mainstream agrobiodiversity consideration through a strong backup of policies. Major achievements include: (i) Establishment of protection of Plant Varieties and Farmer's Rights Authority (PPV&FR Authority) and granting incentives to farmers in the form of “Plant Genome Savior Community Recognition” through the creation of National Gene Fund for conservation and development of plant genetic resources; and (ii) Establishment of a multilateral system to facilitate access to Plant Genetic Resources for Food and Agriculture (PGRFA) through International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The PPV&FR Act, 2001 and the PPV&FR Rules, 2003 provides measures to protect plant breeders' rights over new varieties developed by them. It also ensures farmers' rights to register new varieties that they have developed and also to save, breed, use, exchange, share or sell the plant varieties, improved and maintained over many generations.

Two programmes that are of great relevance for sustainable and nutritive agriculture are the *Paramparagat Krishi Vikas Yojna* (PKVY) and the *Poshan Abhiyaan*. The PMKSY, a sub-component of Soil Health Management (SHM) scheme under the National Mission of Sustainable Agriculture (NMSA), aims at developing sustainable models of organic farming through a mix of traditional wisdom and modern science to ensure long term soil fertility build-up, resource conservation and support in climate change adaptation and mitigation. It primarily aims to increase soil fertility

and thereby helps in production of healthy food through organic practices without the use of agro-chemicals. The *Poshan Abhiyaan*, is a multi-ministerial convergence mission with the vision to ensure attainment of malnutrition-free India by 2022 and is particularly targeted at the holistic development and adequate nutrition for pregnant women, mothers and children. Although there is no explicit mention of agrobiodiversity in either of the programmes, there is significant scope to integrate agrobiodiversity into the objectives of both programmes to support their respective goals.

3.3 Sharing of a Best Practice

FAO India worked on a project (2017-2019) under its Technical Cooperation Programme (TCP) on Strengthening agriculture and allied sector contributions to India's National Biodiversity Action Plan (NBAP) 2008 and NBTs. This project supported the efforts of the Government of India (GOI) with increased capacity at national, state and local levels through the development of an action plan to mainstream biodiversity conservation into agriculture and allied sectors. Appropriate training modules and materials were developed and tested to build the capacity of national, state and local actors. Three state curricula on agrobiodiversity in three regional languages were developed and relevant stakeholders in all three States trained through these curricula. The States in question were Kerala, Mizoram and Punjab.

The diversity of millets has in the past been a significant part of agrobiodiversity across the world. Millets are amongst the ancient food grains known to humans and played a key role in household food security and dietary diversity before rice began to replace millets as a staple grain in many regions. The country also has rich millet diversity. According to the National Bureau of Plant Genetic Resources (NBPGR), there are 59,434 millet accessions stored in its base collection as on 31 January 2020. However, unfortunately in the field, this millet diversity has been replaced by more commercially viable crops over the years.

To respond to the challenges posed by increasing population and associated food insecurity and changes in climate, the UN General Assembly adopted by consensus a resolution sponsored by India declaring **2023 as the International Year of Millets**. FAO's support to India's proposal will

cement the trusted partnerships and prioritise policies that advocate for inclusive value chain development for millets. This gains prominence in the backdrop of the UN General Assembly resolution proclaiming the United Nations Decade of Action on Nutrition 2016-2025, and the need to implement sustainable food systems that promote healthy diets, which include a variety of foods like millets.

3.4 Pathways for 2030

Recommendation I

- There is a need to internalise agrobiodiversity concerns in routine departmental activities to ensure that these become part of relevant policies, programmes and agriculture extension institutes that deal with capacity building. This is particularly important for relevant programmes of the Government of India such as the Poshan Abhiyaan and the Paramparagat Krishi Vikas Yojna (PKVY).

Recommendation II

- Agrobiodiversity data needs to be routinely captured. New tools and appropriate indicators would be required along with adequate capacity building for recording the same.

