

# Agriculture, Animal Husbandry and Fisheries

## S e c t o r   R e p o r t



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Husbandry and Fisheries**  
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## **PREFACE**

The Government of India (GoI) spends close to Rs. 14 lakh crores annually on development activities, through nearly 750 schemes implemented by Union Ministries. To improve the effectiveness and efficiency of public finance, and the quality of service-delivery to citizens, all schemes have been mandated to undergo third party evaluations, to provide an evidentiary foundation for scheme continuation from 2021-22 to 2025-26. In 2019, the Development Monitoring and Evaluation Office (DMEO), NITI Aayog was assigned the task of evaluating 28 Umbrella Centrally Sponsored Schemes (UCSS), which are schemes/programmes funded jointly by the Centre and the States and implemented by the States. This historic exercise, undertaken between April 2019 and February 2021, evaluated 125 Centrally Sponsored Schemes (CSS), under 10 Sectors, together covering close to 30% of the GoI's development expenditure, amounting to approximately Rs. 3 lakh crore (USD 43 billion) per annum.

In order to fulfil this mandate to the highest standard possible, to optimize both the robustness and the uptake of the evidence generated, DMEO adopted a nationally representative mixed methods evaluation methodology and a consultative review process for the reports. Through qualitative and quantitative analysis of secondary literature, analysis was done at three levels: the sector, the umbrella CSS and the scheme itself. The studies thus produced then underwent a review process involving consultations with NITI Aayog subject matter divisions, concerned Ministries and Departments, and external experts.

The present report is an outcome of this evaluation study and presents an analysis of the Agriculture, Animal Husbandry and Fisheries Sector based on primary and secondary data collection. In this Report, we seek to cover the agriculture and allied sector in India, identifying the intended and actual contribution of GoI schemes to sector outcomes. This includes areas for more focused effort to achieve national priorities/SDGs.

We hope that this Report will further our understanding of the Agriculture, Animal Husbandry and Fisheries Sector and help us move towards achieving the Sustainable Development Goals and the National Development Agenda, to promote the well-being of all sovereign citizens of India.



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DMEO team has been at the core of the evaluation studies - in this package specifically, Ms. Harshala Jambhulkar, Ex-YP and Mr. Jayanta Kumar Patel, Economic Officer worked on every last detail of this herculean endeavor, under the guidance of Ms. Anjum Dhamija, M&E Lead, Mr. Anand Trivedi, Monitoring and Evaluation Specialist and Mr. Ashutosh Jain, DDG. Across packages, Deputy Directors General Mr. Jain and Ex-DDG Ms. Harkiran Sanjeevi also oversaw coordination, standardization and monitoring of the study design, analysis and implementation processes across packages. They were supported by the Evaluations Core Team: Dr. Shweta

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## List of Abbreviations

AAHI	Assistance to Animal Health Institutes
AL	Agricultural Labourers
ARIMA	Auto Regressive Integrated Moving Average
BII	Breed Improvement Institute
CAGR	Compounded Annual Growth Rate
CAPI	Computer-assisted Personal Interviewing
CS	Central Sector Schemes
CSS	Centrally Sponsored Schemes
DEDS	Dairy Entrepreneurship Development Scheme
DFI	Doubling Farmers Income
DIDF	Dairy Processing & Infrastructure Development Fund
FAO	Food and Agriculture Organization
FCI	Food Corporation of India
FDI	Foreign Direct Investment
FIDF	Fisheries and Aquaculture Infrastructure Development Fund
FPC	Farmer Producer Companies
FPO	Farmer Producer Organizations
GDP	Gross Domestic Product
GIS	Geographic Information System
GVA	Gross Value Added
Ha	Hectares
HH	Household
ICAR	Indian Council of Agriculture Research
ICT	Information and Communication Technology
INR	Indian Rupee
ISAC	Integrated Scheme on Agricultural Cooperation
ISACS	Integrated Scheme on Agriculture Census and Statistics
ISAM	Integrated Scheme on Agriculture Marketing
KII	Key Informant Interviews

LCISS	Livestock Census and Integrated Sample Survey
LHDC	Livestock Health & Disease Control
MIDH	Mission for Integrated Development of Horticulture
MoFPI	Ministry of Food Processing Industries
MOVCDNER	Mission Organic Value Chain Development for North Eastern Region
MPCE	Monthly Per-capita Consumer Expenditure
MSP	Minimum Support Price
NABARD	National Bank for Agriculture and Rural Development
NBM	National Bamboo Mission
NCAER	National Council of Applied Economic Research
NDP-I	National Dairy Plan-I
NFSM	National Food Security Mission
NLM	National Livestock Mission
NPDD	National Programme for Dairy Development
NRLM	National Rural Livelihood Mission
NSSO	National Sample Survey Office
OBC	Other Backward Classes
PACS	Primary Agriculture Cooperative Societies
PKVY	Paramparagat Krishi Vikas Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojna
RAD	Rainfed Area Development
REESI	Relevance, Effectiveness, Efficiency, Sustainability, Impact Framework
RFP	Request for Proposal
RGM	Rashtriya Gokul Mission
RKVY	Rashtriya Krishi Vikas Yojna
SMAE	Sub Mission on Agriculture Extension
SC	Scheduled Castes
SFAC	Small Farmers' Agribusiness Consortium
SHG	Self Help Groups
SHM	Soil Health Management
SMAF	Sub Mission on Agroforestry

SMAM	Sub Mission on Agriculture Mechanisation
SMPPQ	Sub-Mission on Plant Protection and Plant Quarantine
SMSP	Sub-Mission on Seed and Planting Material
SSCDF	Supporting State Cooperatives Dairy Federations
ST	Scheduled Tribes
USD	US Dollars
UT	Union Territory

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# Part: A – Agriculture Sector

## Chapter 1: Sector Level Analysis: Agriculture

### 1.1 Background of the Sector

Agriculture is one of the most important sectors of India's economy, given its vast land resources and conducive climate. In 1960s, the share of agriculture in the Indian economy was as high as 35%<sup>2</sup> which reduced over time with development in manufacturing and services sector in the country. In the late 1950's and early 1960's the country had been ridden with various issues including severe food deficiency. Various attempts have been made since independence to implement effective agricultural policies to improve the production level in agriculture and thus supporting both producers and consumers. Post-independence, the focus of agricultural policy was on ensuring food security to battle with crisis like shortage of food and extremely low yield rates. Between 1960 and 1970, the widespread adoption of rice and wheat was promoted along with an array of supportive initiatives around production subsidies, minimum support prices, public procurement, storage and distribution of foodgrains and trade protection. This had a long standing impact on the overall improvement in the yield rates and helped the nation achieve self-sufficiency in food grains. As a result of the Green Revolution in 1960s, the growth rate in agriculture started improving. The growth in agriculture was recorded as 0.7% in the period 1960-69 which improved gradually over the following decades to achieve a growth of 3.88% in the period of 2004-17<sup>3</sup>. Soon after the green revolution, several production-centric initiatives were taken to support land reclamation and harvesting of ground water, development at animal husbandry & fishery sector and give impetus on research and training. A comprehensive National Agricultural Policy was drafted in 2000 with an endeavor to bring large scale sectoral development. Progress on the parameters set by the policies led to further growth in the agriculture and allied sectors.

This section on sector analysis of agriculture covers background on production trends, contribution of the sector to Gross Value Added (GVA), key growth drivers, exports, and employment share. It further captures sector performance in terms of production and productivity, land use patterns, irrigation, storage and processing infrastructure, post-harvest infrastructure, price-realization by farmers, export trends and social considerations. At the end, an analysis of major centrally sponsored schemes (CSS) is detailed out, covering the scheme objectives, components, and Deloitte's assessment of the impact of these schemes on beneficiary groups, infrastructure creation/ upgradation, and capacity building, etc. wherever available. A summary of agriculture sector's key challenges and strengths along with the most impactful schemes has been given at the end of this section. A number of previous studies, evaluation reports, and annual reports were reviewed through the course of the study, including those from UN Food and Agriculture Organization (UNFAO), Report on Doubling Farmers' Income, Economic Survey, Ministry-level reports, Departmental Annual Reports, other independent evaluation reports and analysis, among others.

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<sup>2</sup> Ministry of Agriculture & Farmers Welfare, Inter-Ministerial Committee of Doubling Farmers Income. (2018). Strategy for Doubling Farmers' Income by 2022 (Movement of Indian Economy: trends in GDP/GVA across sectors, Volume I). Retrieved from <http://agricoop.nic.in/doubling-farmers>

<sup>3</sup> Ministry of Agriculture & Farmers Welfare, Inter-Ministerial Committee of Doubling Farmers Income. (2018). Strategy for Doubling Farmers' Income by 2022 (Movement of Indian Economy: trends in GDP/GVA across sectors, Volume I). Retrieved from <http://agricoop.nic.in/doubling-farmers>

The yield for a majority of crops in India is still lower than the world average. Low irrigation levels, use of sub-par quality seeds, low adoption of technology, and limited knowledge about improved agricultural practices. Another oft-discussed issue is maintaining food security in the midst of low productivity and higher migration of agricultural workers into cities for better incomes, particularly small and marginal farmers. Infrastructure availability for perishable food items is another concern that calls for attention.

The overarching objective of the sector is maintaining food security while also ensuring remunerative prices to farmers. The goal is to modernize agriculture technology to ensure increase in productivity, efficiency, and crop diversification. Closing the information gap regarding best irrigation practices (given the region’s topography), latest technologies, and improved agricultural practices through extension services is required for enhancing production and productivity. This may be done through Kisan Melas, demonstrations, exposure visits, Krishi Vigyan Kendras (KVKs), and Farmer Friends, or through Gram Panchayats. The government must also seek to transform the rural economy through the creation of modern rural infrastructure and an integrated value chain system. This shall also incorporate promotion of value-added products, enable diversification to high value crops, and boost country’s exports. All this would call for a policy environment that enables income security for farmers, whilst maintaining India’s food security so that farmers are willing to experiment with diversified crops/cropping patterns. Further, more agripreneurs must be encouraged so that even small and marginal farmers can capture a higher share of value addition from ‘farmgate to fork’. Private sector participation must be encouraged in agricultural development to ensure better remuneration and marketing/distribution of products. Promotion of Research & Development, better marketing infrastructure, and natural farming shall further contribute to sectoral development. Lastly, boosting agriculture credit is critical for the sector and thus is one of the key objectives for the sector.

A representative illustrative of the sector’s vision is given below:

Figure 1 Agriculture Sector Vision

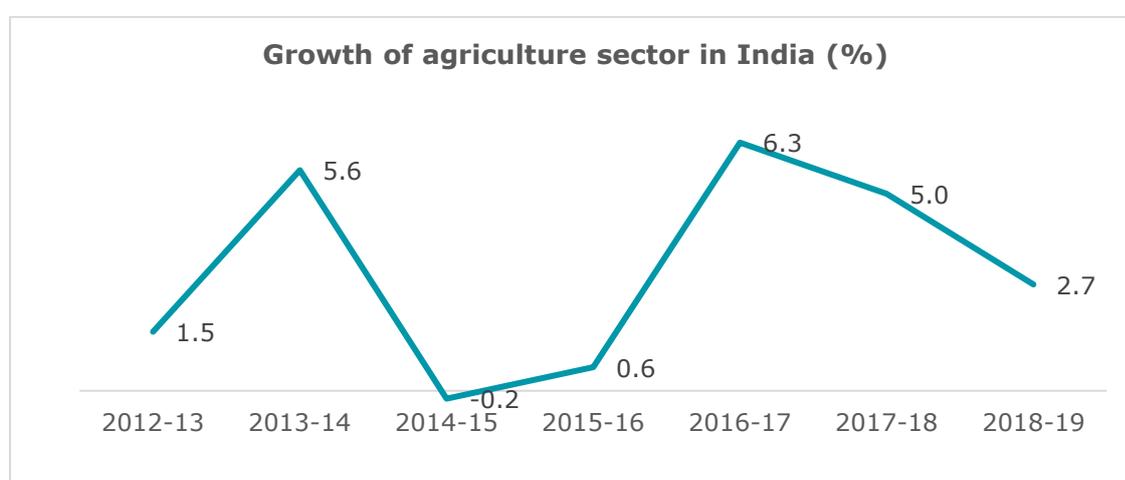


Source: Strategy for New India @ 75, NITI Aayog, November 2018; Deloitte analysis

## Agriculture Sector Assessment

Agriculture is one of the largest contributors to the economy in India with agriculture, fishing and forestry having 13.18% share in the GDP of the country as of 2018-19<sup>4</sup>. Agriculture is the primary source of livelihood for over 58% of households in rural area. Endowed with 15 agro-climatic zones, ~400 million acres of arable area and 46 to 60 types of soil types, the country has abundant agricultural produce across the year. In order to address food security concerns, India focused on maximizing production in agriculture and is currently a net exporter of agriculture with the global rank of 8<sup>5</sup>. India is the largest producer of spices, pulses, milk, tea, cashew, mango, banana and jute, and the second-largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds. The overall growth registered in the agriculture sector in terms of percentage increase year on year has been depicted below.

Figure 2: Growth in agriculture sector in India (%)



Source: Agricultural Statistics at a Glance, 2018

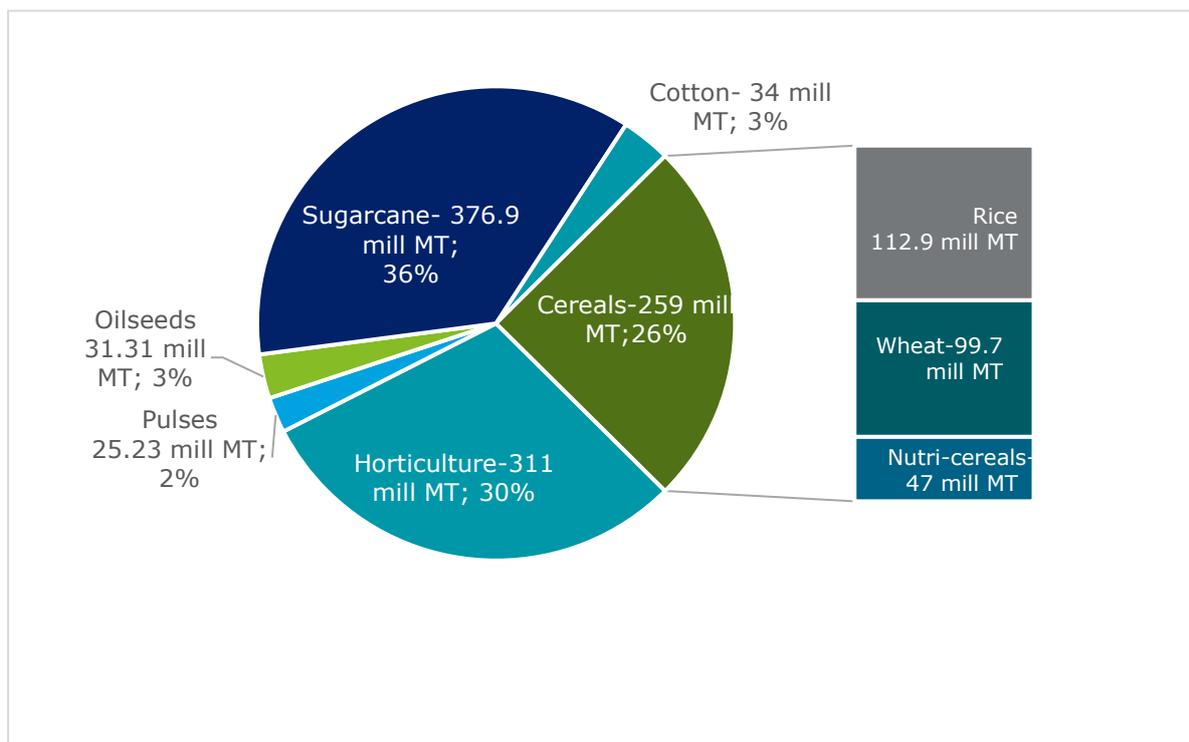
According to the 4<sup>th</sup> advance estimates of 2017-18<sup>6</sup>, India produces more than one billion tons of agricultural produce. Advance estimates for 2017-18 indicate that food grains output reached 284.83 million tonnes with pulses at a record 25.23 million tonnes and cereals (rice, wheat, maize, millets, etc.) at 259.60 million tonnes. Oilseeds production is estimated at 31.31 million tonnes in 2017-18 and in horticulture the production has reached 311 million tonnes. Sugarcane, cotton, jute, tea, coffee, tobacco, etc. adds more than 400 million tonnes to the agricultural production of the country.

<sup>4</sup> Provision Annual Estimates of GDP as of 2018-19 at constant prices taken from the website of MOSPI as accessed on 20<sup>th</sup> January 2020.

<sup>5</sup> World Trade Organization. (2019). *World Trade Statistical Review 2019* (Statistical Tables, Chapter VIII). Retrieved from [https://www.wto.org/english/res\\_e/statis\\_e/wts2019\\_e/wts19\\_toc\\_e.htm](https://www.wto.org/english/res_e/statis_e/wts2019_e/wts19_toc_e.htm)

<sup>6</sup> Department of Agriculture, Cooperation and Farmers' Welfare. Agriculture Statistics. Retrieved from <http://agricoop.gov.in/sites/default/files/Time-Series-4th-Adv-Estimate-2018-19-Final.pdf>

Figure 3: Share of Agricultural Commodities in terms of total Production. 2017-18



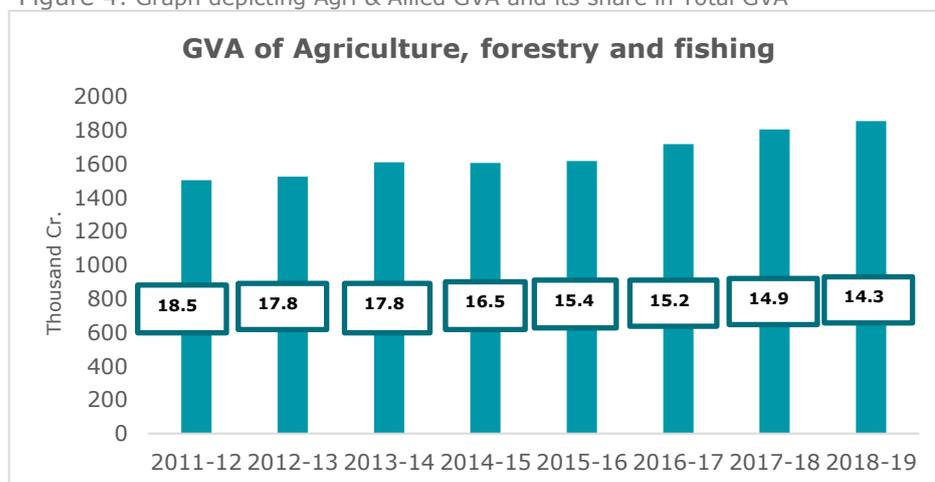
Source: Agriculture Statistics at a Glance 2018

As a result of near normal rainfall during monsoon in 2017 and various policy initiatives undertaken by the Government, country witnessed record food grain production in 2017-18. As per 4th Advance Estimates for 2017-18, total food grain production in the country is estimated at 284.83 million tonnes which is higher by 9.72 million tonnes than the previous record production of food grain of 275.11 million tonnes achieved during 2016-17. The production during 2017-18 is also higher by 24.66 million tonnes than the previous five years' (2012-13 to 2016-17) average production of food grain.

### Gross Value Added (GVA) from Agriculture and Allied Activities

Agriculture and allied sector has one of the highest contribution to the country's economy in 2018-19 with a share of 14.3% in the total Gross Value Added (GVA) at constant prices. In the year 2018-19, the GVA in agriculture and allied sector has been pegged at Rs

Figure 4: Graph depicting Agri & Allied GVA and its share in Total GVA



Source: Pocket book of Agricultural Statistics 2018

1,852,580 crores<sup>7</sup>. The trend of GVA of agriculture and allied sector along with the share of agriculture, forestry & fishing sector in GVA is shown the graph below. There has been a steady decrease in the share of Agri-Allied GVA from the year 2011-12 to 2017-18. The agriculture and allied sector comprises of crops, livestock, forestry & logging, and fishing & aquaculture and their respective share in the total GVA over the last 6 years has been given in the following table. As discussed in the Economic Survey 2018-19, the decline in share of Agriculture and allied sector is attributed to the continuous decline in contribution of crops over the given period.

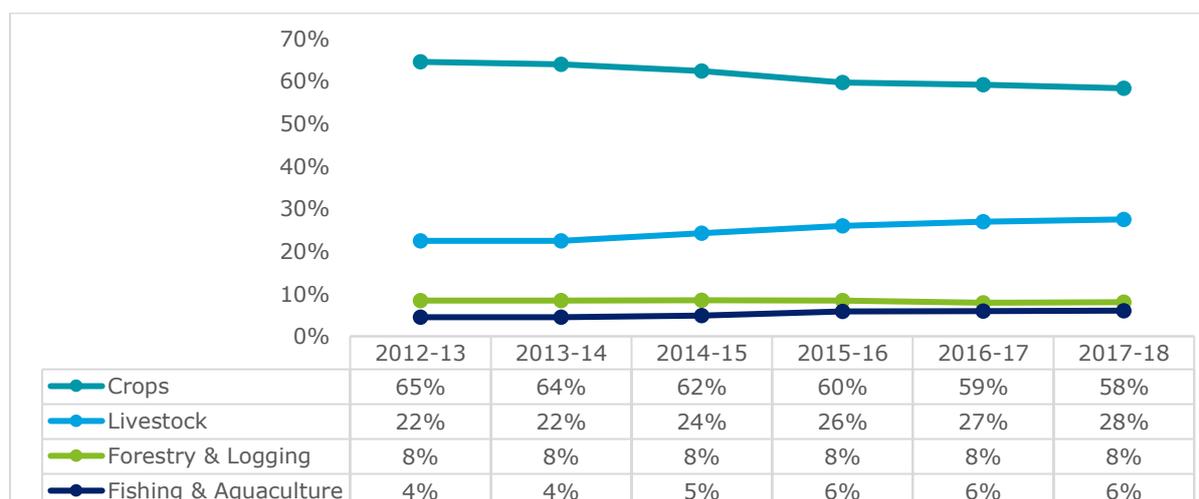
Table 1: Share of Agriculture and allied sector in total GVA for the period 2012-13 to 2018-19

Share in %	2012-13	2013-14	2014-15	2015-16 <sup>8</sup>	2016-17 <sup>9</sup>	2017-18 <sup>10</sup>	2018-19 <sup>11</sup>
Agriculture, forestry & fishing	17.8	17.8	16.5	15.4	15.2	14.9	14.4
<b>Crops</b>	11.5	11.4	10.3	9.2	9	8.7	NA
<b>Livestock</b>	4	4	4	4	4.1	4.1	NA
<b>Forestry &amp; Logging</b>	1.5	1.5	1.4	1.3	1.2	1.2	NA
<b>Fishing &amp; Aquaculture</b>	0.8	0.8	0.8	0.9	0.9	0.9	NA

Source: Economic Survey 2018-19

In the agriculture and allied sector, the share of the crop sector declined from 65% in 2012-13 to 58% in 2017-18 while the share of livestock and fishing & aquaculture, both have increased over the given duration. Share of GVA from livestock in the total agriculture and allied GVA has increased from 22% to 28% between 2012-13 and 2017-18 and the share of GVA from fishing and aquaculture in the total agriculture and allied GVA has increased from 4% to 6% between 2012-13 and 2017-18.

Figure 5: Composition of Agriculture Sector 2012-17



Source: Agricultural Statistics at a Glance, 2018

<sup>7</sup> Ministry of Finance Govt. of India (2019). *Economic Survey 2018-19* (Chapter 7, Agriculture and Food Management). Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

<sup>8</sup> 3<sup>rd</sup> revised estimate

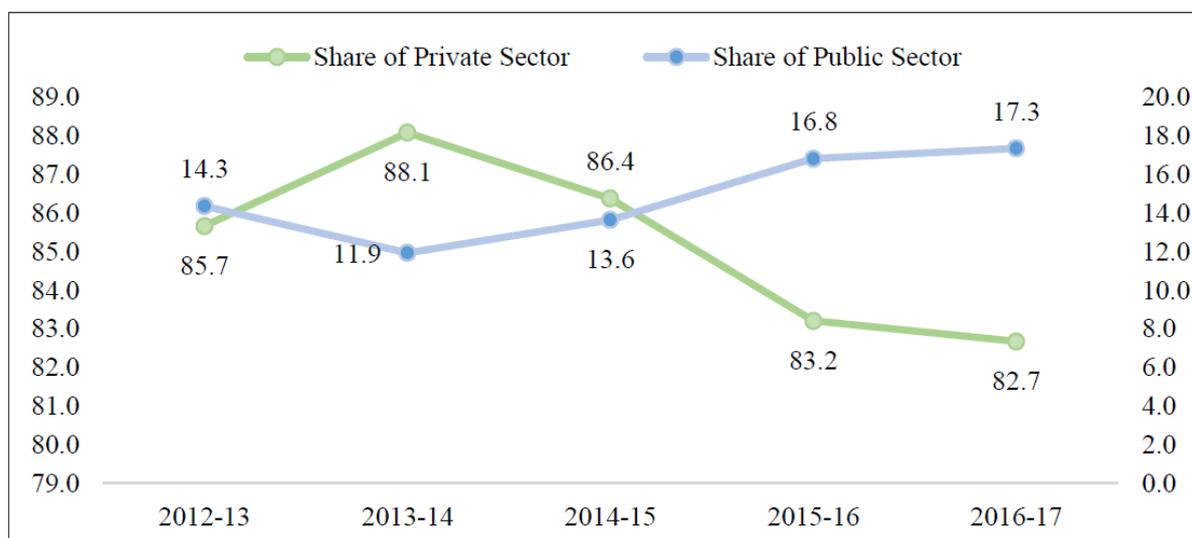
<sup>9</sup> 2<sup>nd</sup> revised estimate

<sup>10</sup> 1<sup>st</sup> revised estimate

<sup>11</sup> Provisional Estimates of Annual National Income 2018-19

The comparison of the share of public and private expenditure in the Total Gross Capital Formation in agriculture brings out the trend of the components during the period of FY2013-14 to FY2016-17. While private expenditures have declined in share gradually from 88% in FY2013-14 to 82.7% in FY2016-17, the share of public expenditure increased from 11.9% FY2013-14 to 17.3% in FY2016-17. The graph below depicts the discussion made above.

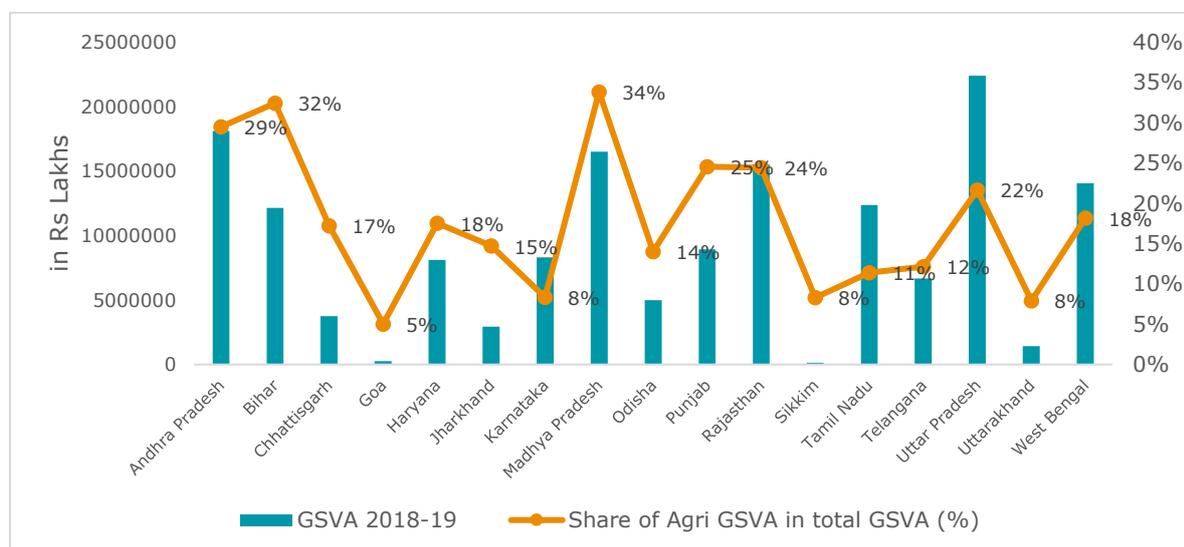
Figure 6: Share of Public and Private Sector in Total GCF in Agriculture



Source: Economic Survey 2018-19, Chapter Agriculture and Food Management

The sectoral GSVA across states and its share in the total GSVA has been depicted in the graph below.

Figure 7: State wise Agri GSVA at constant prices and its share in total GSVA, 2018-19



Source: MOSPI Statistics

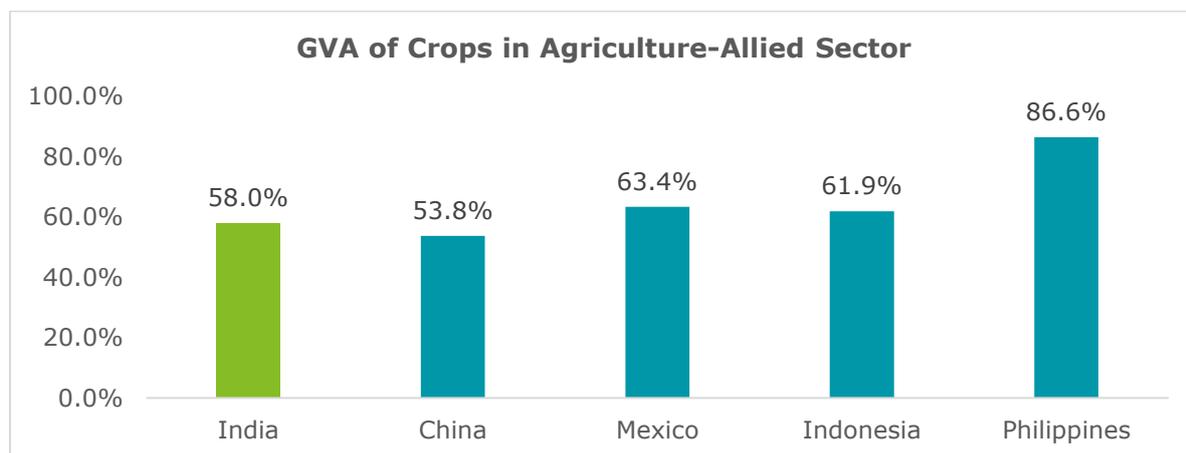
At the state level<sup>12</sup>, the Agri & Allied GSVA of Uttar Pradesh is the highest in the country followed by Andhra Pradesh. The share of Agri-GSVA as a percentage of total GSVA depicts the dependency of the state's economy on agriculture and allied activities. Moreover, the states of Andhra Pradesh

<sup>12</sup> The GSVA data for some of the states is not available for 2018-19.

(11%), Telangana (10%), and West Bengal (12%) had registered double-digit growth in overall GSVA (in constant prices) during 2018-19.

The contribution of the crop sector to the economy as represented through the Gross Value Added from Crop sector to that of Agriculture and Allied sector has been compared across different geographies to benchmark India's status. The graph below compares the GVA of Crops as a share of GVA in Agri-Allied Sector.

Figure 8: Comparison of Crops GVA as a share in Total Agri GVA of India and Other Countries



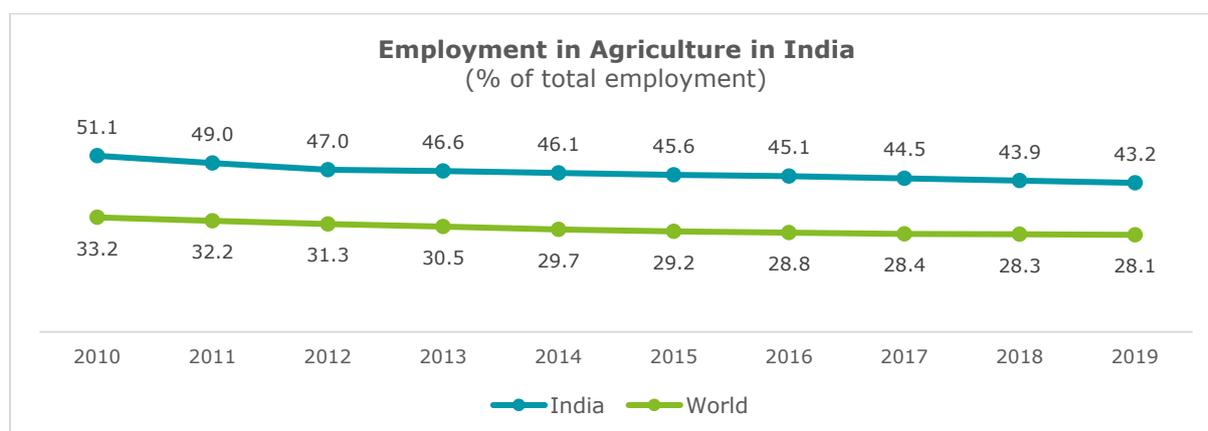
Source: EMIS Insights Industry Reports- China, Philippines, Indonesia, and Mexico; Economic Survey 2018-19 India

### Contribution to Employment

As the Indian economy has diversified and grown, agriculture's contribution to GDP has steadily declined from 1951 to 2018, yet it is still the country's largest employment source and a significant piece of its overall socio-economic development.

Total share of employment in Agriculture in India has shown a gradual decline from 51.1% in 2010 to 43.2% in 2019 as per latest data estimates from World Bank.

Figure 9: Employment in Agriculture in India



Source: World Bank Group, <https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS>

This has been in-line with the declining trend across the world level aggregate data (decline from 33.21 per cent in 2010 to 28.1 per cent in 2019). The declining trend has been largely because of

the rapid economic growth in services, increase in industrial output and more focus on non-agricultural sectors.

## Key Drivers for Growth in the Sector

The performance of agriculture, especially growth in the sector, is dependent on a host of factors. The key drivers for growth in the agricultural sector in India can be clustered into the following categories –

- Growing population and growth in income:** Growth in agriculture sector is chiefly driven by domestic demand. Population growth in India and the rising disposable incomes aligned with increasing awareness of healthy eating is expected to keep the demand for sustainably-sourced agricultural products high. According to the analysis drawn in the report Demand & Supply Projections Towards 2033: Crops, Livestock, Fisheries and Agricultural by NITI Aayog Working Group<sup>13</sup>, demand for agricultural produce is expected to increase with the population and the estimates for FY 2029-30 have been provided as below.

Table 2: Estimated demand for agricultural produce

<i>Agricultural Commodities</i>	<b>Current Production (2018-20) (mill. Tons)</b>	<b>2029-30 Estimate (mill. Tons)</b>	<b>%Growth in Demand between 2020 to 2030</b>
<i>Cereals</i>	249.31	301.78	21.05%
<i>Pulses</i>	26.05	35.23	35.24%
<i>Edible Oils</i>	16.5	27.88	68.97%
<i>Vegetables</i>	214.82	360.77	67.94%
<i>Fruits</i>	121.38	203.55	67.70%
<i>Sugar</i>	39.66	46.37	16.92%

Source: Projections on Demand of Food Commodities by NITI Aayog Working Group Report 2018, Demand & Supply Projections Towards 2033: Crops, Livestock, Fisheries and Agricultural Inputs Retrieved from <https://niti.gov.in/documents/working-papers>

However apart from increase in population, the demand is also driven by socio-economic factors that is expected to result in shift in consumption patterns. As per the analysis provided above, the estimated demand for fruits, vegetables and oilseeds would be the highest. This would imply a shift in usage of land towards high value crops.