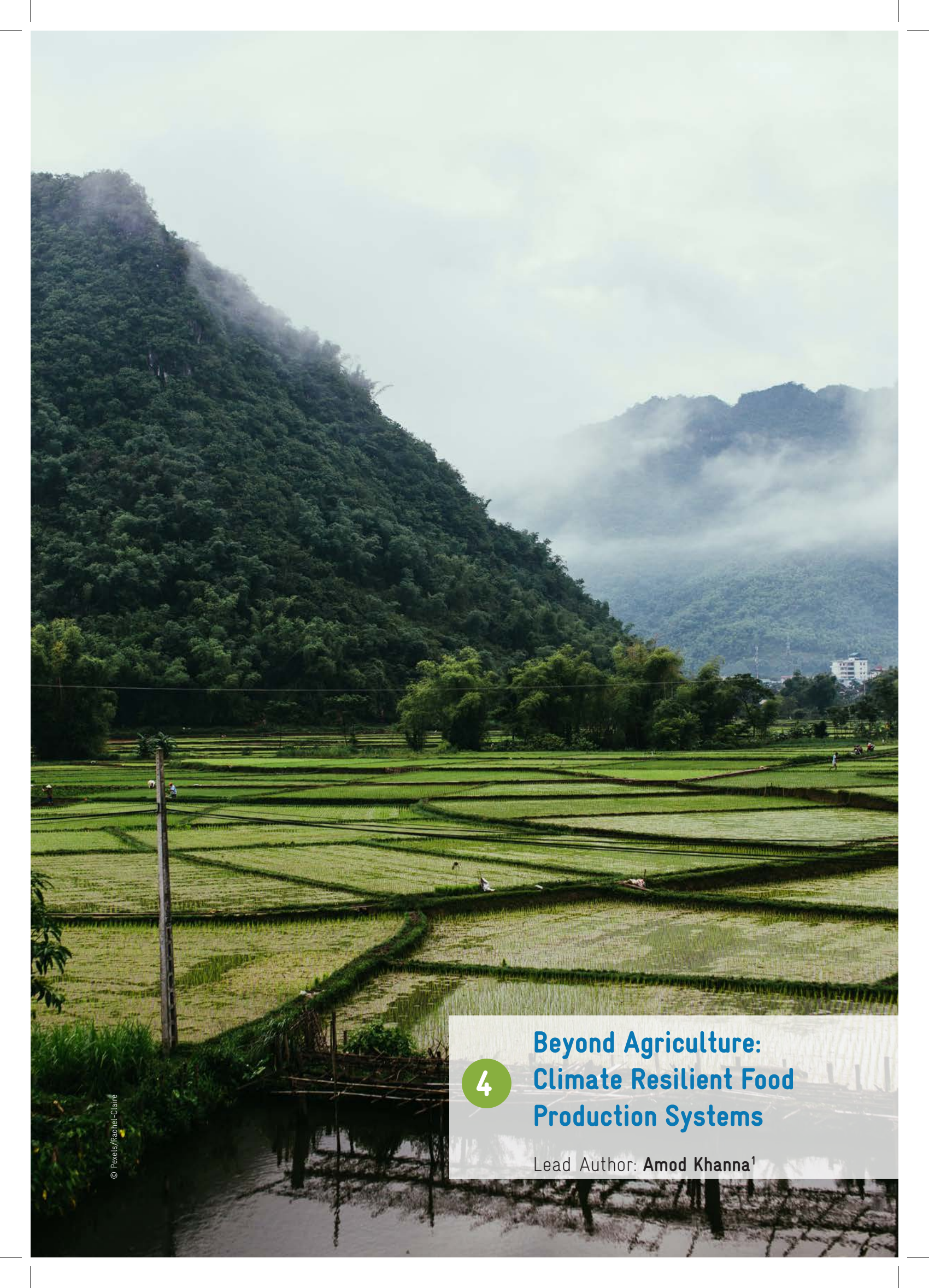
Recommendation III

- Consumer awareness for nutrition and healthy diets, which in turn creates awareness about the significance of agrobiodiversity, is needed. In this context, the scope for public-private partnerships for alternate marketing that links the rural markets to urban areas needs to be explored. Food innovation funds to motivate start-ups supporting agrobiodiverse foods need to be promoted.

Recommendation IV

- There is a need to recognise, acknowledge and promote the role of women in the conservation of agrobiodiversity.

Nations Decade of Action on Nutrition 2016-2025, and the need to implement sustainable food systems that promote healthy diets, which include a variety of foods like millets.



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4

Beyond Agriculture: Climate Resilient Food Production Systems

Lead Author: **Amod Khanna**¹



VISION STATEMENT

Local climate resilient food and nutritional security systems integrate diversity in all forms through collective, collaborative and integrated actions by communities, government, civil societies, consumers and changemakers and ensure the nation continues to be self-reliant and ecologically sustainable.

4.1 Actionable Agenda

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (2021/22) has estimated that **global warming** of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO₂ and other greenhouse gas emissions occur in the coming decades. Globally, temperature projections are projected to rise at higher latitudes, but no region is expected to witness a fall in temperature. At the same time, climate change will be spatially variable. The projections with respect to precipitation are more uncertain and trends in rainfall are likely to be more variable spatially.

There is an all-round acceptance that adaptation is, equally if not more, important as mitigation and hence requires substantial investment in resources and field level interventions. However, considering the spatial variability of climatic changes, there are varying capacities of systems (including food production systems) to adapt to climatic shocks. These variabilities prompt localised assessment of climatic changes and their respective impact

on local production systems. Adaptation investments will essentially have to address local climatic vulnerabilities with the aim to enhance climate resilience of production systems.

The Coupled Model Intercomparison Project 5 estimates that **for India** the average climate is likely to be warmer by 1.7 to 2.0°C for 2030 and by 3.3 to 4.8°C for 2080 when compared to preindustrial levels.² The precipitation is likely to increase by 5-6% and 6-14% for 2030 and 2080 respectively. Food production systems are part of the biological processes and hence changes in climate will have direct as well as snowballing impacts on production as well as on the livelihood of people that are dependent on it.

The Indian Council³ of Agricultural Research (ICAR) study for all the 576 rural districts of the country (except Andaman and Nicobar Islands) mapped the risks due to climate change in agriculture based on exposure and vulnerability. The study defined risk as the result of interaction among exposure, vulnerability and hazard.

¹Lead Author: Mr. Amod Khanna, Founder of Towards Learning and Action (TAAL). Discussants and inputs: Madhuri Mewale (Expert NRM), Ms. Swati (RySS), Dr. Pankaj Tiwari (Aarohi), Mr Ashok Kumar Singha (CTran Consulting), Mr M P Vasimalai (Dhan Foundation), Mr. Kundal Burnwal (GIZ), Dr. Jagdish Purohit (GIZ), Mr. Navin Twarakavi (IBM Weather company), Mr. Rajeev Ahal (GIZ), Mr. Ashirwad Das (GIZ), Mr. Kirti Prasanna Mishra (Ecociate) and Ms. Neha Khara (GIZ).

²Rama Rao, C. A.; Raju, B. M. K.; Islam, A.; Subba Rao, A. V. M.; Rao, K. V.; Ravindra Chary, G.; Nagarjuna Kumar, R.; Prabhakar, M.; Sammi Reddy, K.; Bhaskar, S.; Chaudhari, S. K. (2019): "Risk and Vulnerability Assessment of Indian Agriculture to Climate Change". ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, p.124.