- Increase in access to farm inputs:** Agricultural productivity depends on availability of farm inputs such as high quality seeds, fertilizers, and amenities of farm mechanization. Substantial agricultural surplus can be produced through modernization of farming practices which would employ improved farm inputs including high level of farm mechanization. Currently farm mechanization in India is as low as 40%-45% with an available farm power of 2.02 kW/Ha (2016-17)<sup>14</sup>; the current national level of farm mechanization is much lower in comparison to BRIC countries like China and Brazil<sup>15</sup>. With use of modern farm equipment,

<sup>13</sup> NITI Aayog. 2018. Demand & Supply Projections Towards 2033: Crops, Livestock, Fisheries and Agricultural Inputs. Retrieved from <https://niti.gov.in/documents/working-papers>

<sup>14</sup> NABARD. 2018. Sector Paper on Farm Mechanization. Retrieved from <https://www.nabard.org/auth/writereaddata/file/NSP%20Farm%20Mechanisation.pdf>

<sup>15</sup> FICCI & Grant Thornton, 2015, Transforming Agriculture Through Mechanisation, A knowledge paper on Farm mechanization. Retrieved from <http://ficci.in/spdocument/20682/agrimach.pdf>

the farm productivity is estimated to increase by up to 30% and reduce the input cost by 20%<sup>16</sup>.

- **Access to credit:** Access to farm credit is an important factor leading to a stable farm produce. Farm loans for investment purposes are available for irrigation, agricultural mechanization, land development, plantation, horticulture and post-harvest management. The central Indian government supports Indian farmers through credit facilities and MSP mechanisms available for various crops. In FY2018, bank credits to agriculture and allied industries represented about 40% of the country's total "priority sector" credit. Currently schemes like Interest Subvention scheme for institutional credit and PMFBY (Pradhan Mantri Fasal Bima Yojana) for crop insurance is being implemented to support small and marginal farmers financially and ensure consistent production each year.
- **Post production infrastructure and logistic facilities:** Presence and easy access to market the agricultural produce is a critical driver of growth for agriculture. Product-wise organized primary market channels enable farmers to monetize their farm output. The infrastructure required to market the farm produce is availed through the following market avenues:
  - Near farm mandis – (for primary assembly and wholesale transaction)
  - Near farm farmers market – retail transactions
  - Wholesale markets –local, national, APMC (food grains) including eNAM
  - Central and State government procurement (food grains)
  - Private procurement

Post-production infrastructure in agriculture includes setting up of improved warehouses, regulated market yards and cold storages. As of 2017, the total warehouse capacity in India is assessed to be 77.63 million tonnes and an estimated 34 million tonnes of storage capacity in cold storages has been created.

- **Skilled Human Resource:** In India around 85% of farmers are small and marginal with fragmented land holdings and practicing primitive subsistence farming. While the productivity of farm depends on the use of inputs like fertilizer, access to irrigation, technology, crop intensity and choice of crops (crop pattern) grown at the farm, the farmer's access to the knowledge is critical to ensure a consistent production every year. In an endeavor to improve the agricultural production and the farmer's knowhow, agricultural extension is provided to provide research based knowledge for capacity building of farmers and improve their income. Agricultural Technology Management Agency offers extension services to farmers by disbursing information, knowledge and skills through awareness generation, demonstration and thus empowering the farmers and ensuring a self-reliant farming system in the country.

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<sup>16</sup> NABARD. 2018. Sector Paper on Farm Mechanization. Retrieved from <https://www.nabard.org/auth/writereaddata/file/NSP%20Farm%20Mechanisation.pdf>

## 1.2 Performance of the Sector

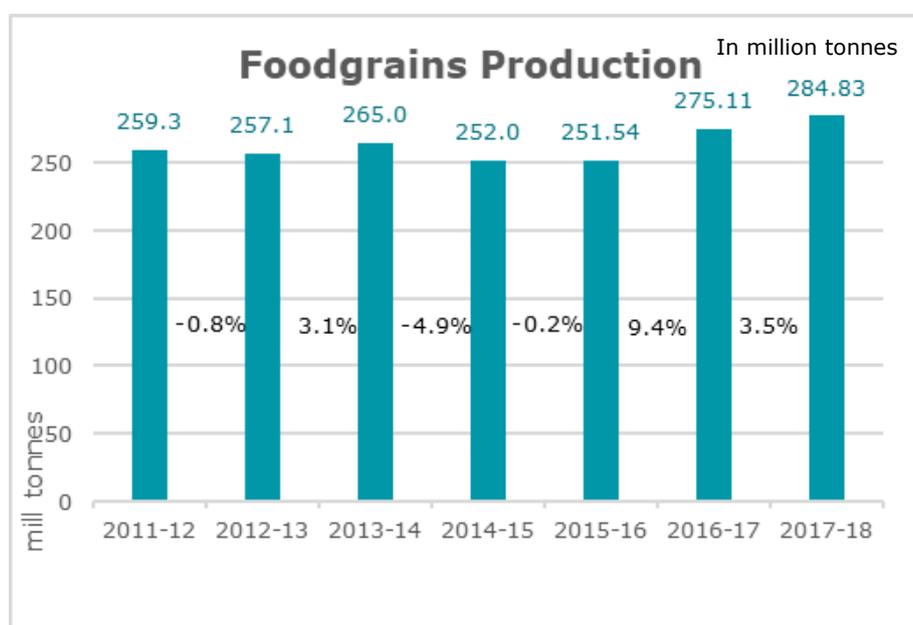
### Production of important agriculture products<sup>17</sup>

The agriculture sector consists of food grains, oilseeds, horticulture crops among other crops like plantation crops etc. The trend of production of food grains, oilseeds and horticulture crops from 2011-12 to 2017-18, along with their growth rate over the years has been presented in the graphs below.

#### (1) **Food grains**

India is the second largest producer of food grains globally and third largest producer of cereals in the world. The basket of cereals includes rice, wheat, maize, and a wide variety of millets or nutri-cereals. However, speciality rice like basmati have made a mark in the global market. The food grains production has increased at a CAGR of 1.35% between 2011 and 2018, with the growth rate being volatile over the past years.

Figure 10: Food grain production

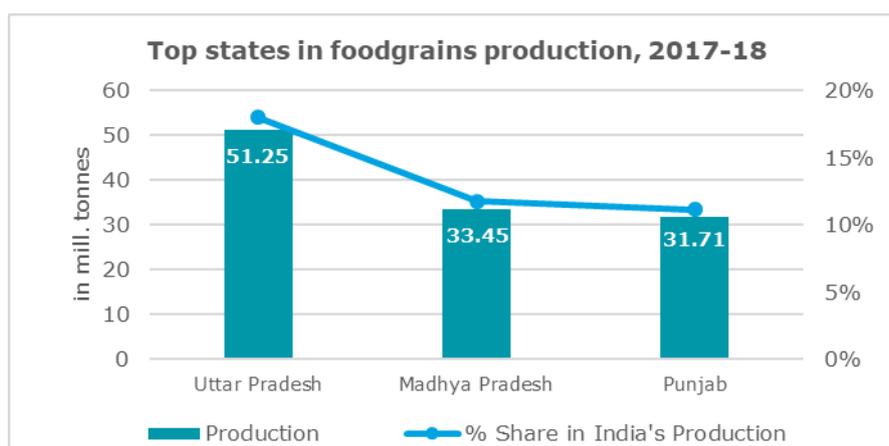


Source: Agricultural Statistics at a Glance, 2018

Food grains production in India has jumped from 259.3 million tonnes in 2011-12 to 284.8 million tonnes in 2017-18. Within India, the states of Uttar Pradesh, Madhya Pradesh and Punjab were the top food grains producer states in 2017-18. These three states accounted for over 40% of total food grains production in India. Among the top producer states, Uttar Pradesh accounted for 18% of total production in 2017-18, followed by Madhya Pradesh accounting for about 12% of the total production.

<sup>17</sup> Department of Agriculture Cooperation and Farmer's Welfare, Agriculture at a Glance 2018

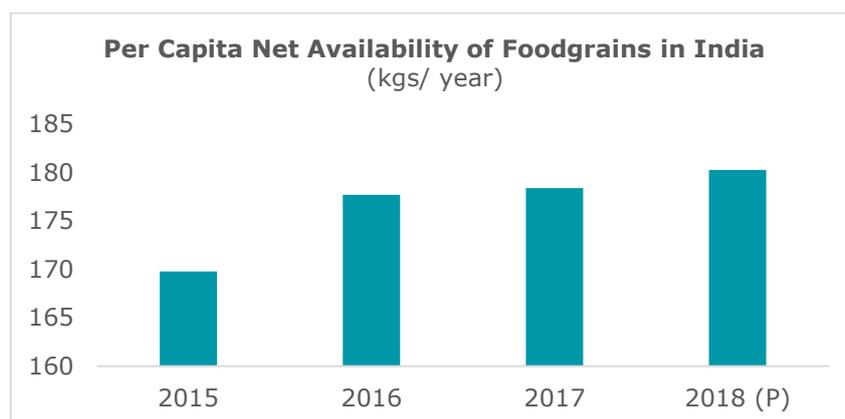
Figure 11: Top states in food grains production, 2017-18



Source: Agricultural Statistics at a Glance, 2018;

In 2015, the per capita availability of foodgrains was 169.8 kgs per annum and it has steadily increased to 180.3 kgs per annum in 2018 at a CAGR of 2.02 per cent. This is a good sign taking into account the growing population of India in the past years.

Figure 12: Per-capita availability of foodgrains in India (kg/year)



Source: Directorate of Economics and Statistics, DAC&FW

### a) Cereals

The total production of cereals in India during 2017-18 was 259.6 million tonnes. The top cereal producing states include Uttar Pradesh (18%), Punjab (11%), Madhya Pradesh (11%) and Rajasthan (6.9%) accounting for almost 48% of the total cereals production in the country.

## Production and Productivity of Major Cereals

**Rice:** Rice accounts for 39.4% of the total food grains production in India as of 2017-18. Total production of Rice during 2017-18 is estimated at record 112.91 million tonnes. Production of rice has increased by 3.21 million tonnes from the production of 109.70 million tonnes during 2016-17. It is also higher by 6.61 million tonnes than the five years' average production of 106.29 million tonnes. Major rice producing states are – West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, and Bihar comprising of 50% of the total rice production in the country.

The productivity of some of the top rice producing states in the country as compared with the overall average

productivity of India, has been depicted in the chart alongside. The largest producer of rice is West Bengal and has an average productivity of 2.93 MT/Ha which is 6<sup>th</sup> highest in the country. Punjab is the second highest producer with the highest productivity of 4.36 MT/ha followed by Uttar Pradesh which has a productivity of 2.28 MT/Ha, ranking 8<sup>th</sup> in the country.

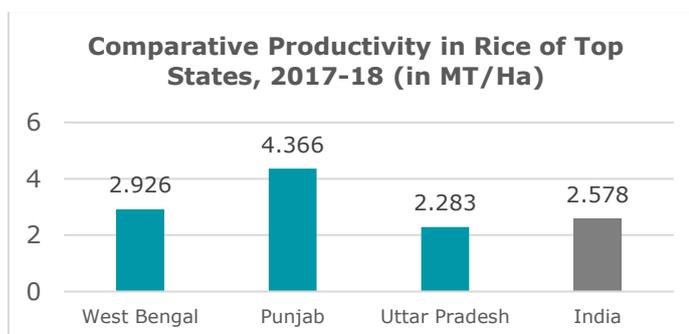
**Wheat:** Wheat production stood at record 99.70 million tonne in the 2017-18 having a share of 35% of the food grains in the country. Major wheat producing states are – Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, and Rajasthan, comprising of 85% of the total wheat production in India.

The productivity of the top 3 wheat producing states in the country as compared with the overall average productivity of India, has been depicted in the chart alongside. Uttar Pradesh is the top producer of wheat in the country having a productivity of 3.26 MT/Ha which ranks 4<sup>th</sup> in productivity in the country and lesser than the national average productivity (3.371 MT/ha). It is followed by Punjab which has the highest productivity of 5.09 MT/ha.

Madhya Pradesh is the 3<sup>rd</sup> largest producer of wheat and with 2.993 MT/Ha productivity, ranking 5<sup>th</sup> in the country.

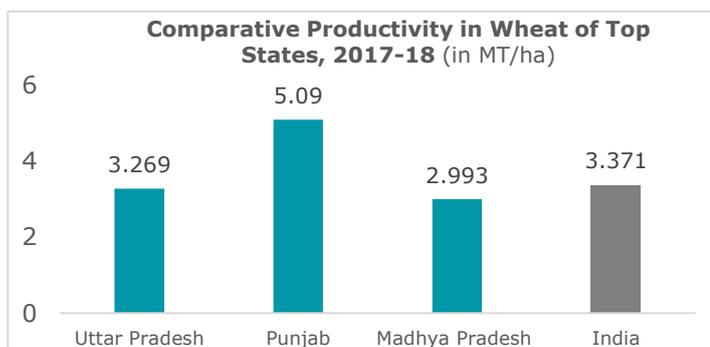
The production and productivity of major cereals producing countries across the world is presented below.

Figure 13: Comparative Productivity of Rice, 2017-18



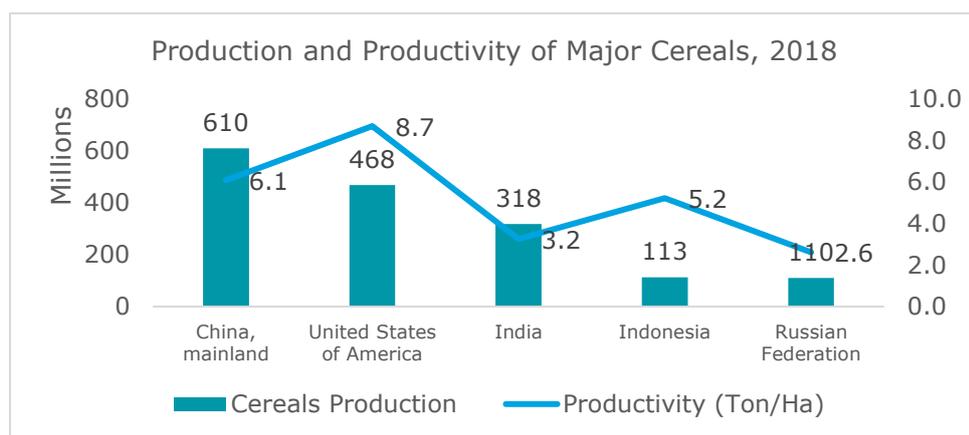
Source: Agricultural Statistics at a Glance 2018

Figure 14: Productivity Comparison of Wheat 2017-18



Source: Agricultural Statistics at a Glance 2018

Figure 15: Global Comparison of Production and Productivity of Cereals, 2018



Source: UN FAO

China is the highest producer of cereals followed by United States of America as the second highest producer of cereals. India is in the 3rd position, producing nearly 50% of the total production of China.

In terms of productivity, United States of America has the second highest productivity with 8.7 tonnes/ha yield rate. China, the top cereal producer has 6.1 tonnes/ha productivity, ranking 23rd globally. India lags in terms of yield rate and has one of the lowest productivity among the top 5 cereal producers, ranking 88th globally.

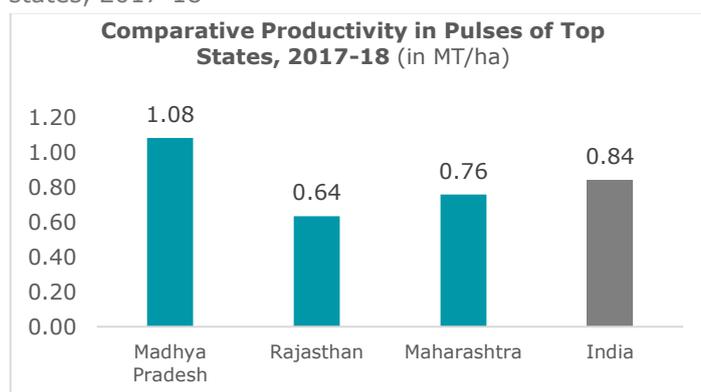
## b) Pulses

India is the world's largest producer of pulses. Total Pulses production during 2017-18 is estimated at 25.23 million tonnes which is higher by 2.10 million tonnes from the previous year's production of 23.13 million tonnes. Moreover, the production of pulses during 2017-18 is higher by 6.39 million tonnes than the 5 years' average production of 18.84 million tonnes. Pulses have a share of 9% of the food grains production in the country.

The top states in pulses production are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh comprising of 66% of the total pulses production in the country.

Madhya Pradesh is the top producer of pulses in the country having the highest productivity of 1.08 MT/Ha. Rajasthan is the second highest producer with 0.635 MT/ha productivity, ranking 10<sup>th</sup> in the country and much lesser than national average productivity of 0.841 MT/ha. Maharashtra is the 3<sup>rd</sup> highest producer with productivity of 0.759 MT/ha and ranking 8<sup>th</sup> in the country.

Figure 16: Productivity Comparison of Pulses in top states, 2017-18

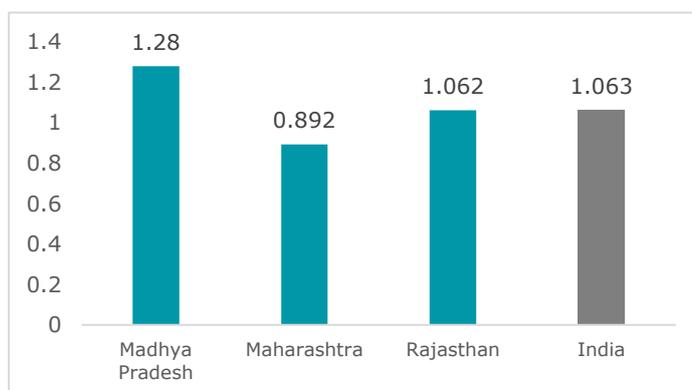


Source: Agricultural Statistics at a Glance 2018

## Production and Productivity of Major Pulses

**Gram:** Gram is the top pulse variety in India having a production of 11.23 million tonnes as of 2017-18, with a share of 44.5% of total pulses production in the country. The productivity of the top gram producing states as compared with the overall average productivity of India, has been depicted in the chart. The largest producer of gram – Madhya Pradesh has an average productivity of 1.28 MT/Ha which ranks 1<sup>st</sup> in the country in terms of productivity. The second highest gram producer is Maharashtra which has 0.892 Mt/Ha productivity (ranking 8<sup>th</sup> in the country in productivity). Rajasthan is the 3<sup>rd</sup> largest gram producer with 1.062 MT/Ha productivity.

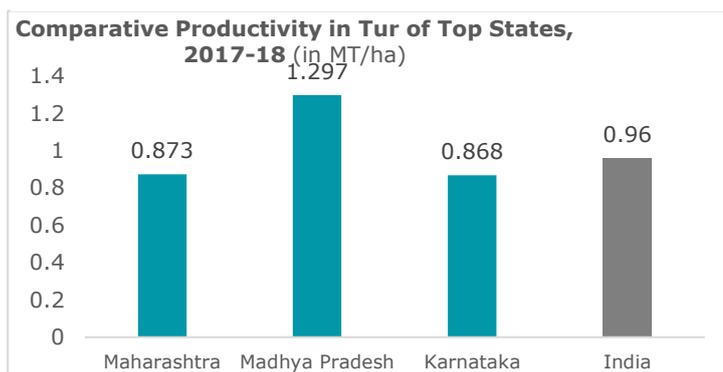
Figure 17: Productivity Comparison of Gram in top states, 2017-18



Source: Agricultural Statistics at a Glance, 2018

**Tur:** Tur or arhar has a total production of 4.25 million tonnes as of 2017-18, having a share of 16% of the total pulses production in the country. The productivity of the highest tur producing states as compared with the overall average productivity of India, has been depicted in the chart alongside. Maharashtra is the largest producer of tur having a productivity of 0.873 MT/Ha which is lower than the national average productivity in India (0.96 MT/ha) and ranks 8<sup>th</sup> in productivity in India. Madhya Pradesh is the second highest producer of tur and has the highest productivity of 1.297 Mt/Ha. Karnataka is the 3<sup>rd</sup> highest producer with the productivity being 0.868 MT/Ha (9<sup>th</sup> rank in the yield rate in the country).

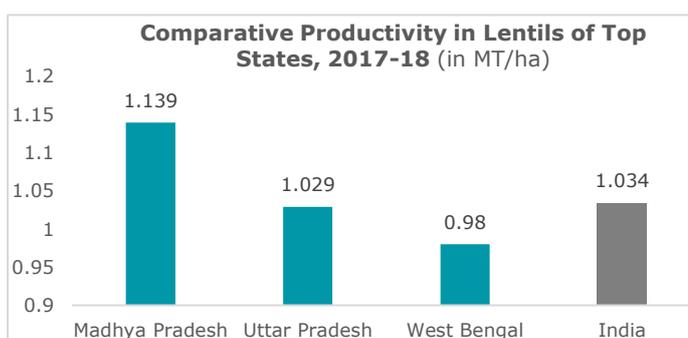
Figure 18: Productivity Comparison of Tur of top state MT/ha, 2017-18



Source: Agricultural Statistics at a Glance 2018

**Lentil:** Lentil or masoor has a production of 1.61 million tonnes as of 2017-18. The productivity of the top lentil producing states as compared with the overall average productivity of India, has been depicted in the chart alongside. Madhya Pradesh is the top producer of lentil in the country having the highest productivity of 1.139 MT/Ha. It is followed by Uttar Pradesh which has 3<sup>rd</sup> highest productivity of 1.029 MT/Ha. West Bengal is the 3<sup>rd</sup> largest producer of

Figure 19: Productivity Comparison of Lentil for top states, 2017-18

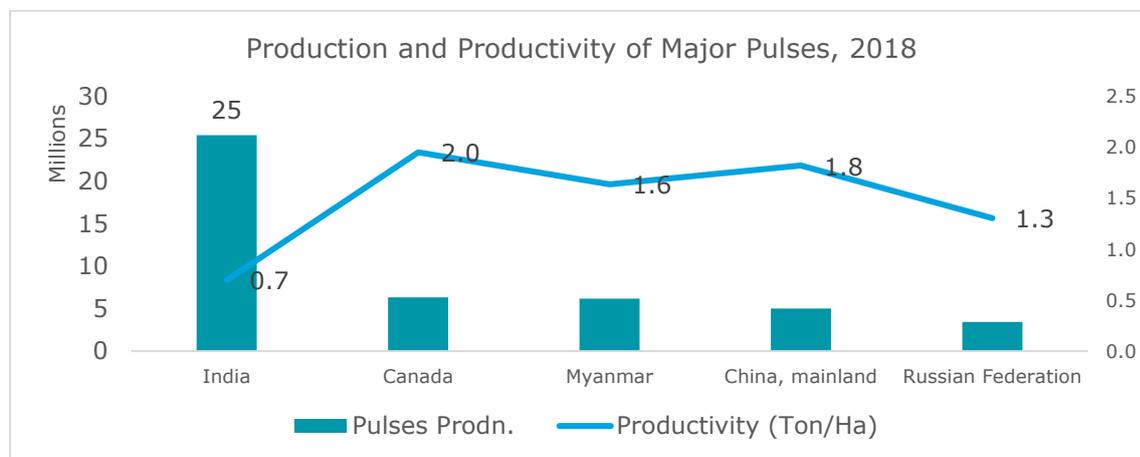


Source: Agricultural Statistics at a Glance 2018

lentil and has a 0.98 MT/Ha yield rate ranking 4<sup>th</sup> in the country.

The production and productivity of major pulses producing countries across the world is presented below.

Figure 20: Global Comparison of Production and Productivity of Pulses, 2018



Source: UN FAO

In pulses production, India is the highest producer followed by Canada and Myanmar. However in productivity, Canada, the second highest producer of pulses has a yield rate of 2.0 tonnes/ha followed by China having a yield rate of 1.8 tonnes/ha. India has a much lower productivity compared to the top 5 producer of pulses across the world, and ranks 147<sup>th</sup> in yield rate globally.

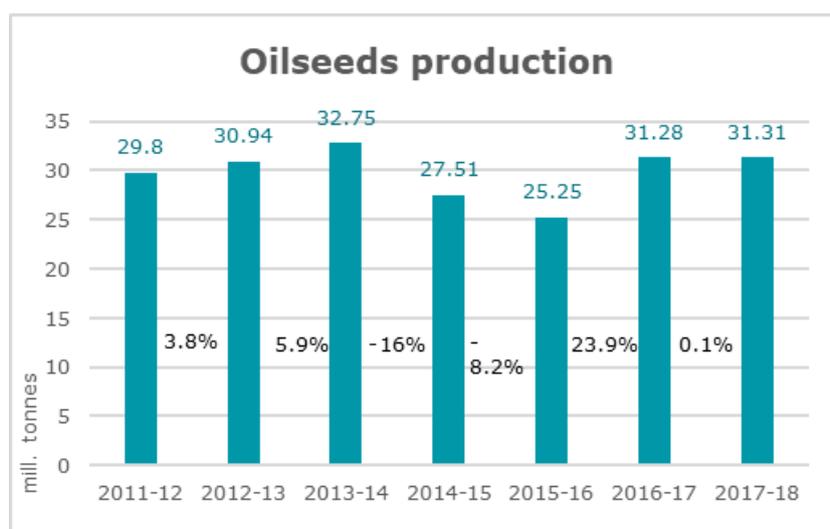
## (2) Oilseeds

India is one of the major oilseeds grower and importer of edible oils. India's vegetable oil economy is the world's fourth largest after USA, China & Brazil.

The basket of oilseeds in India comprises of 9 oilseeds which include 7 edible oilseeds (groundnut, rapeseed & mustard, soybean, sunflower, sesame, safflower and niger) and two non-edible oilseeds (castor and linseed). Oilseeds cultivation is undertaken across the country in about 27 million hectares mainly on marginal lands, of which 72% is confined to rainfed farming. India is yet to reach self-sufficiency in the production of oilseeds with per capita availability of vegetable oil at the rate of 19.5 kg/year/person<sup>18</sup> and has to depend on import of palm oil from Indonesia and Malaysia. Under the scheme, National Mission on Oilseeds and Oil Palm, strategies have been taken to increase production and productivity of oilseeds, palm oil, and other treeborne oilseeds like sal, mahua, simarouba, kokum, olive, karanja, jatropha, neem, jojoba, cheura, wild apricot, walnut, tung etc. The production of oilseeds has been fluctuating over the given period and grown at a CAGR of 0.71% between 2011 and 2018 as presented in the graph below.

<sup>18</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2018-19 (Statistical-Appendix). Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

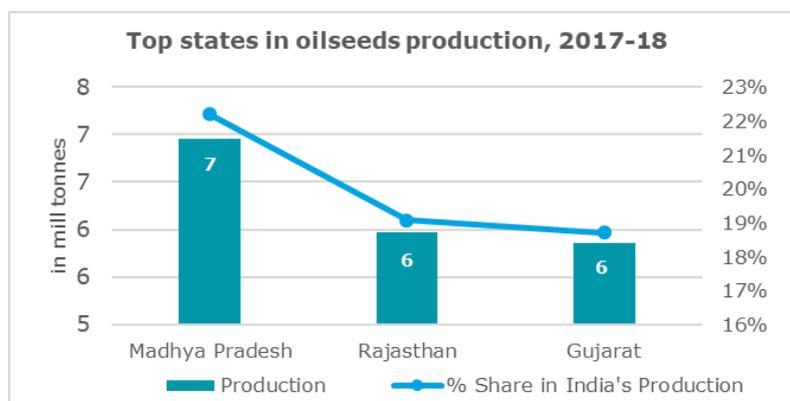
Figure 21: Oilseeds production, 2011-12 to 2017-18



Source: Agricultural Statistics at a Glance, 2018

Oilseeds production in India has increased from 29.8 million tonnes in 2011-12 to 31.31 million tonnes in 2017-18. Within India, the states of Madhya Pradesh, Rajasthan and Gujarat were the top oilseeds producer states in 2017-18. These three states accounted for about 60% of total oilseeds production in India. Among the top producer states, Madhya Pradesh accounted for 22% of total production in 2017-18, followed by Rajasthan and Gujarat, each of them accounting for about 19% of the total production.

Figure 22: Top states in oilseeds production



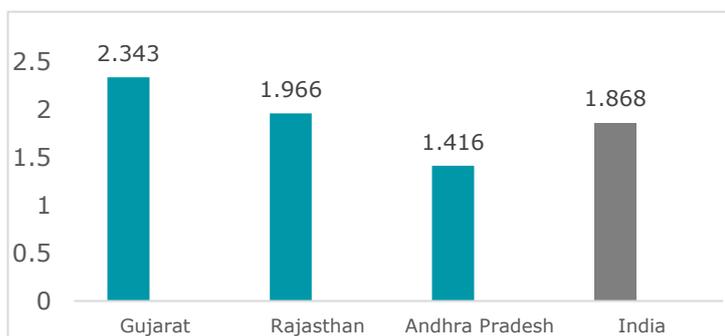
Source: Agricultural Statistics at a Glance, 2018

### Production and Productivity of Major Oilseeds

The three major oilseeds that comprise of 90% of the production of oilseeds in India are groundnut, rapeseed and mustard, and soybean.

**Groundnut:** Groundnut oilseed has a production of 9.18 million tonnes as of 2017-18 having a share of 29% of the total oilseeds production in India. The productivity of the top groundnut producing states as compared with the overall average productivity of India, has been depicted in the chart below. Gujarat is the top producer of groundnut in the country having the second highest productivity of 2.34 MT/Ha.

Figure 23: Productivity Comparison of Groundnut in top states, 2017-18 (MT/ha)

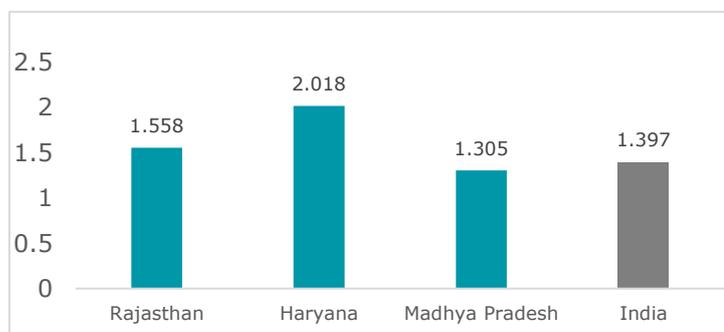


Source: Agricultural Statistics at a Glance 2018

It is followed by Rajasthan having productivity of 1.966MT/Ha ranking 5<sup>th</sup> in the country in yield rate. Andhra Pradesh is the 3<sup>rd</sup> highest producer with productivity of 1.416MT/ha which is much below the national average productivity of 1.868MT/Ha.

**Mustard and Rapeseed:** The production of mustard and rapeseed in India is 8.32 million tonnes with a share of 26.5% of the total oilseeds production as of 2017-18. The productivity of the top mustard and rapeseed producing states as compared with the overall average productivity of India, has been depicted in the chart below. Rajasthan is the top producer of mustard and rapeseed in the

Figure 24: Productivity Comparison of Mustard and Rapeseed in top states, 2017-18 (MT/ha)

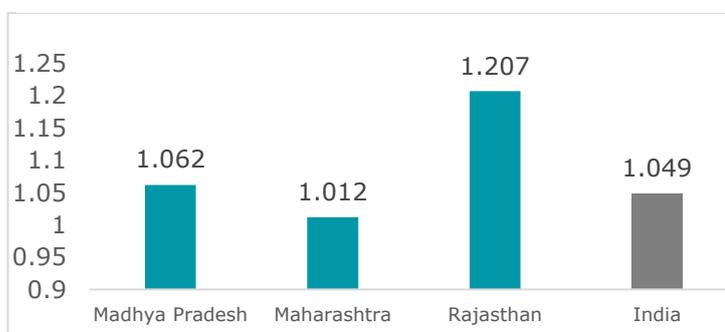


Source: Agricultural Statistics at a Glance 2017-18

country having the third highest productivity of 1.558 MT/ha. Haryana is the second highest producer with highest productivity of 2.018 MT/ha followed by Madhya Pradesh having productivity of 1.305 MT/ha, ranking 6<sup>th</sup> in the country.

**Soybean:** The production of soybean is 10.98 million tonnes as of 2017-18 and has a share of 35% of the total oilseeds produced in the country. Madhya Pradesh is the highest producer of soybean with a productivity of 1.062 MT/ha which is similar to the national average productivity of 1.049 MT/ha (ranking 3<sup>rd</sup> highest in the country). Maharashtra is the second highest producer with productivity of 1.012 MT/ha ranking 4<sup>th</sup> in the country. Rajasthan is the 3<sup>rd</sup> highest producer with the second highest productivity of 1.207 MT/ha.

Figure 25: Comparative Productivity in Soybean of Top States, 2017-18 (in MT/ha)



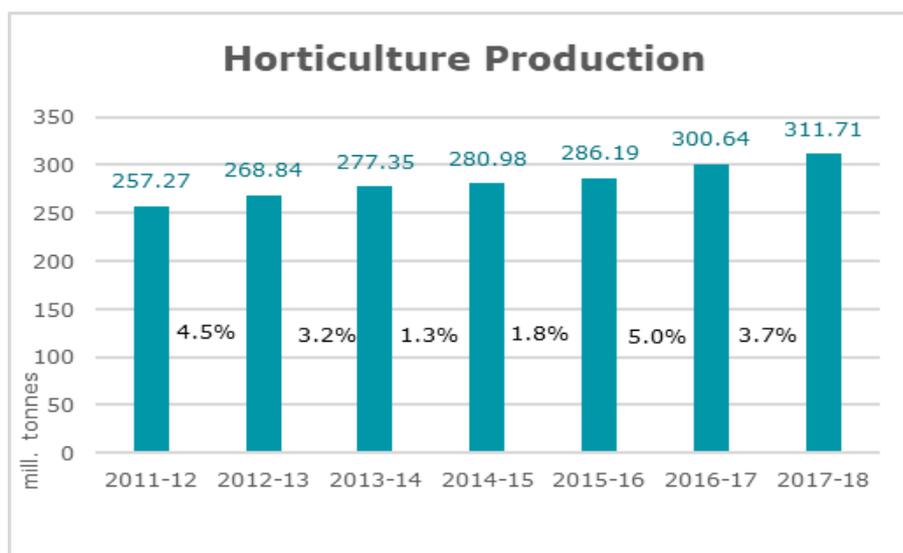
Source: Agricultural Statistics at a Glance 2017-18

### (3) Horticulture Crops

Horticulture comprises a wide array of cultivation systems and is classified in 6 broad categories namely, pomology (fruits), olericulture (vegetables), floriculture (flowers), plantation crops, spices, aromatics and herbal medicines. Horticulture is considered as the sunrise sector in agriculture given its higher monetisable potential relative to field crops like cereals, pulses and oilseeds. Horticulture contributes more than a third of the agricultural GDP, though it occupies less than a fifth of the cultivated area and is expected to increase further fuelled by high demand for fresh fruits and vegetables.

Significant progress has been made in area expansion under horticulture resulting in higher production. Over the last decade, the area under horticulture grew by about 2.6% per annum and annual production increased by 4.8%<sup>19</sup>. The production of vegetables has increased from 101.2 million tonnes to 184.40 million tonnes since 2004-05 to 2017-18 and 50.9 million tonnes to 97.35 million tonnes since 2004-05 to 2017-18. The growth in horticulture production has been comparatively consistent over the last few years compared to growth in production of food grains and oilseeds. Horticulture production has grown at a CAGR of 2.78% between 2011 and 2018.

Figure 26: Horticulture production in India

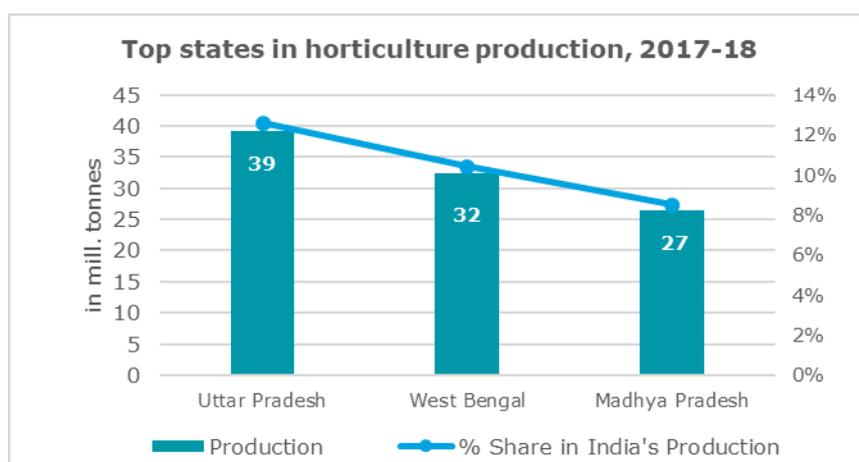


Source: Agricultural Statistics at a Glance, 2018

Horticulture crops production in India has increased from 257.27 million tonnes in 2011-12 to 311.71 million tonnes in 2017-18. Within India, the states of Uttar Pradesh, West Bengal and Madhya Pradesh were the top horticulture crops producer states in 2017-18. These three states accounted for more than 30% of total horticulture crops production in India. Among the top producer states, Uttar Pradesh accounted for 13% of total production in 2017-18, followed by West Bengal accounting for about 10% of the total production.