³Ibid.

The study assessed that 50 districts have a very *high* and 150 districts have *high* exposure; 22 and 172 districts *very high* and *high* vulnerability respectively; 46 and 128 districts *very high* and *high historical* hazards; and 199 districts are estimated to have moderately unfavourable future hazards. Based on these assessments, the composite climate change risk has found that there are 109 districts with *very high* risk due to climate change and 201 with *high* risk to climate change in reference to agriculture in the country.

Mapping of risks due to climate change indicates spatial distribution with most of the *very high*-risk districts located in the states of Uttar Pradesh, Rajasthan, Bihar, Kerala, Uttarakhand, Odisha, and Punjab. The *high-risk* districts are additionally located in the states of Madhya Pradesh, Chhattisgarh, Karnataka and Maharashtra and need to be given higher priority while planning for protecting farmers from adverse impacts of climate change.

Spatial distribution of risk is also indicative of the relative importance of risk across geo-economic realities and thus demands local specific approaches to risk reduction, that place greater emphasis on the reduction of vulnerabilities through adaptive interventions, which too have to be embedded in locally relevant and locally specific climate related vulnerabilities and exposures.

4.2 Major Challenges

Food production systems can be very diverse and therefore create a variety of challenges, especially when connected to climate resilience. Above all, however, there is no one food production system to which an analysis can refer. Rather, it is necessary to differentiate, which is why in this case three main areas have been identified. A first field is settled agriculture, dealing with agricultural products from traditional agriculture, forestry and fisheries. The next area is pastoralism, i.e., intensive livestock farming. Finally, the third area are uncultivated food systems. Here, the focus is on politically ignored food reservoirs in forests and commons. In the following three chapters, each of these areas will be analysed regarding their current status in India, the sustainability of the respective food system, their climate-resilience as well as policy, action and knowledge pathways.

4.3 Settled Agriculture Food System

4.3.1 Current Status

The agricultural food system encompasses the entire range of actors and their interlinked value adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry and fisheries and parts of the broader economic, societal and natural environments in which they are embedded.⁴ Globally and in India, the human endeavour to produce food has moved from a self-provisioning economic activity to a business that produces surplus for sale in market. This gradual but a definite shift has had a major impact on the manner in which food is produced, not only at the farm level in use of resources and deployment of package of practices but also on the priorities in agri-research and development of agricultural technologies; on market behaviour and on the consumer preference for food and food products; and the priorities of government and related agencies in deployment of resources and designing interventions.

The agricultural food system in the country has hovered around two major cereal crops, wheat and paddy, at the cost of minor millets, pulses and other food grains. The research and technological development too have been led by these two crops. The net impact of this has been a decline in agro-biodiversity, both in terms of plant species and varieties that have contributed to increased vulnerability to climate risk at the farm level.

Industrial methods that focus on production as the sole arbiter of performance have moved the food production system away from the farmer and farm to a pre-defined package of practices. Universal (almost) solutions to problems of production have diluted the role, preference, and goals of farmers in the conduct of agriculture-based food system. The erstwhile farmer who was a plant breeder, generated of his own farmyard manure and other agriculture inputs has now become consumer of seeds and agro-chemicals that has seriously impacted his ability to increase his income due to higher proportion of costs that he has to incur on procurement of agri-inputs. The long-term impact on increased (and often irrational dosage) of

⁴FAO (2018): "Sustainable food systems. Concept and framework". Available online at: <https://www.fao.org/3/ca2079en/CA2079EN.pdf>. Last accessed: 08.09.2022.

agro-chemicals on the farm has led to decreased fertility of lands, destruction of farm biodiversity and increased risks in maintaining production and ensuring food and nutritional security.

4.3.2 Sustainability⁵

Achievements of agri-food systems in India include (reference year 2020):

- Record of food grain production 296.65 million metric tons
- Horticulture production at 326.6 million metric tons; milk at 208 MT and sugar production 26.26 million metric tons
- Gross Value Added by agriculture, forestry and fisheries was Rs 19.48 lakh
- Largest producer of milk, pulses and jute in the world, and ranks as the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruit and cotton and leading producers of spices, fish, poultry, livestock and plantation crops
- Primary source of livelihood for 58% of the population
- Organic food segment worth Rs 2700 crs (2015)
- Food processing represented market of Rs 1931288 crs with employment of 1.77 million persons

Despite remarkable achievements through production centricity in policies, programmes and practices have led to a regime that subsidises agri-inputs (both material and financial resources), promotes agro-chemical (as indicator of progressive farming), and understatedly works on the assumption that there is an underlying conflict between economic and ecological goals in a farming food system. Paradoxically the country is in a situation, where despite increases in agriculture outputs the issue of food insecurity and under-nutrition co-exist with the regime of increased production which are sought to be addressed through distributive policies that are based on central procurements and subsidies for consumption. The distribution is limited to some food (wheat and rice mainly) and does not provide for balanced distribution of nutrition (pulses, proteins, fat and vitamins).

In a country where 85% of the farms are less than 2 ha in size, where 45% of the net area sown is operated by small and marginal farmers, and where 358 districts have more than 80% farmers as small and marginal farmers the exposure to climatic stresses is high and widespread, especially due to movement towards the culture of mono cropping and limitations of crop specific package of practices.