<sup>19</sup> Department of Agriculture, Cooperation and Farmers Welfare. 2019. Horticulture at a Glance 2018. Retrieved from <http://agricoop.gov.in/statistics/publication-reports>

Figure 27: Top states in horticulture production, 2017-18



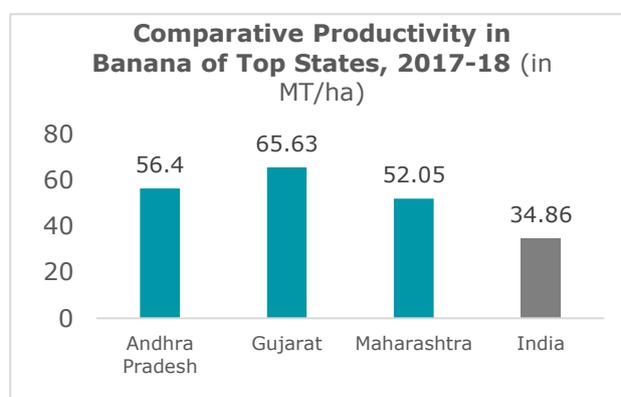
Source: Agricultural Statistics at a Glance 2018

Among all components under horticulture crops, fruits and vegetables comprise of 90% of the total horticulture production in the country. The productivity of top fruits and vegetables among the top states have been discussed below. Among all fruits, mango, banana and citrus fruits are the top crops having a share of 67% of the total fruits production in India. Among all vegetables, potato, onion and tomato are the top crops and comprises of a share of 51% of total vegetable production in the country.

### Production and Productivity of Major Fruits

**Banana:** Banana is the top fruit crop in India having a production of 30.80 million tonnes as of 2017-18, with a share of 31.6% of total fruits production in the country. The productivity of the top banana producing states as compared with the overall average productivity of India, has been depicted in the chart alongside. The largest producer of banana – Andhra Pradesh has an average productivity of 56.4 MT/Ha which ranks 4<sup>th</sup> in the country in terms of productivity. The second highest banana producer is Gujarat which has 65.63 Mt/Ha productivity (ranking 2<sup>nd</sup> in the country in productivity). Maharashtra is the 3<sup>rd</sup> largest banana producer with 52.05 MT/Ha productivity, thus all three having yield rate higher than national average of 34.86MT/ha.

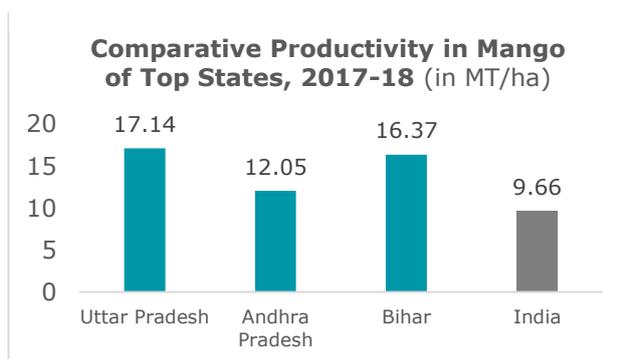
Figure 28: Productivity Comparison of Banana, 2017-18



Source: Agricultural Statistics at a Glance 2018

**Mango:** Mango has a total production of 21.82 million tonnes in India with a share of 22% of the total fruits production in the country. The productivity of the top mango producing states as compared with the overall average productivity of India, has been depicted in the chart. The largest producer of mango – Uttar Pradesh has an average productivity of 17.14 MT/Ha which is second highest in the country in terms of productivity. It is followed by Andhra Pradesh with productivity of 12.05 MT/ha with 6<sup>th</sup> rank and still higher than national average productivity of 9.66 MT/ha. Bihar is the 3<sup>rd</sup> largest producer of mango with third highest productivity of 16.37 MT/ha.

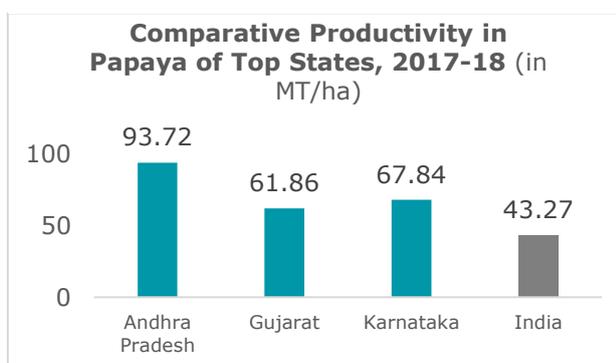
Figure 29: Productivity Comparison of Mango, 2017-18



Source: Agricultural Statistics at a Glance 2018

**Papaya:** Papaya has a total production of 5.98 million tonnes in India and has a share of 6% in the total fruits production in India. The productivity of the top papaya producing states as compared with the overall average productivity of India, has been depicted in the chart alongside. The largest producer of papaya – Andhra Pradesh has an average productivity of 93.72 MT/Ha which is the highest in the country. Gujarat is the second highest producer with productivity of 61.86 MT/ha (ranking 5<sup>th</sup> in the country in terms of yield rate), followed by Karnantaka having yield rate of 67.84 MT/Ha and ranking 3<sup>rd</sup> in terms of productivity. All three states have higher yield rate than the national average of 43.27 MT/ha.

Figure 30: Productivity Comparison of Papaya, 2017-18

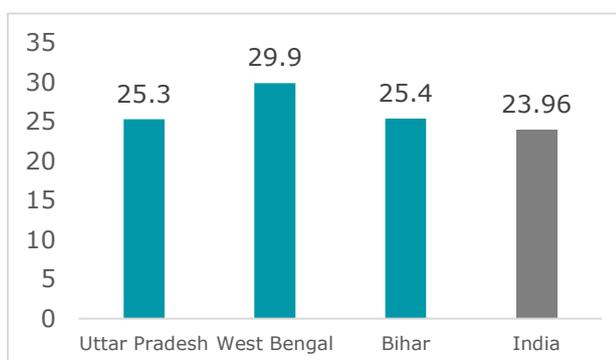


Source: Agricultural Statistics e at a Glance 2018

### Production and Productivity of Major Vegetables

**Potato:** Potato has a total production of 51.31 million tonnes in India and has a share of 27.8% in the total vegetable production in India. The productivity of the top potato producing states as compared with the overall average productivity of India, has been depicted in the chart. The largest producer of potato – Uttar Pradesh has an average productivity of 25.3 MT/Ha which ranks 7<sup>th</sup> in the country. West Bengal is the second highest producer with highest productivity of 29.9 MT/ha, followed by Bihar having yield rate of 25.4 MT/Ha and ranking 6<sup>th</sup> in terms of productivity. All three states have higher yield rate than the national average of 23.96 MT/ha.

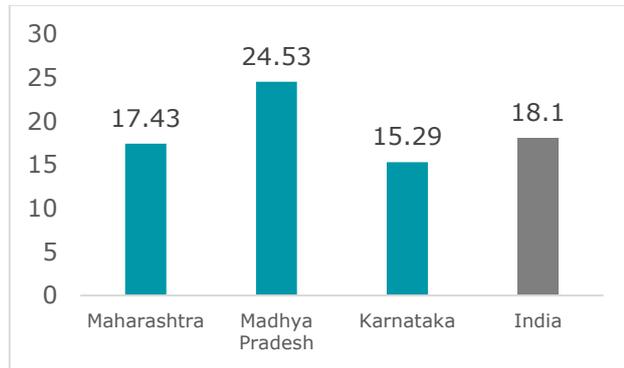
Figure 31: Productivity Comparison of Potato, 2017-18 (MT/ha)



Source: Agricultural Statistics at a Glance 2018

**Onion:** Onion has a total production of 23.3 million tonnes in India with a share of 12% of the total vegetables production in the country. The productivity of the top onion producing states as compared with the overall average productivity of India, has been depicted in the chart. The largest producer of onion – Maharashtra has an average productivity of 17.43 MT/Ha which ranks 12<sup>th</sup> in the country in terms of productivity. It is followed by Madhya Pradesh with 2<sup>nd</sup> highest productivity of 24.53 MT/ha. Karnataka is the 3<sup>rd</sup> largest producer of onion with productivity of 15.29 MT/ha, which is lesser than national average productivity of 18.1 MT/ha.

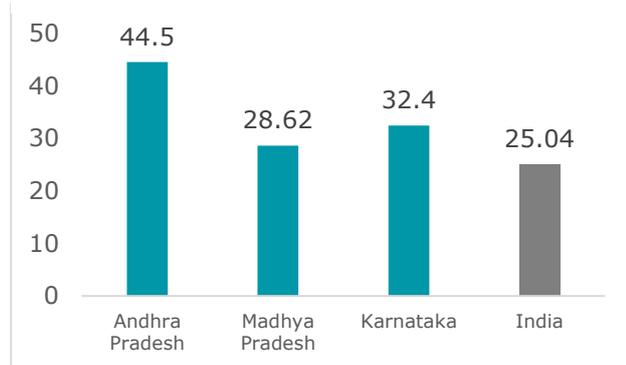
Figure 32: Productivity Comparison of Onion, 2017-18 (MT/ha)



Source: Agricultural Statistics at a Glance 2018

**Tomato:** The total tomato production in India is 19.7 million tonnes as of 2017-18 and has a share of 10.7% in the total vegetable production in the country. The productivity of the top tomato producing states as compared with the overall average productivity of India, has been depicted in the chart. The largest producer of tomato – Andhra Pradesh has the highest productivity of 44.5 MT/Ha followed by Madhya Pradesh with productivity of 28.62 MT/ha (ranking 8<sup>th</sup> in the country). Karnataka is the 3<sup>rd</sup> largest producer with 32.4 MT/ha productivity ranking 4<sup>th</sup> in the country.

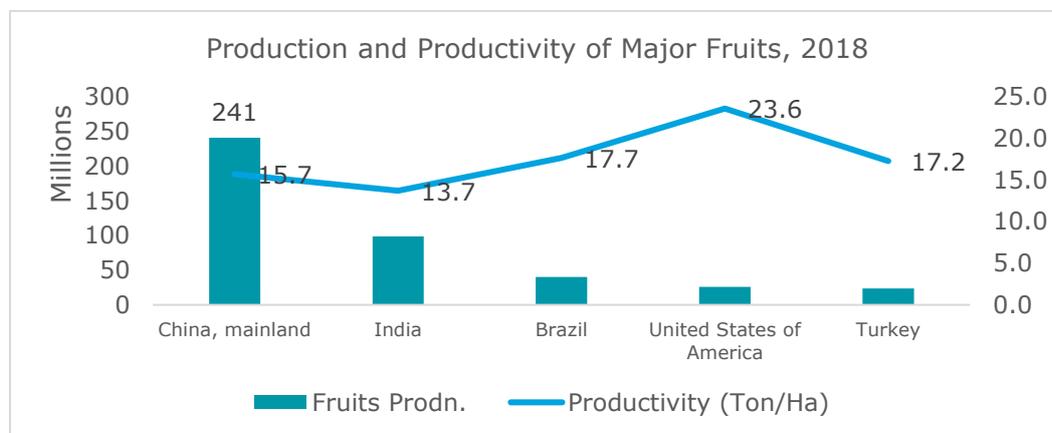
Figure 33: Productivity Comparison of Tomato, 2017-18



Source: Agricultural Statistics at a Glance 2018

The production and productivity of major fruits producing countries across the world is presented below.

Figure 34: Global Comparison of Production and Productivity of Fruits, 2018



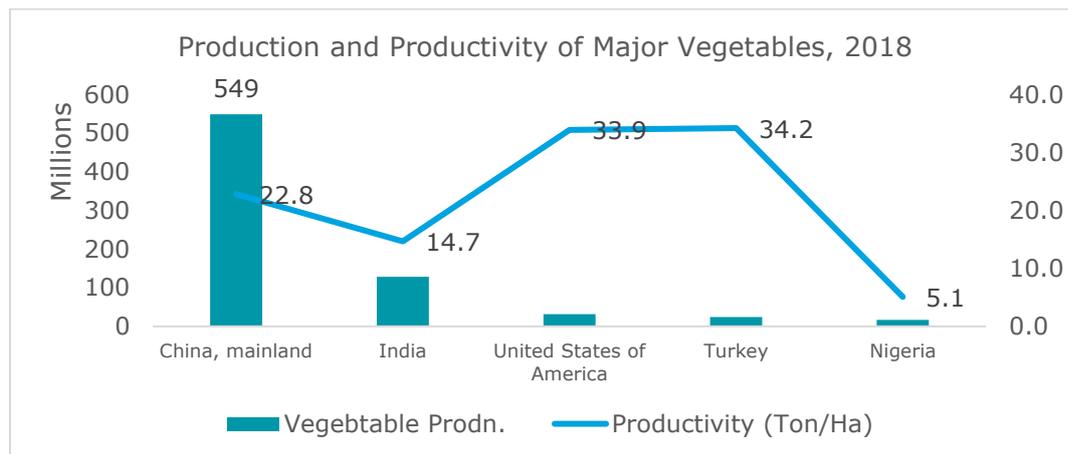
Source: UN FAO

China has the highest production of fruits in the world followed by India in the second position and Brazil in the 3rd position.

As can be seen from the graph above figure, India ranks fairly low on the productivity of fruits (13.7 tonnes/ha) while holding the 2nd rank in fruit production across the world. China, the top producer has a productivity of 15.7 tonnes/ha. Brazil and USA has 17.7 tonnes/ha and 23.60 tonnes/ha.

Likewise, the production and productivity of major vegetables producing countries across the world is presented below.

Figure 35: Production & Productivity of Major Vegetables producing countries 2018



Source: UN FAO

China is the highest producer of vegetables across the globe followed by India in the second position and United States of America in the 3rd position.

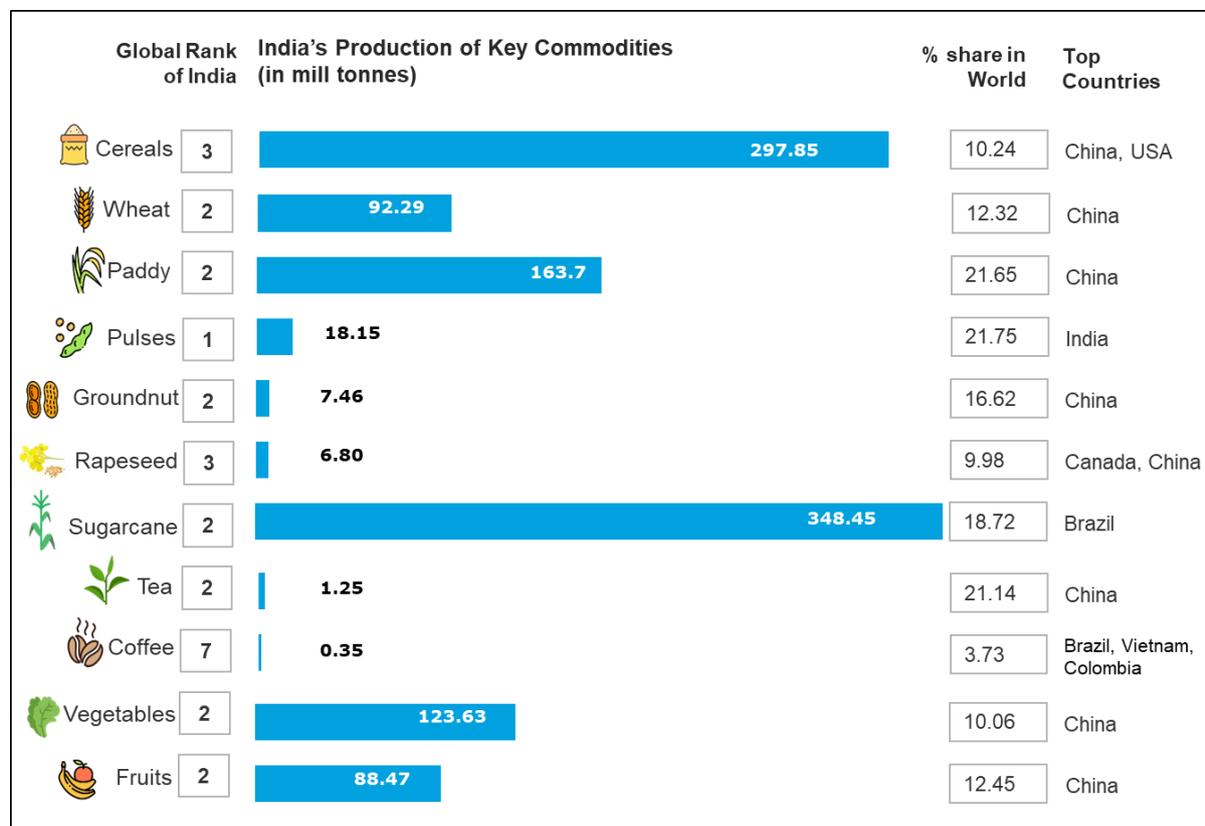
While the production-wise India is the second highest vegetable producer in the world, the productivity level (14.7 tonnes/ha) is second lowest among the top 5 vegetable producing countries. Countries like United States of America, Turkey and China have much higher productivity than India with values of 33.9 tonnes/ha, 34.2 tonnes/ha and 22.8 tonnes/ha respectively.

Evident from the above statistics, China ranks first in both fruits and vegetables production across the world, having higher productivity than India in both segments.

## Contribution of Key Commodities

The global position of India in terms of production of key agricultural commodities have been presented in figure below.