Another factor that has impacted the sustainability of the present agri-based food system is its over-reliance on groundwater for irrigation, which has been found to be the most significant factor for yield stabilisation. In the

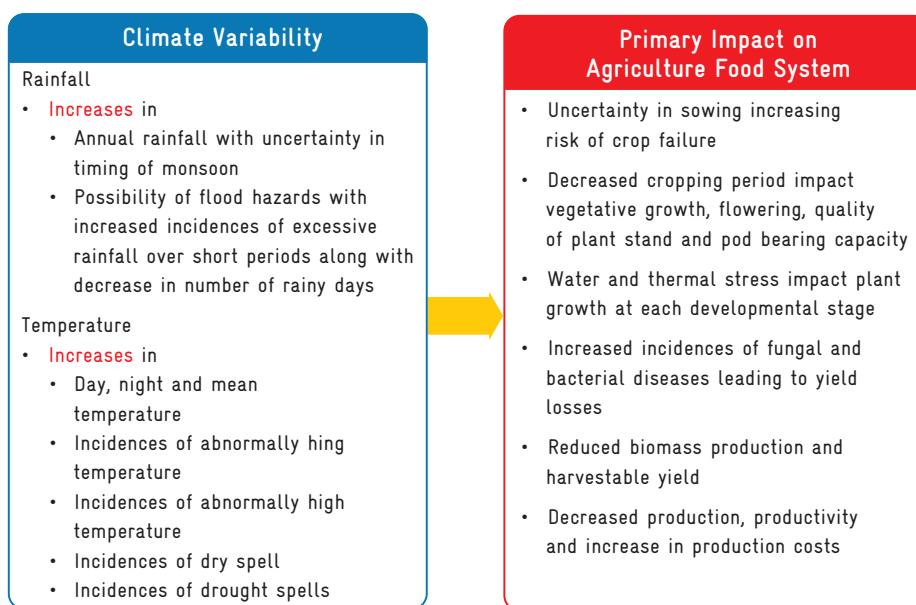


Figure 1: Climate variability and impact on the agriculture food system (Figure by the author)

⁵Sustainable food system is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised; <http://www.fao.org/3/ca2079en/CA2079EN.pdf>.

absence of mechanisms to maintain the abundance of ground water, there are 390 districts that were found to have less than 20 ha m/km² groundwater availability and 42 districts with more than 40 ha m/km² availability of groundwater. With water holding capacity of soil varying from less than 60 mm in 164 districts to more than 125 mm in 154 districts, availability of water and soil moisture has serious implications for the sustainability of the food system.

4.3.3 Climate Resilience

Agriculture is a biological production process and is directly impacted by climatic variations. These changes impact both the sustainability of the system and of the livelihoods of the people dependent on it. The existing evidence indicates that the productivity of crops, livestock and fish is likely to be impacted by climate change. This will have direct implications for food security, livelihoods and sustainability of agriculture food system. The data suggest that rising temperatures and declining rainfall will adversely affect agriculture productivity (with some exceptions in temperate hill regions).

With 24 districts having more than 80% of their geographical area under net sown area, and another 151 districts between 60% - 80%, the exposure of agriculture to climatic stress is high. This is further compounded by the presence of a high proportion of small and marginal farmers within the farming community. Vulnerabilities in addition from variations in rainfall and temperature further include low levels of literacy (pseudo indicator of low adaptive capacity), low market density, high income inequalities, low per capita income from agriculture, and low technological adoption rate.

Broadly there are three pathways that are recommended for enhancing climate resilience of agriculture food systems in the country: *One*, is the **Policy Pathway** that seeks to align the short and long term goals of the food systems with the realities of climate vulnerabilities that impact it. These recommendations deal with revisiting the existing paradigms that guide action and also development of alternative perspectives that then become the harbinger of action at the ground. The recommendations for policies are directed to both the central and state government to ensure complementarities in their outlook and action. *Second*, the **Action Pathway** deals with action that is manifested through programmes and projects that aim to demonstrate/experiment climate adaptive practices at the ground level. These recommendations seek to prioritise action for development of climate adaptive practices and

for disseminating the same at a wider level. *Third*, is the **Knowledge Pathway** which aims to develop the agenda for research and knowledge generation that will feed into policy and action in a real time basis in addition to assessing the impact on climate resilience of food systems.

4.3.4 Policy Pathway

■ Paradigm shifts in policy perspectives

Policies governing the agriculture production system need to shift from the yield-oriented production centric perspective to system-oriented perspective that accounts for the productivity of water, soil and other components of the ecological system. This approach will allow accounting for the water and carbon footprints of different crops and will thus enable to focus on crops that are more nutritious, less water guzzling and do not have a negative impact on soil.

■ Sharper focus on farmer and diversity

Policies need to be farm- and farmer centric to allow spaces for multiple realities and vulnerabilities faced by farmers. Further such policies need to recognise promotion of crop diversity not only on count of being remunerative, but also as a major risk minimiser for the producers. Policy prescriptions will enable farmers to regain their position as plant breeder, develop a bio-diverse crop mix and create agri-businesses as well as support infrastructure that promotes agroecological farming at local and regional levels.

■ Women as drivers of change

Climate change will affect women much more than men as it will increase their burden of work and they will have to bear the consequences of increased production costs and crop failures. Women in forefront will bring their lived-in realities in decision making and hence the policies need to recognise that women are not mere labourers or beneficiaries of the food system, but they are also drivers of change.

■ Climate adaptation as a major policy plank

Short- and medium-term policies to promote climate resilience in agri-food systems need to consider multiple vulnerabilities faced by farmers and institute economic, fiscal, technical and institutional measures that explore and develop climate adaptive practices in different geo-ecological conditions. The State Action Plans for Climate Change should be integrated with agriculture and allied activities to make them relevant and effective at local and regional levels.

4.3.5 Action Pathway

■ Development of demonstrations of climate adaptive practices

Development of localised climate adaptive demonstration practices for different micro ecosystems. Such demonstrations will also account for short- and medium-term programmes to improve soil health and reduce risk arising from climate variations as well as integrate plans for sustainability in water availability as a measure to reduce crop failure on account of climatic variations. These practices will be specifically available and accessible to small and marginal farmers.

The experiences in incremental adaptation from varietal breeding and management practices can strengthen such efforts and can be further used to deepen such experiences.

■ Promotion of agroecological practices

Promotion of agroecological practices, that are based on recognition of ecological resource endowment at the farm level, as adaptive practices in reference to specific climate vulnerabilities identified for each such region and one that sets in a circular agricultural economy at the local level.

Good practices such a Millet Mission of Odisha and Panchdhanya of Andhra Pradesh and Odisha should be explored, that not only introduce climate resilient crops but also increase crop diversity at the farm level. These practices demonstrate how area under millet can be promoted through value chain-based approaches, where focus is across production, postproduction, processing and marketing stages.

■ Promotion of technological development and practices

Acceleration in development and promotion of climate resilient crop varieties that are adapted to local climate variabilities. Such development should also include investments on knowledge acquisition and transfer to extension systems, so that it reaches the producer with a minimum time gap. Promoting technologies and farm implements that encourage and incentivise sustainable agriculture practices such as equipment for crop residue management, direct seeding of rice, solar dryers etc. Priority in development of efficient irrigation and water management systems and practices that tap into surface and sub surface water systems will be required to complement adaptive practices that will be developed at the local levels.

Aquaculture is an important source of livelihoods and nutrition to communities. There is a need to develop climate resilient aquaculture practices so that fishers and farmer-cum-fishers do not face economic and nutritional challenges.

4.3.6 Knowledge Pathway

■ Democratising information and knowledge

The challenge of taking the technology to a larger number of farmers can be addressed by making information and knowledge democratic, derived, customised, evolved and co-created with localised wisdom. This can be achieved by harnessing the social capital and collective power of the community with a specific focus on women and producers and disseminators of experience and knowledge.

■ Applying farmer centric research

Research needs to be farm-based and be farm and farmer centric. Experiences and knowledge should be co-created with producers and the stakeholders that comprise the value chain of the produce and the product. Lab to land models of extension through the institutional mechanisms and practices of farmer schools will enable early adaptation through customised solutions.

■ Conducting climate vulnerability studies

Local, crop and variety specific climate vulnerability studies need to be undertaken in wider geographical areas to map vulnerabilities among different categories of farmers and assess climate deficits amongst them. Such studies will feed into exploration and development of range of climate adaptive options and practices for farmers under different climatic variations.

4.4 Pastoralism

4.4.1 Current Status

Pastoralism is the extensive livestock production system that involves the tracking and use of grazing and water across a given landscape (normally a “rangeland”). Normally practiced in dry land areas, mobility is the key to this system.⁶ In India however, pastoralism has not gained recognition in public discourses and hence we do not have a working definition of pastoralism or pastoralists. In policies and administrative discourses, the term nomads is used but it includes non-pastoral groups as well. As

⁶Little, M. A. (2015): “Pastoralism”. In: Muehlenbein, M. (ed.): “Basics in Human Evolution”. pp. 337-347. Academic Press. ISBN: 9780128026526.

such there are no appreciation of pastoralism as a food system in policies and prescriptions for development of agriculture or livestock.

The study on pastoralism in India⁷ concludes that there is no official data on the number of pastoralists in India, though a figure of 35 million is often quoted (without reference to any source). Other sources⁸ estimate that pastoralists make up 6% of the population. The study estimates that the actual number is likely to be closer to 1% of the population or about 13 million people.

Variety of pastoralists systems that exist in India include transhumance, nomadic, semi nomadic and village-based herding.⁹ Studies have documented that there are 46 caste communities that have specialised pastoralists identities. Animals reared by these communities include cattle, buffalo, sheep, goat, yak, camel, ducks, pigs, guinea fowls, horses and donkeys.

According to LIFE Network¹⁰ 77% of the livestock in India are either herded or left to range on common land. These animals contribute to 53% of India's milk and 74% of its meat. Given the fact that India is the largest producer of milk and largest exporter of beef, sheep and goat the significance of pastoralist food production system can neither be undermined nor ignored.

4.4.2 Sustainability

The core elements of pastoralism include (a) sharing of a common resource pool (range or common lands for grazing and water); (b) herd comprising of indigenous breed of animals (e.g. pastoralists of Banni grasslands in Kutch maintain the original bloodline of their buffaloes and every buffalo is marked and identifiable)); (c) closely interlinked relationship with farmers and local population (e.g. reciprocity in sale of manure and fodder to farmers); and (d) deep understanding of different ecosystems that determine their migratory routes and movements and thus represent a sustainable method of utilising micro-ecosystems (pastoralists are located in arid lands such as desert, steppes, and mountainous).