Figure 36: Global Position of Key Agricultural Produce of India, 2016-17<sup>20</sup>



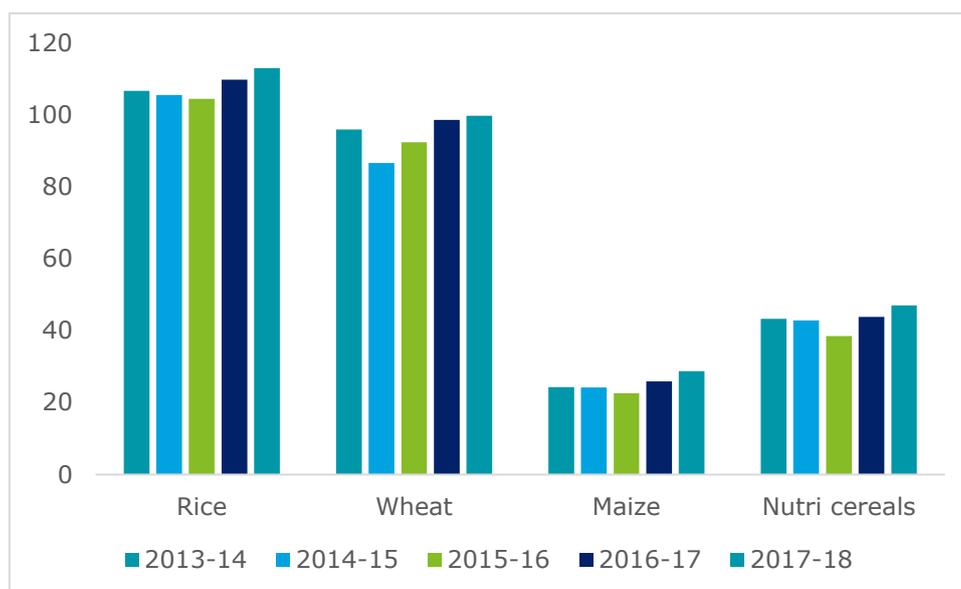
Source: Agriculture at a Glance, 2018

### Cereals

The production of key cereals such as rice, wheat, maize and nutri cereals, highlights an upward trend from 2013-14 to 2017-18. Production of rice has increased from 106.65 million tonnes from 2013-14 to 112.91 million tonnes in 2017-18. Wheat has seen an increase in production from 95.85 million tonnes in 2013-14 to 99.7 million tonnes in 2017-18. For maize, the production increased from 24.26 million tonnes in 2013-14 to 28.72 million tonnes in 2017-18. While for nutri cereals, production moved from 43.29 million tonnes in 2013-14 to 46.99 million tonnes in 2017-18.

<sup>20</sup> As per the latest data available on India's rank in the global context.

Figure 37: Year-wise production of key Cereals (million tonnes)

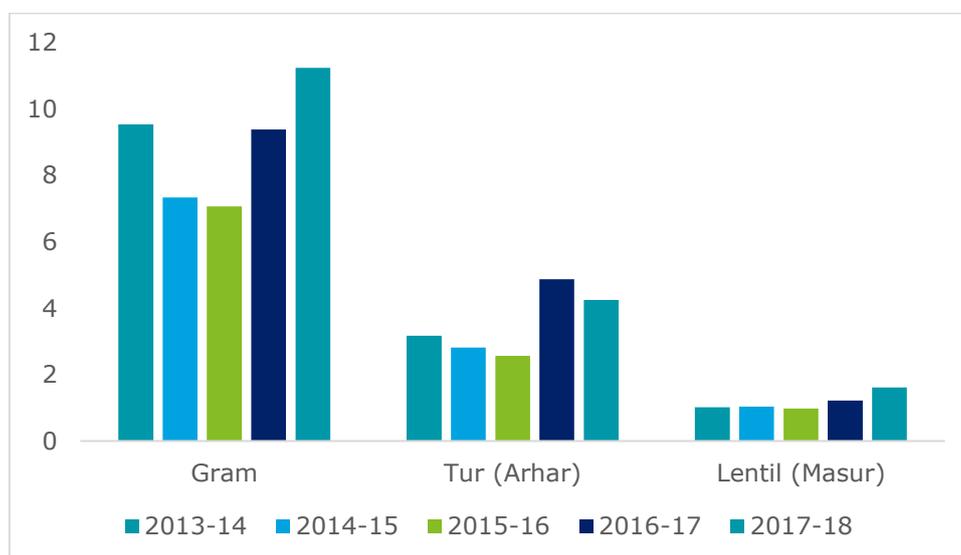


Source: Directorate of Economics & Statistics

### Pulses

The production of key pulses, Gram, Tur (Arhar), and Lentil (Masur) highlights an upward trend from 2013-14 to 2017-18. Production of Gram has increased from 9.53 million tonnes from 2013-14 to 11.23 million tonnes in 2017-18. Tur has seen an increase in production from 3.17 million tonnes in 2013-14 to 4.25 million tonnes in 2017-18. For Lentil, the production increased from 1.02 million tonnes in 2013-14 to 1.61 million tonnes in 2017-18.

Figure 38: Year-wise production of key pulses (Million tonnes)



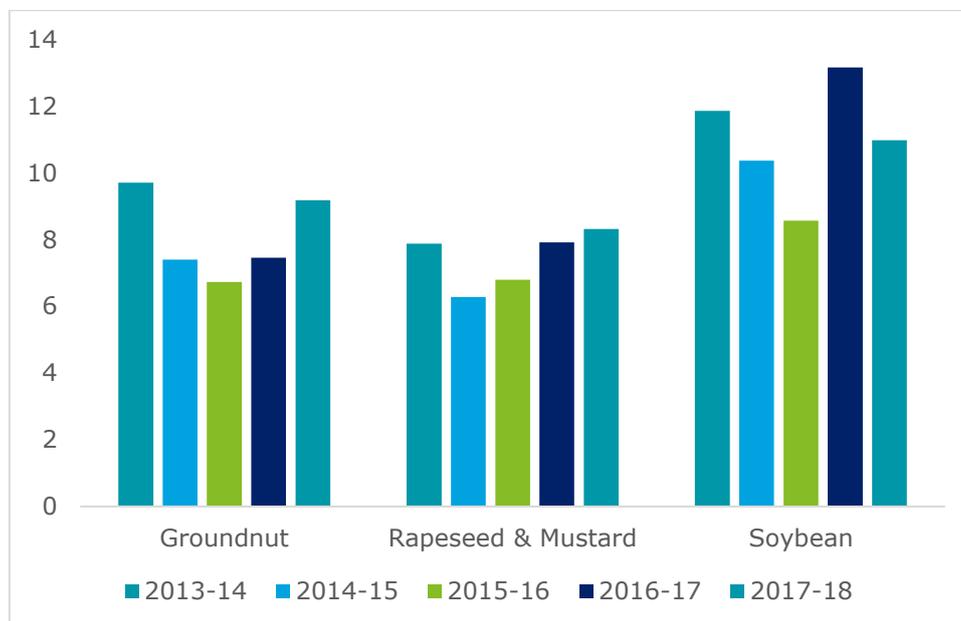
Source: Directorate of Economics & Statistics

### Oilseeds

The production of key oilseeds, groundnut, rapeseed & mustard, and soybean highlights an upward trend for rapeseed & mustard. In groundnut and soybean seeds there has been a dip followed by increase during the period 2013-14 to 2017-18 implying an irregular production.

Production of groundnut has decreased from 9.71 million tonnes from 2013-14 to 9.18 million tonnes in 2017-18. Rapeseed & mustard has seen an increase in production from 7.88 million tonnes in 2013-14 to 8.32 million tonnes in 2017-18. For soybean, the production decreased from 11.86 million tonnes in 2013-14 to 10.98 million hectares in 2017-18.

Figure 39: Year-wise production of oilseeds (million tonnes)

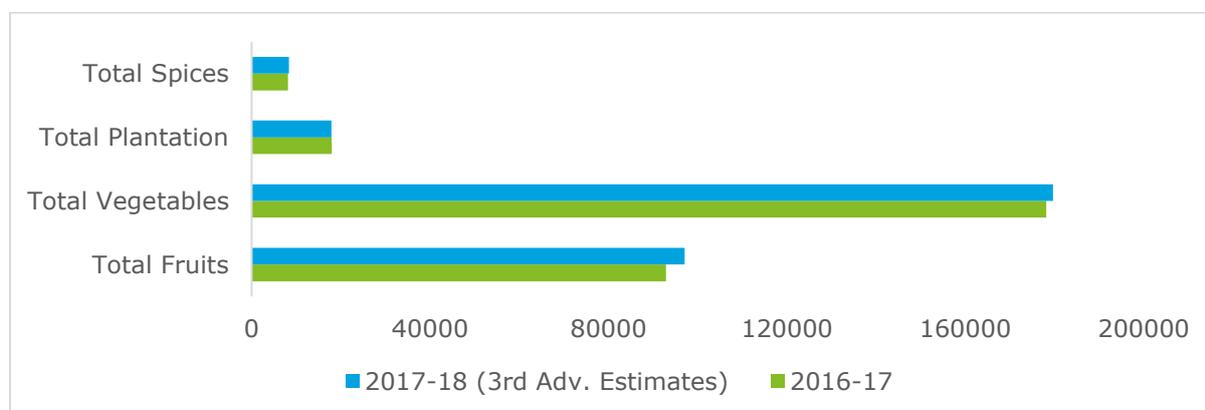


Source: Directorate of Economics & Statistics

### Horticulture Crops

The production of key horticulture crops, fruits, vegetables, plantation and spices highlights an upward trend from 2016-17 to 2017-18 (3<sup>rd</sup> Advance Estimates) production of fruits has increased from 92,918 million tonnes from 2016-17 to 97,055 million tonnes in 2017-18. Vegetables have seen an increase in production from 1,78,172 million tonnes in 2016-17 to 1,79,692 million tonnes in 2017-18. For plantation crops, the production decreased from 17,972 million tonnes in 2016-17 to 17,874 million tonnes in 2017-18. While for spices, production moved from 8,122 million tonnes in 2016-17 to 8,369 million tonnes in 2017-18.

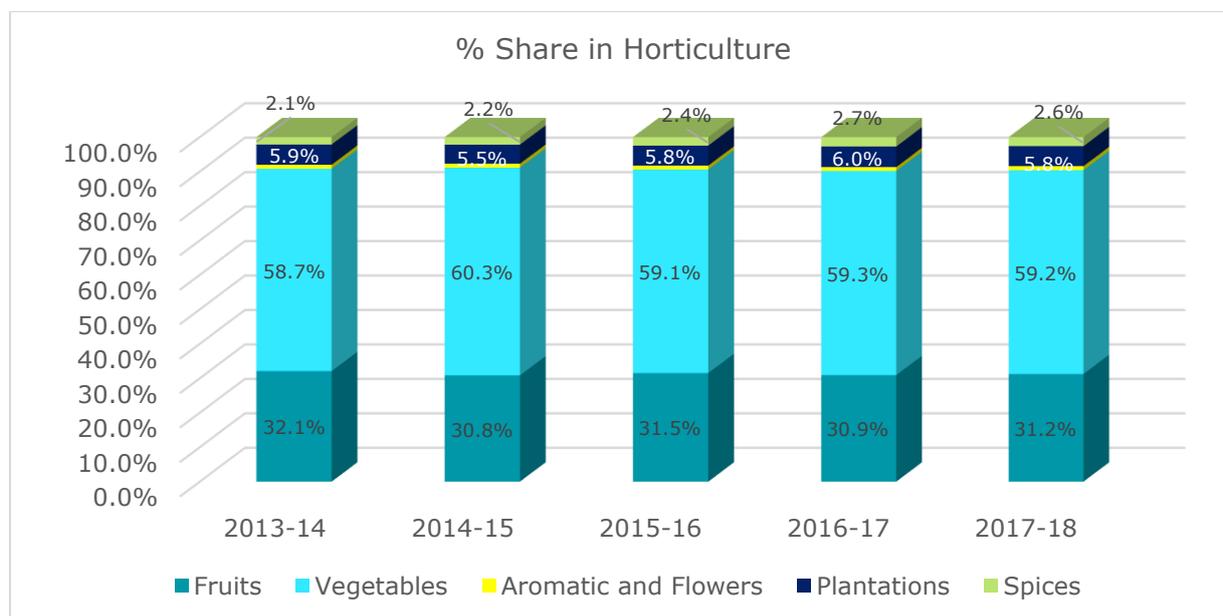
Figure 40: Year-wise production of horticulture crops ('000 MT)



Source: Directorate of Economics & Statistics

The production share of various horticulture crops has remained more or less same from 2012 to 2017 as can be seen from the highlight below:

Figure 41: Commodity wise share in horticulture production (%)



Source: Agriculture Statistics at a Glance 2018

The share of fruits, and vegetables have remained similar in the bracket of 30%-32% and 58%-60% respectively steadily increased among the various horticulture crops over the years, while plantation crops share has declined slightly over the period.

### Land-Use Pattern

India's land-use pattern shows total geographical area of 328 million hectares. Out of this, 94% of the area is available for utilization. Out of this, 45.5% is net sown area, forest cover is 23%, and 5% is current fallow land.

Net area sown has not changed drastically and has remained around the levels of 140 million hectares over the past years. The gross irrigated area shows an upward trend from 88.94 million hectares in 2010-11 to 96.46 million hectares in 2014-15. Area irrigated more than once has seen an upward shift from 25.27 million hectares in 2010-11 to 28.07 million hectares in 2014-15.

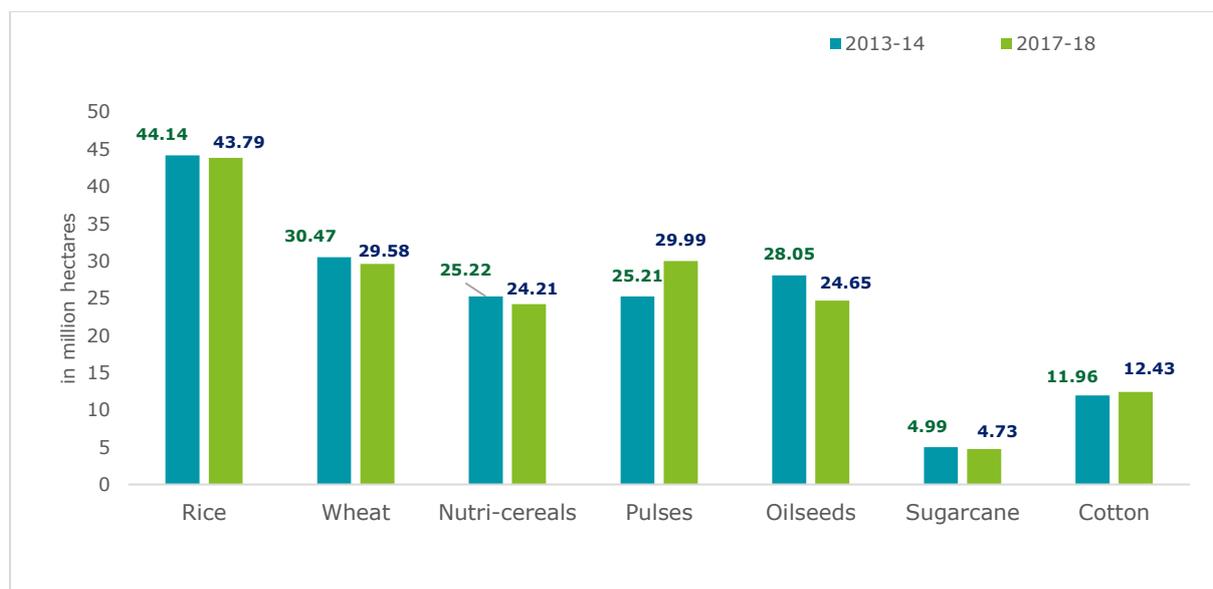
Table 3: Selected categories of land use in India (2010-11 to 2014-15) (million ha)

Year	Net area sown	Total cropped area	Area sown more than once	Net Irrigated Area	Gross Irrigated Area	Area Irrigated more than once
2010-11	141.56	197.68	56.12	63.67	88.94	25.27
2011-12	140.98	195.8	54.82	65.71	91.79	26.08
2012-13	139.94	194.25	54.31	66.29	92.25	25.96
2013-14	141.43	200.95	59.52	68.12	95.77	27.66
2014-15	140.13	198.36	58.23	68.38	96.46	28.07

Source: Agricultural Statistics at a Glance 2018, Directorate of Economics & Statistics, Department of Agriculture Cooperation & Farmers Welfare

The area utilization and changes over last 5 years for key agriculture commodities have been depicted in the figure below.

Figure 42: Area Utilization under key agricultural crops between 2013-14 and 2017-18 (in million hectares)

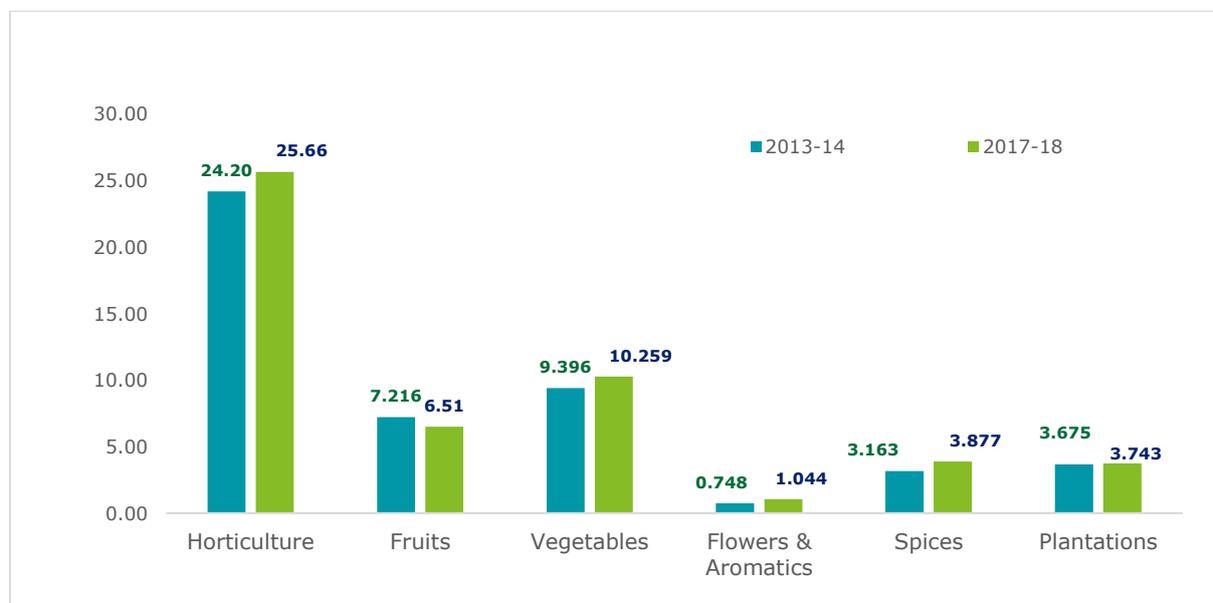


Source: Agricultural Statistics at a Glance 2018

In food grains, while area under cereal cultivation has decreased marginally, area under pulses has increased by 19% and area under oilseeds has decreased by 12%.

In horticulture crops, total area has increased by 6% in the given 5 years. While area under fruits have reduced by 10% from 2013-14 to 2017-18, area under vegetables and spices have increased by 9% and 23% respectively. The area utilization and changes over the last 5 years for components under horticulture has been given in the figure below.

Figure 43: Area Utilization under key horticulture crops between 2013-14 and 2017-18



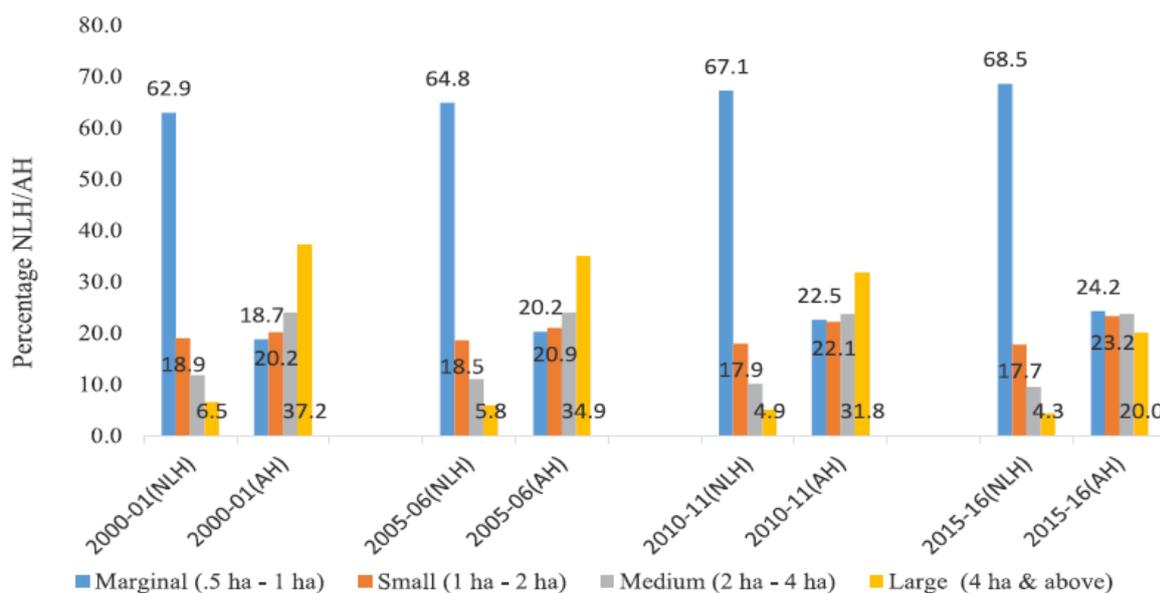
Source: Agriculture at a Glance 2018

## Landholding of Farmers

The number of operational holdings, i.e. land put to agricultural use, has increased from 13.8 crores in 2010-11 to 14.6 crores in 2015-16 as per the Agriculture Census 2015-16.

The share of marginal holdings (less than 1 hectare) in total operational holdings increased from 62.9% in 2000-01 to 68.5% in 2015-16, while the share of small holdings (1 ha to 2 ha) decreased from 18.9% to 17.7% during this period. Large holdings (above 4 ha) decreased from 6.5% to 4.3%.

Figure 44: Operational Land Holdings (Number & Area operated in Ha)



Note: NLH: Number of Operational Land Holdings, AH: Area Operated by Operational Land Holdings; Source: Economic Survey 2018-19, Agriculture Chapter

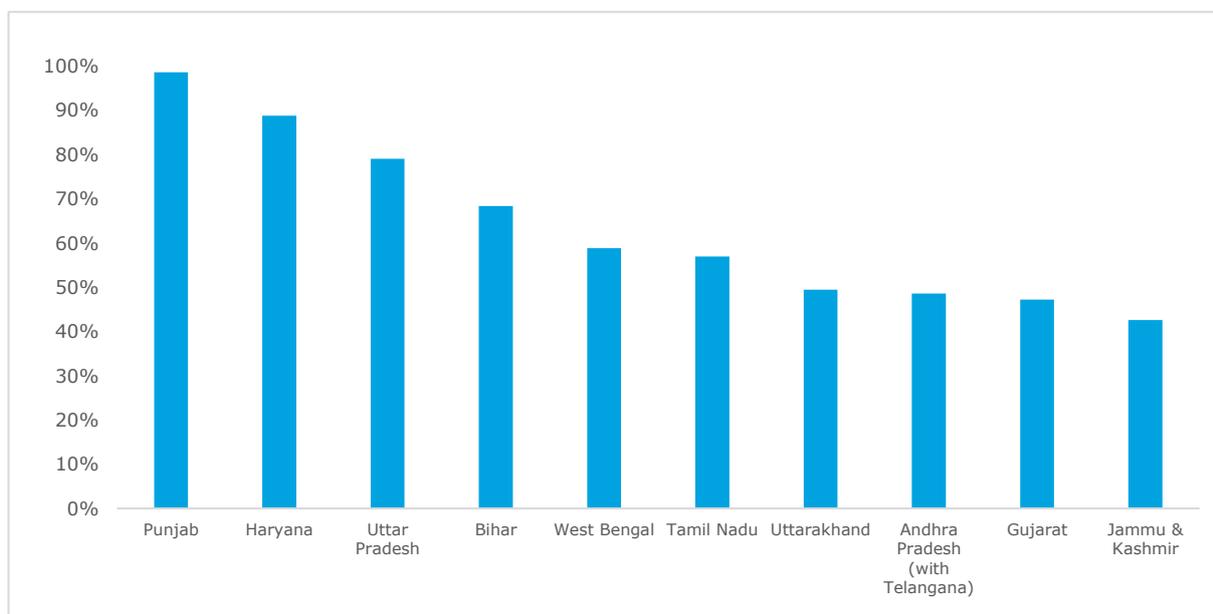
The area operated by the marginal and small farmers increased from 38.9% in 2000-01 to 47.4% in 2015-16, while large holdings decreased from 37.2% to 20% during this period.

## Irrigation

India has improved its performance in bringing agricultural land under irrigation in the last decade. The gross irrigated area in the country increased by 13% between 2006-07 and 2014-15 and irrigation intensity expressed as the ratio of gross irrigated area (GIA) to gross cropped area (GCA), increased by 9% as reported in the report Doubling Farmers' Income – Volume I.

Between 2006-07 and 2014-15, area brought under irrigation in Madhya Pradesh alone was 3.5 million hectares, followed by Rajasthan (2.2 million ha), and Uttar Pradesh (1.5 million ha). A total of 10788 hectares of gross cropped area has been brought under irrigation. Out of a total of 197852 thousand hectares (as of 2014-15), a total of 94825 thousand hectares is gross irrigated area. The top 10 states with the highest percentage of gross cropped area under irrigation are featured in the graph below.

Figure 45: Top States with Gross Cropped Area under Irrigation, 2014-15



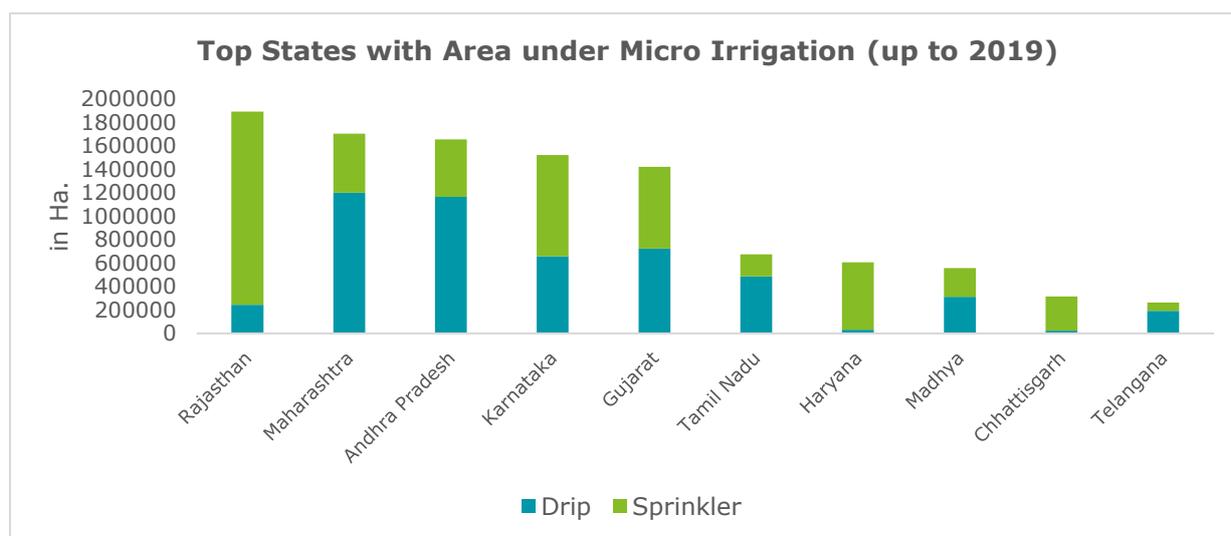
Source: State wise Irrigated Area table, Doubling Farmers' Income – Volume I;  
<http://agricoop.gov.in/sites/default/files/DFI%20Volume%201.pdf>

### Micro Irrigation

In an attempt to improve production efficiency in agriculture and enhance the output, strategies for implementing Micro Irrigation have been taken in India. Micro Irrigation enhances water use efficiency through appropriate technological interventions like drip & sprinkler irrigation systems and encourage the farmers to use water saving and conservation technologies.

As per estimates of micro irrigation data, out of the total potential area of 42.24 million hectares, only 18% is under micro-irrigation. The area under drip irrigation and sprinkler irrigation for the top 10 states has been shown in the graph below.

Figure 46: Top States with Area under Micro Irrigation, up to 2019



Source: Agriculture at a Glance 2018, Data for 2018-19 as shared by Department of Agriculture

Centrally Sponsored Schemes for Micro Irrigation, National Mission on Micro-Irrigation is being implemented to increase water use efficiency and crop productivity especially in states with low rainfall. Under this scheme, the reduction in resource cost and productivity enhancement has been assessed state-wise. The irrigation cost reduced by 20-50 per cent with an average of 32.3 per cent. Saving of fertilizers with average reduction of about 28 per cent in total fertilizer consumption was reported in the surveyed states along with 30% energy consumption savings. Gains in productivity registered an increase in average productivity of fruits and vegetables by 42.3%.

After adoption of micro irrigation systems, the states of Haryana, Rajasthan and Gujarat are enjoying both high energy consumption savings as well as fertiliser consumption savings.<sup>21</sup>

### Infrastructure

Agriculture production in India is focused on incremental growth and providing input for further growth in food and beverage manufacturing industry in the country. Being one of the largest global agricultural producer, India has potential to improve its food processing industry with substantial agriculture surplus production, storage and cold chain infrastructure, modernized post-harvest facilities and government support. India's food and beverage industry was the fifth-largest sector in manufacturing, and the leader in terms of employment generation in FY2017. The sector is expected to attract private investment post the approval of 100% FDI in food trading for food manufactured in India.

There is need to strengthen and add to the existing post-harvest infrastructural facilities, primary processing units, cold storages and distribution facilities. Hence the strategies undertaken to improve agricultural trade includes infrastructure creation, enhanced access to marketing information and reduced food loss.

<sup>21</sup> Grant Thornton & FICCI, 2016, Accelerating growth of Indian agriculture: Micro irrigation an efficient solution, Retrieved from <https://www.grantthornton.in/globalassets/1.-member-firms/india/assets/pdfs/micro-irrigation-report.pdf>

## Warehousing and Cold Storages

Warehousing and cold storages are the primary post-production infrastructure for holding surplus stock for extended duration. Under the Warehousing Development & Regulatory Authority (WDRA), warehouses managed by Food Corporation of India (FCI), Central Warehousing Corporation, State Marketing Federations, State Civil Supplies Corporation are registered. In 2018-19, a total storage capacity of 162.71 million tonnes was available for food grains including cereals and pulses.

Table 4: Warehouse Capacity in India (2018-19)

Sl.	Name of Organization	Storage Capacity (million tonnes)
1	Food Corporation of India	12.73
2	Central Warehousing Corporation	10.10
3	State Warehousing Corporations and State Agencies	24.08
4	Other State Agencies	11.66
5	Cooperative Sector	16.51
6	Private Sector	77.68
	<b>Total</b>	<b>162.71</b>

Source: Annual Report of WRDA 2018-19, <https://wdra.gov.in/web/wdra/annual-reports>

Procurement of food grains for the Central Pool is done through Food Corporation of India and State agencies through Minimum Support Price as declared in the given year by Government of India. The stock position of food grains under Central Pool as of 2016-17 was 380.04 lakh MT which included rice (297.84 lakh MT), wheat (80.59 lakh MT), pulse (1.47 lakh MT) and coarse grains (1.61 lakh MT).

Cold chain infrastructure is one of the most critical component for handling the agricultural produce, especially the perishable goods to store and connect to the market. Cold-chain ensures that fresh whole produce reaches gainful end-use and thus reduces food loss. Cold chain infrastructure is a logistic chain that includes cold storages or refrigerated warehousing integrated with refrigerated transportation. India lacks adequate transportation facilities in the cold chain infrastructure with only 12% of the total refrigerated capacity in transport infrastructures. 88% of the cold storage capacities are stand-alone infrastructures. An estimated 34 million tonnes of storage capacity in cold storages (as of March 2017) has been created, but with allied development of only about 11,000 refrigerated transport units having a capacity of 4 million tonnes only. The transport units are exclusively as trucks, as there are no multi-modal reefer containers for domestic use (rail shipment) of temperature sensitive fresh produce or processed products.

The gap in the cold chain infrastructure in India had been assessed in All India Cold-chain Infrastructure Capacity study by National Centre for Cold-chain Development (NCCD) conducted in 2015. The infrastructural gap found in the study is as follows:

Table 5: Gap Analysis of Cold Chain Infrastructure in India

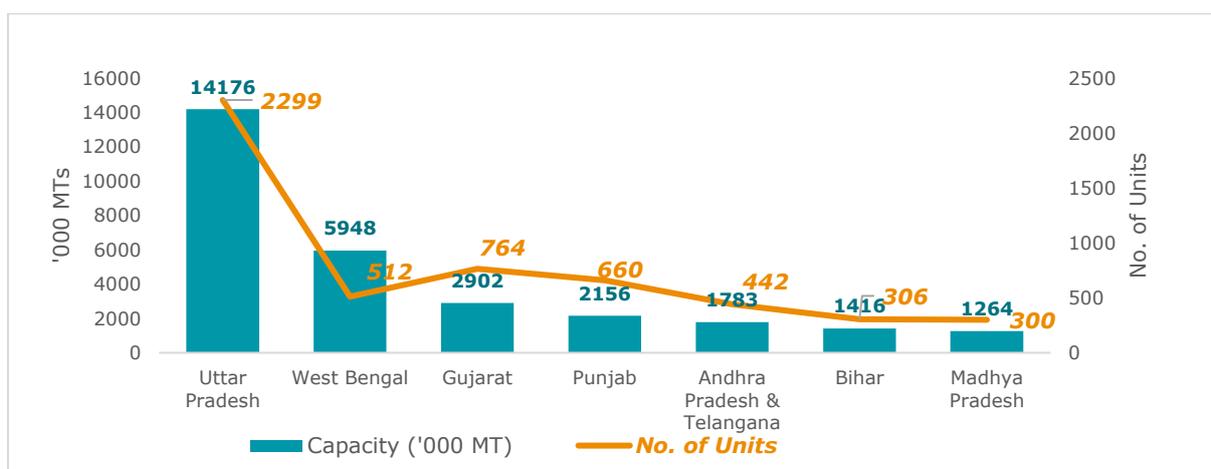
Sl.	Type of Infrastructure	Infrastructure Requirement	Infrastructure Created	All India Gap	% share Shortfall
1	Integrated Pack-house	70,080 nos.	249 nos.	69,831 nos.	99.6
2	Reefer Transport	61,826 nos.	<10,000 nos.	52,826 nos.	85
3	Cold Storage (Bulk)	341,64,411 MT	318,23,700 MT	32,76,962 MT	10
4	Cold Storage (Hub)	9,36,251 MT			

Sl.	Type of Infrastructure	Infrastructure Requirement	Infrastructure Created	All India Gap	% share Shortfall
5	Ripening Units	9,131 nos.	812 nos.	8,319 nos.	91

Source: All India Cold-chain Infrastructure Capacity study by National Centre for Cold-chain Development

Currently there are 7,645 cold storage units in India with a total capacity of 34.95 million tonnes as estimated in 2016-17.<sup>22</sup> The distribution of cold storages is highly uneven with majority of the cold storages located in Uttar Pradesh, West Bengal, Gujarat, Punjab, Andhra Pradesh, Telangana, Bihar and Madhya Pradesh. 85% of the cold storage capacity is concentrated in these 8 states. The top states with the highest capacities of cold storage facilities have been depicted in the following graph.

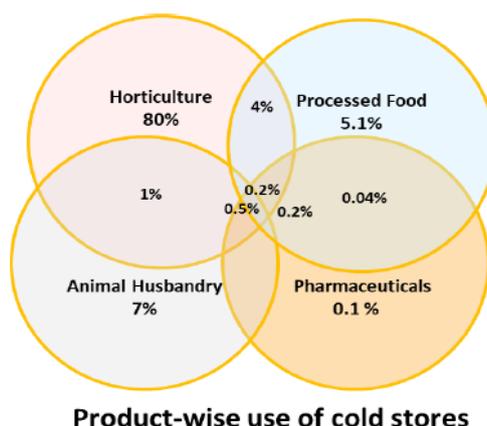
Figure 47: Top States with Cold Storage Facilities



Source: State wise distribution of Cold Storage capacity, 2017, PIB;  
<https://pib.gov.in/newsite/PrintRelease.aspx?relid=168990>

Most of the cold storages in the country are used for horticulture crops and are designed for crops like potato and dried chilly. The product-wise segmentation of the crops<sup>23</sup> being handled in cold storages has been presented in the figure below.