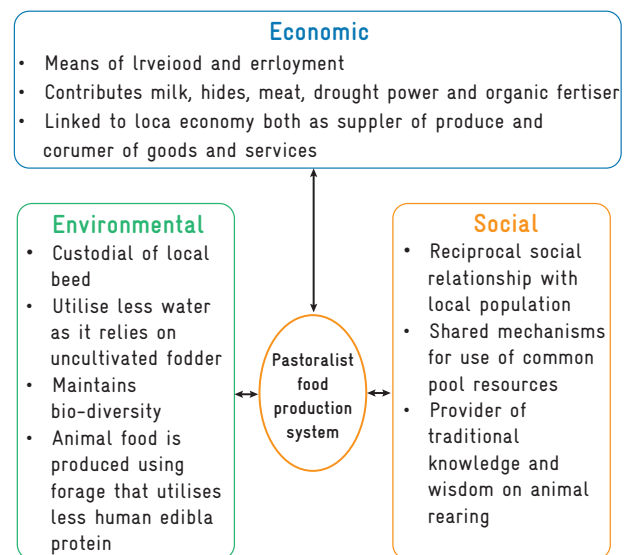


Figure 2: Environmental, economic and social interactions with pastoralist food production systems (Figure by the author)

Presently, one of the major issues faced by pastoralist food production system is the lack of recognition and appreciation of their contribution as a sustainable food production system at the policy level. This has led to a common perception that they threaten environmental conservative measures and hence their decentralisation often emerges as the only policy option. Lack of tenurial rights of pastoralists, especially on common lands and water, and their lack of representation in economic and political decision-making processes are main institutional issues that have been instrumental in marginalising them in legal and development programmes.

Climate vulnerabilities for pastoralists appear both on account of warming and changing rainfall patterns across the geographical terrain, where they migrate to and move within. The direct impact these changes have on the pastoralist food production system are related to the availability, quality and abundance of fodder and water for their livestock, the two critical factors that determine the health and productivity of the herd. There have been reportings of new disease outbreaks among animals that increases morbidity, and the intensity of floods directly impacts the mortality of the animal stock.

⁷Sharma, V. P.; Koehler-Rollefson, I.; Morton, J. (n.a.): "Pastoralism in India: A Scoping Study". Centre For Management in agriculture, Indian Institute of Management. Natural Resource Institute, University of Greenwich. Available online at: <https://assets.publishing.service.gov.uk/media/57a08ce2e5274a31e00014fa/ZC0181b.pdf>. Last accessed: 08.09.2022.

⁸Jitendra (2019): "Recognize environmental contribution of pastoralists: Experts". DownToEarth. Available online at: <https://www.downtoearth.org.in/news/wildlife-biodiversity/recognize-environmental-contribution-of-pastoralists-experts-67077>. Last accessed: 08.09.2022.

⁹Kishore, K.; Koehler-Rollefson, I. (2020): "Accounting for Pastoralists in India". League for Pastoral Peoples and Edogenous Livestock Development. Available online at: <http://www.pastoralpeoples.org/wp-content/uploads/2020/09/Accounting4pastoralists-IN.pdf>. Last accessed: 08.09.2022.

¹⁰Foundation For Ecological Security (2016): "Kullu Call For the Recognition of the Importance of Common Pool Resources (CPRs) and Pastoralism for India's Livestock Sector". Available online at: <http://rtn.org.in/wp-content/uploads/2019/04/Kullu-Call-Brochure.pdf>. Last accessed: 08.09.2022.

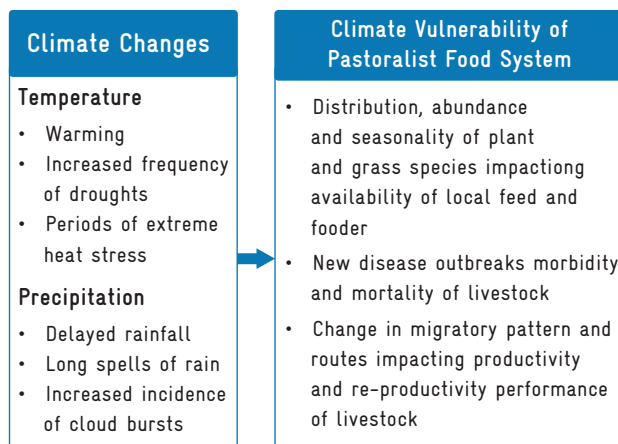


Figure 3: Climate vulnerability of pastoralist food systems (Figure by the author)

Shrinking of common lands, construction of urban landscape, changing cropping patterns and varieties, earmarking of protected areas (forest and national parks), multiple demands on water, and decrease in local biodiversity indirectly impact sustainability of pastoralist's food production system. Together, these factors disturb the migratory routes and accessibility of pastors to common resource pools which further impinges on the productivity of animals that result in undermining the sustainability of the pastoralist food production system.

4.4.3 Climate Resilience

Given the contribution of pastoralism to the food system of the country, its inherent strength of being based on indigenous breed of livestock, traditional knowledge, reciprocal transactional economic relationships with local population, and practices that are based on principles of circular economy (resilience through diversity, regenerating through spread of organic manure, and reliance on renewable sources of energy) makes it an important and significant food system that demands to be focused upon for transformation of food systems in the country. The following pathways are suggested for enhancing the climate resilience of pastoralism as a food system in the country:

4.4.4 Policy Pathway

■ Recognition of pastoralism in national policies

Though pastoralism is specific to states, but the routes and pathways of pastoralists cut across states and thus demand attention at the national level. There is need to develop a common framework that will provide recognition and protection to pastoralists at the national level. Such a framework will thus develop definition and typologies of pastoralism as it practices in the country.

■ Promotion of rights and entitlements of pastoralists

With recognition of pastoralism, it will be equally important to define the rights and entitlements of pastoralists that will allow them to practice their livelihoods across regions and geo-economic regions. The policy framework, especially for tenurial rights of pastoralists over common lands, rangeland management, and rights to share in common resource pool will impart institutional legal and administrative protection to pastoralists across regions. These rights will have to be accounted during the development of land use policies of respective states. The rights of pastoralists need to be aligned with the rights of bodies of local governance that determine land use patterns and sharing of common resources.

4.4.5 Action Pathway

■ Development programmes for pastoralists

Menu based development programmes for pastoralists need to be developed and implemented. The programmes should encompass their linkages with veterinary services, with animal gene pool for cross breeding, market based safety nets e.g. insurance, grading of their produce/product, linkages with financial institutions and crafting of space in market and market institutions.

■ Agro-pastoralism and silvi-pastoralism as climate adaptive models for pastoralism

The development and implementation of programmes that innovate in management of grazing lands without disrupting the existing ecological landscape through use of agro-pastoralism and silvi-pastoralism models under different geo-cultural contexts will feed into development of climate resilient fodder production plans. With limitations of commercial fodder production, the need to conserve and sustain common lands for ensuring availability of fodder has gained greater importance. Such efforts would be well complemented with better use of crop residue as fodder for the pastoralist's livestock.

4.4.6 Knowledge Pathway

■ Documentation of pastoralism

Urgent need to recognise and document existence of pastoralism in the country through series of layered micro studies that also maps their migratory routes and grazing lands along with the traditional mechanisms for sharing of common pool resources. Such studies will impart legitimacy to pastoralism and bring them into mainstream discussion.

- **Documentation of traditional knowledge of pastoralists**

Immersive studies that document knowledge and traditional wisdom of pastoralists on ecology, animal care and breeding will add value to the knowledge that is aimed at developing climate resilient pastoralist food systems. These studies will also feed into adaptive practices of agri-based and uncultivated food systems as well.

- **Adaptation to climate challenges and promotion of resilience**

State Action Plans for climate change need to incorporate pastoralism as a distinct food system and undertake nuanced studies on the impact of climate variabilities on pastoralist food systems. Such studies will list present attempts by central and state governments to address the climatic challenges and will also identify climate resilience that exists within these food systems. Latter can be used for further research to develop area specific approaches and solutions.

4.5 Uncultivated Food System

4.5.1 Current Status

Forests and commons have been food reservoirs and many communities rely on such forests and commons to fulfil their food needs. Termed as “treasure troves” of nutrition, the uncultivated food systems have not gained recognition in policies and programs related either to agriculture or to forests.

Uncultivated foods are organic, naturally regenerative, based on local eco system, resilient to local climatic conditions, and represent an extensive low input food system. Communities that live near forests and where common lands like permanent pastures and meadows have been preserved have reported a rich biodiversity in availability of such foods that significantly contribute to their food and nutritional security.

A study conducted by the Centre for Studies in Ethnobiology, Biodiversity, and Sustainability (CEiBa), Malda on wild edible plants reported that there were 1403 wild edible species from 184 families that were consumed across India. The study further noted that leafy shoots followed by fruits were the two most eaten plant parts.¹¹ In another study by Living Farms in 2013, across the villages of Rayagada district in Odisha, recorded 121 different

kinds of forest foods that were harvested between the last week of July 2013 and December 2013. On an average, 4.56 kg of such foods were harvested per household, which ranged from 21 to 69 different kinds of food. On an average, 0.725 kg of forest foods became part of the household daily diet, accounting for 12% to as much as 24.4% of total cooked foods across six villages. The dependence of communities on forest foods ranged from 20% to 50%, depending on the characteristics of a village and the biodiversity composition of the forest. This is both in terms of diversity and quantity.

Food available from forests, common lands and water bodies include edible flowers, leaves, fruits, seeds, mushrooms, roots and tubers, bamboo shoots, edible insects, birds, honey, fishes, crab and other aquatic plants and aquatic species. Micro studies have indicated that these foods form the food and nutrition bank for communities gain significance during times of food insecurities and during the intermittent cropping periods.

4.5.2 Sustainability

India, with its wide bio-geographic diversity, harbours high floral diversity that has promoted high divergent human adaptation to consume this plant variety as part their dietary diversity. The inclusion of edible wild food species as part of human diet is directly correlated to plant availability, which in turn is governed by local environmental parameters, namely soil type, temperature, altitude, rainfall etc. The communities living near such food banks are well versed in the identification and consumption of these foods. They have a strong knowledge base and their own wisdom for harvesting of such foods. Being available as part of common resource pools, the communities have developed and have shown resilience in demarcating areas for each other's that each one of them are able to maintain their respective food diversity from this pool.

The economic system interlinked to uncultivated foods is based on barter/cash exchange of foods and also in sale of surplus food that has been gathered/harvested. The underlying principle of this exchange is not profit maximisation but optimisation of dietary diversity – where each group is able to access and consume diverse food through these transactional exchanges.

Uncultivated food system is a representative of an agroecological production cycle as it based on use of local resources (natural endowments); follows natural

¹¹Ray, A.; Ray, R.; Sreevidya, E. A. (2021): “Corrigendum: How Many Wild Edible Plants Do We Eat—Their Diversity, Use, and Implications for Sustainable Food System: An Exploratory Analysis in India”. *Front. Sustain. Food Syst.* 5:667541. doi: 10.3389/fsufs.2021.667541.

regenerative cycles; any organic waste is used and consumed within the habitat (as food for animals or for enriching organic matter); traditional knowledge ensures responsible harvesting/gathering so that carrying capacity of the plant species maintained; and the economic and ecological balance is maintained through reciprocal exchanges.

4.5.3 Climate Resilience

Climate variability of changing micro climatic weather patterns manifested in warming, extreme weather events of temperature and precipitation, increased incidences of frost and/or hailstorms, local storms and flooding has impacted the regenerative capacities of wild foods and anthropogenic interferences have further slowed down the process of natural selection among these plant species. However, based on indigenous varieties and well adaptation to local climatic conditions, wild foods have an in-built resilience to bounce back and continue to provide bio-food diversity to human population.

Wild and uncultivated foods, however, face increasing challenges from the uncontrolled spread of industrial farming that not only encroaches on common lands but also through the use of agro-chemicals adversely impacts the ecological habitat of such foods. Further with the predominant paradigm of conservation through protection that governs forest policies have reduced access of communities to wild and uncultivated foods. Uncultivated foods do not appear in major development discourses nor does it find place in agriculture of food policies of national or state governments. The potential of the uncultivated food system to contribute to enhancing climate resilience of food systems in the country can be ensured through the following suggested pathways:

4.5.4 Policy Pathway

■ **Changing the policy paradigm of agriculture and food security in the country**

There is a need to revisit the present policy paradigm of food security that is based on industrial farming as the only available option for food and nutritional security through food fortification in favour of an integrative policy perspective that is based on a mix of industrial farming, food biodiversity, and uncultivated foods contributing to human dietary diversity. Food policies need to recognise the contribution of uncultivated foods to increasing climate resilience of food system and thus prioritise projects that conserve, protect and promote such landscapes in the country.

4.5.5 Action Pathway

■ **Switching food preference**

Increasing awareness among consumers to switch food preference for wild foods, including enhancing skills in cooking such foods and wide spreading the recipes without compromising their nutritive value.

■ **Promoting market recognition of uncultivated and wild foods**

A food grading system that recognises and certifies wild foods (e.g. wild honey) will help food gatherers/harvesters a market advantage for their produce. Further undertaking research to enhance the shelf life of wild foods will enable these foods find wider markets and can be consumed across seasons. Start-ups and other technology enabled systems may be encouraged to take a lead role in finding such technologies and markets.

■ **Maintaining diversity in wild and uncultivated foods**

Multipronged strategies will be required for maintaining the diversity and abundance of wild foods. These strategies will include use of biodiversity registers as the benchmark for maintaining the stock and diversity of wild foods; sustainable and responsible harvesting practices systematic to ensure that harvesting is within the ecological limits of carrying capacity of the local eco system; sustainable harvesting of high value crops to supplement the income of forest-based communities; separating the scalable and non-scalable foods that will be the determining factor for their revival and growth; and niche crop diversity and linking it with efficient value chain under the cluster development approach.

Strategies will need to be linked with the working plan of forests and dovetailed with corporate social responsibility (CSR) investments in localising minor forest produce on local lands. A specialised approach on assessing and managing the man-animal conflict will be required as fruit trees often form food for animals as well.

■ **Applying a landscape level approach**

Adoption of a landscape level approach with convergence for landscape transformation will be required to strengthen and enrich the wild food systems. This approach will necessitate that investments and benefits under different central, state and local level public programmes are integrated at the local level to bring about changes at the level of landscape.

Convergence is an important component for the landscape level transformation. Identify the central schemes, departments, public programmes and private sector initiative to bring the larger changes at a landscape level.

4.5.6 Knowledge Pathway

- **Documenting traditional knowledge and practices**

Rigorous, nuanced and immersive documentation of wild and uncultivated foods at the local, regional and pan India level along with their contribution in nutritional and dietary diversity needs to be undertaken so that such foods are brought in to mainstream discussion on food and nutritional security in the country. Indigenous knowledge of local communities around their availability, abundance, usage, seasons etc. will further strengthen such documentation.

- **Co-creating knowledge and action**

Learning with the local communities to document edible wild foods and development of their gene pool will be required so that these can be used to re-introduce in case their abundance is threatened or destroyed. Further action research on habitat balance (private and common lands) in respect of biodiversity need to be undertaken to account for changing contexts and demands on wild foods.

4.6. Linkages with the Sustainable Development Goals

Sustainable Development Goal (SDG) 2 to end hunger, achieve food security and improved nutrition and promote sustainable agriculture constitutes the primary goal that drives all countries to align their policies and programmes to achieve the target 2.4 that envisions a sustainable food production system and resilient agriculture practices (by 2030) that increase productivity and production, that help maintain ecosystems, strengthen capacity for adaptation to climate change (extreme weather, drought, flooding, and other disasters) and that progressively improve land and soil quality. Complementarity with other SDG goals,



notable SDG 1 No Poverty; SDG 10 Reduced Inequalities; SDG 12 Responsible Consumption and Production; SDG 13 on Climate action; and SDG 15 Life on land converge to bring synergies in perspectives, actions, benefits and impacts, that together contribute towards the realisation of these goals by 2030.

4.7. Pathways for 2030

Food systems function within the agroecological contexts that are under severe climate stress in the country. The way forward for strengthening food systems in terms of their ability to provide food and nutritional sufficiency in the country is dependent on a multi-layered ecosystem approach that works to fulfill both the economic and ecological goals to define sustainability of food systems. Risk mitigation for producers through economic, fiscal, technological and managerial support and development of climate resilient agriculture infrastructure networked from the farmer to regional and national level will work to address production in food stressed districts.

The overall approach for strengthening climate resilience in food systems is critically based on the panchayat and basin level planning that uses tools of GIS mapping and revival of local biodiversity from disaster (e.g. mangroves) point of view. Such an approach will enable development of regional mitigation and adaptation measures (recalibrating crops) through understanding and development of future weather scenarios at regional levels.

Supporting farmers in accessing carbon finance by developing Voluntary Carbon Market (VCM) projects which are expected to grow by almost 15 folds in this decade due to increasing net zero or climate neutral targets taken by companies globally. Focusing on nature-based solutions through agroecology, forestry, and soil carbon as appropriate candidates that can participate in VCM will be beneficial for the farmer.



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