Figure 48: Product-wise use of cold stores

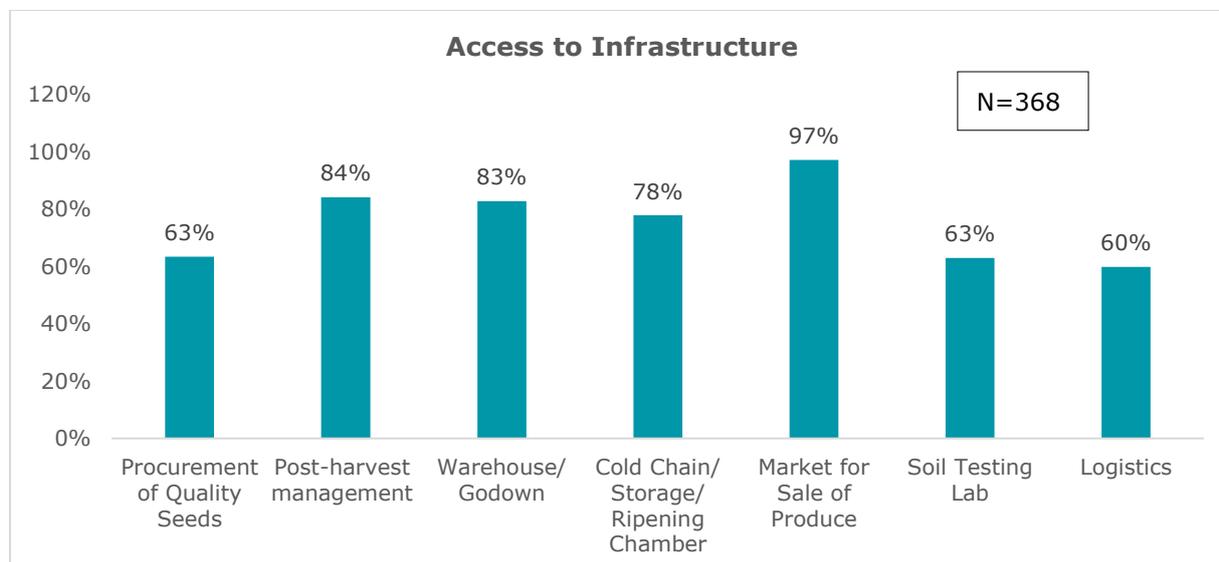


<sup>22</sup> Press Information Bureau, Government of India. 2017. State wise distribution of Cold Storage capacity. Retrieved from <https://pib.gov.in/newsite/PrintRelease.aspx?relid=168990>

<sup>23</sup> Ministry of Agriculture & Farmers Welfare, Inter-Ministerial Committee of Doubling Farmers Income. (2018). Strategy for Doubling Farmers' Income by 2022 (Volume III). Retrieved from <http://agricoop.nic.in/doubling-farmers>

As observed in the household survey, agricultural farmers have been accessing various infrastructure for procurement of seeds, primary and secondary level processing, transportation and others. The graph below depicts the access of various agricultural infrastructure by farmers.

Figure 49: Access to Various Agricultural Infrastructures by Farmers



Note: Respondent adopted more than one practice. Hence, total percentage may exceed 100%

Source: HH Survey, Deloitte Analysis

### Food Losses or Post-harvest losses

Food losses or post-harvest losses are primarily caused by failure in the handling and connecting of food produced to consumption points or markets. The food loss that post-harvest and before connecting to markets, is effectively a loss of saleable volume and value, and is an economic burden on the food supply system. In addition, the perishable agricultural products which are high nutritious food and high value crops are more susceptible to the loss. The post-harvest losses in India had been evaluated in 2015 by a study<sup>24</sup> commissioned by MoFPI to CIPHET. As per their estimates, the total food loss in agricultural products which include food grains, fruits and vegetables ranges between 3.08% and 15.88%. The agricultural commodity wise post-harvest losses estimated in India are depicted in the table below.

Table 6: Estimates of Food Losses in Agricultural Produces

Agricultural Produce	Overall Total Food Loss %
Cereals	4.65-5.99
Pulses	6.36-8.41
Oilseeds	3.08-9.96
Fruits & Vegetables	4.58-15.88

Source: Report on assessment of quantitative harvest and post-harvest losses of major crops - CIPHET 2015 study; <https://www.ciphnet.in/study-on-post-harves-losses.php>

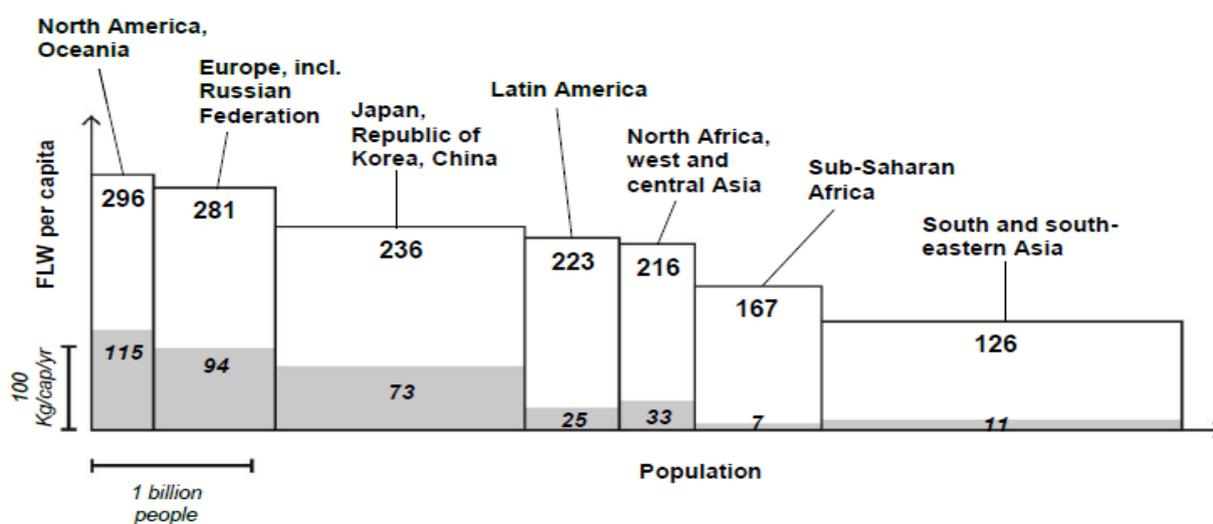
<sup>24</sup> ICAR - Central Institute of Post-Harvest Engineering and Technology (CIPHET). 2015. Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops and Commodities in India.

Moreover, analysis of food loss conducted by SFAC in North Eastern states shows that the food loss is in the range of 9% (potato) to 32% (peas)<sup>25</sup>, implying states with poor connectivity and infrastructure are even more vulnerable to post harvest losses. In another study done in 2015 by NCCD, losses in horticulture produce had been estimated across activities from farm to wholesale markets located mostly in North India. The findings reveal the range of post-harvest losses varies from 7% (watermelon) to 44% (pears). The losses in the agricultural produce were assessed across its journey from the farm to the market. The stages of measurement of the loss were:

- At farm-gate (point of harvest)
- At collection point (aggregation)
- On loading onto transport
- During transportation
- On receiving at wholesale point

According to Food and Agriculture Organization (FAO) of the United Nations, the global food loss and waste<sup>26</sup> incurred amounts to 1.3 billion tonnes (2011)<sup>27</sup>. Fruits and vegetables have the highest food loss and waste of 44%, followed by roots and tubers (20%) and cereals (19%).

Figure 50: Global region-wise data on food losses and wastage



The X-axis represents the population of a region or group of countries. The Y-axis shows per-capita FLW in the given region. The grey part distinguishes consumer waste from post-harvest losses within regional food loss and waste. For each region, the area of the rectangle represents total regional FLW. Source: elaborated from Gustavsson et al. (FAO, 2011a).

Source: HLPE, 2014. Food losses and waste in the context of sustainable food systems. (High Level Panel of Experts on Food Security & Nutrition of the Committee on World Food Security, Rome).

<sup>25</sup> Ministry of Agriculture & Farmers Welfare, Inter-Ministerial Committee of Doubling Farmers Income. (2018). Strategy for Doubling Farmers' Income by 2022 (Harvest and Post Harvest Losses, Volume II). Retrieved from <http://agricoop.nic.in/doubling-farmers>

<sup>26</sup> Food Loss : post-harvest, in-transit, pre-consumer | Food waste: consumer-end, post-monetization, post-retail

<sup>27</sup> Ministry of Agriculture & Farmers Welfare, Inter-Ministerial Committee of Doubling Farmers Income. (2018). Strategy for Doubling Farmers' Income by 2022 (Volume II). Retrieved from <http://agricoop.nic.in/doubling-farmers>

According to the FAO report, HLPE, 2014, food losses and waste in the context of sustainable food systems, in South and South East Asia 28% of the agricultural produce is lost or wasted, out of which 21% is attributed to losses during harvest, post-harvest and processing. The reduction of the crop losses can be ensured by improving the market linkage which includes logistics, transportation, warehousing facilities and cold storages. As per the Economic Survey 2018-19, India's global position in food loss is 70<sup>28</sup> with a score of 86.4 as against the average global score of 84.9.

## Price Realization

### Price realization by farmers

As assessed by the Situation Assessment Survey of Agricultural Household, NSSO, 2015, the share of a producer in each rupee paid by the consumer is found to be as lowest in the case of fruits and vegetables<sup>29</sup>. The price realization of farmers across various key commodities have been assessed in the report and compared with price realization of different agencies such as the mandi, input dealers, cooperatives and government agencies, processors in an endeavor to improve farmers' share in consumer price. The table below gives the price realization by farmers in kharif and rabi crops of 2012-13.

Table 7: Price Realisation (Rs./kg) for major crops and farm categories at Local Traders by farmers (July-December 2012)

	Paddy	Jowar	Bajra	Maize	Arhar	Urad	Moong	Sugarcane	Cotton
Marginal	12	13	11	12	36	29	37	2	37
Small	11	4	10	11	38	28	38	3	39
Semi-medium	14	9	11	12	31	28	41	2	39
Medium	14	9	11	12	36	27	34	3	40
Large	11	11		12	35		40	3	37

Source: Marketing, Prices and Trade Chapter, Doubling Farmers' Income – Volume I;

Table 8: Price Realisation (Rs./kg) for major crops and farm categories at Local Traders by farmers (Jan-June 2013)

	Paddy	Jowar	Wheat	Barley	Gram	Lentil	Rapeseed/ Mustard
Marginal	13	20	13	10	28	44	29
Small	12	14	13	12	30	41	30
Semi-medium	14	20	13	12	31	41	31
Medium	15	15	13	10	33	43	30
Large	14	12	13	11	35	39	29

Source: Marketing, Prices and Trade Chapter, Doubling Farmers' Income – Volume I;

Farmer's share in the price of the agricultural produce to the final consumer is found to be very low due to the inefficiencies of the marketing system. A detailed analysis of price realizations to farmers, expressed as share in consumer rupee across a wider variety of commodities reveal that pulses and fruits & vegetables have the lowest realization. While farmers share in pulses range between 46-56%, for most fruits (aonla, apple, kinnow, litchi, mango, banana, pineapple,

<sup>28</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2018-19 (Chapter 7, Agriculture and Food Management). Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

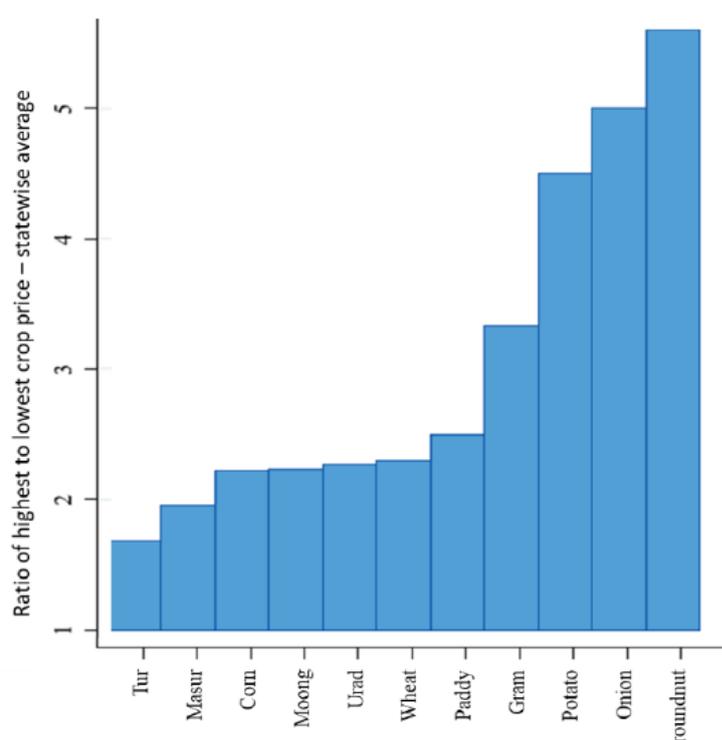
<sup>29</sup> Doubling Farmer's Income Report. Volume I, Marketing, Prices and Trade Chapter. Retrieved from <http://agricoop.gov.in/doubling-farmers>

pomegranate, sapota, sweet orange), it is as low as 26% to 67%. Among all fruits, banana is most profitable to trade as its price realization range between 82% - 85% in most of the markets.

Efficient marketing system is ensured by operational ease and price efficiencies in the market channels of various agricultural produce. Reducing farm gate price dispersion through creation of improved physical infrastructure have enabled better monetization of farm produce by farmers. The extent of price dispersion at farm gate, across multiple markets in the country is thus considered as a measure for marketing efficiency.

According to the NSSO Situation Assessment Survey of Agriculture Households Round 70, price dispersion for specific crops had been studied across states on the basis of 2013 prices. The table below quantifies the price wedges between farm-gate prices to the final consumer prices in which

Figure 51: Price Dispersion in Select Agricultural Commodities in India, 2013



Source: Agriculture Chapter, Economic Survey 2015-16

the biggest price wedges are for potatoes, onions and groundnuts. The wedges are lower for rice, wheat for which there are a large number of farmers and is supported by Minimum Support Price. The price wedges for pulses is in the mid-range. As analyzed in the Economic Survey 2015-16, perishability of agricultural products was inferred as an important factor driving price wedges.

Comparison of India's price dispersion (ratio highest to lowest crop price) in key agricultural commodities have been done with price dispersion in USA for 2012. While India's price dispersion ranged from 1.6 (Tur) to 5.5 (groundnut), price

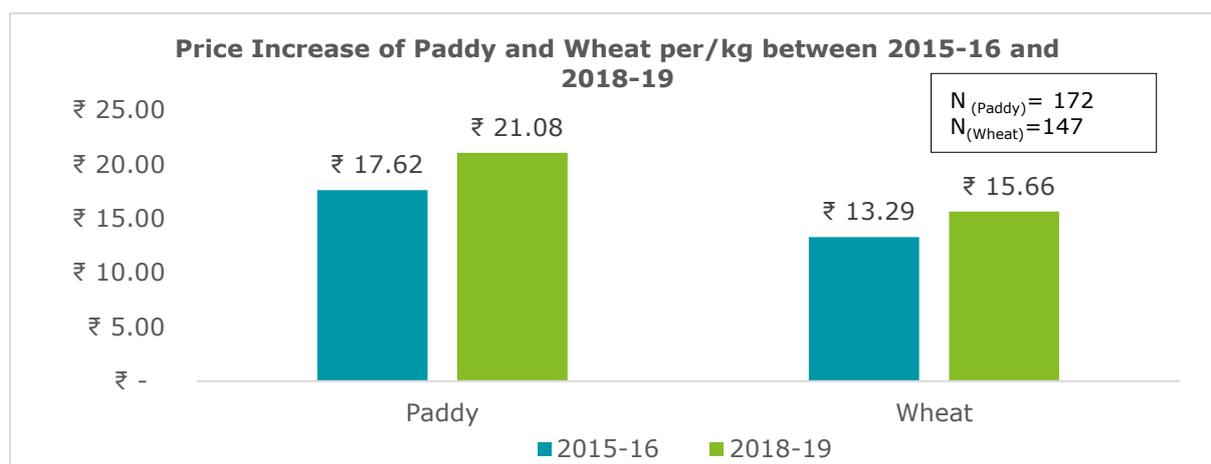
dispersion in USA ranged from 0-1.7 for its key agricultural commodities for the same year<sup>30</sup>.

### Change in Agricultural Prices

As observed in the household (HH) survey, the price of paddy (per kg) and wheat (per kg) has increased by 19.69% and 17.81% between 2015-16 and 2018-19 respectively as realized by farmers. The price of paddy and wheat as of 2015-16 is the base price considered for the analysis. The observation has been depicted in the graph below.

<sup>30</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2015-16 (Agriculture and Food Management Chapter). Retrieved from <https://www.indiabudget.gov.in>

Figure 52: Price Increase of Paddy and Wheat per/kg between 2015-16 and 2018-19



Source: HH Survey, Deloitte Analysis

### Change in Income of Producers

The average annual income of agricultural household comes from components like cultivation, livestock, non-farm business, and wages and salaries. The average income of agricultural households is estimated with representations from marginal and small (owning land size of less than 2 hectares), medium and semi-medium (owning land size in the range of 2 to 10 hectares) and large farmers (owning land size of more than 10 hectares) according to the sizes of the landholdings owned by them. The income for the small and marginal farmers is comprised of a larger share of wages and salaries while for large farmers, a major share of the income comes from cultivation.

The average income of agricultural household has been estimated over the recent years through surveys. In 2012-13, a Situation Assessment Survey of Agricultural Households had been conducted through the NSSO 70th Round, which estimated the average annual income to be Rs 77,976. In 2016-17, NABARD All India Rural Financial Inclusion Survey 2016-17 was further conducted which revealed about 40% higher income levels in agriculture households during a three year period ending 2015-16 as compared with the estimates by NSSO Situation Assessment Survey, 70th round for the year 2012-13.

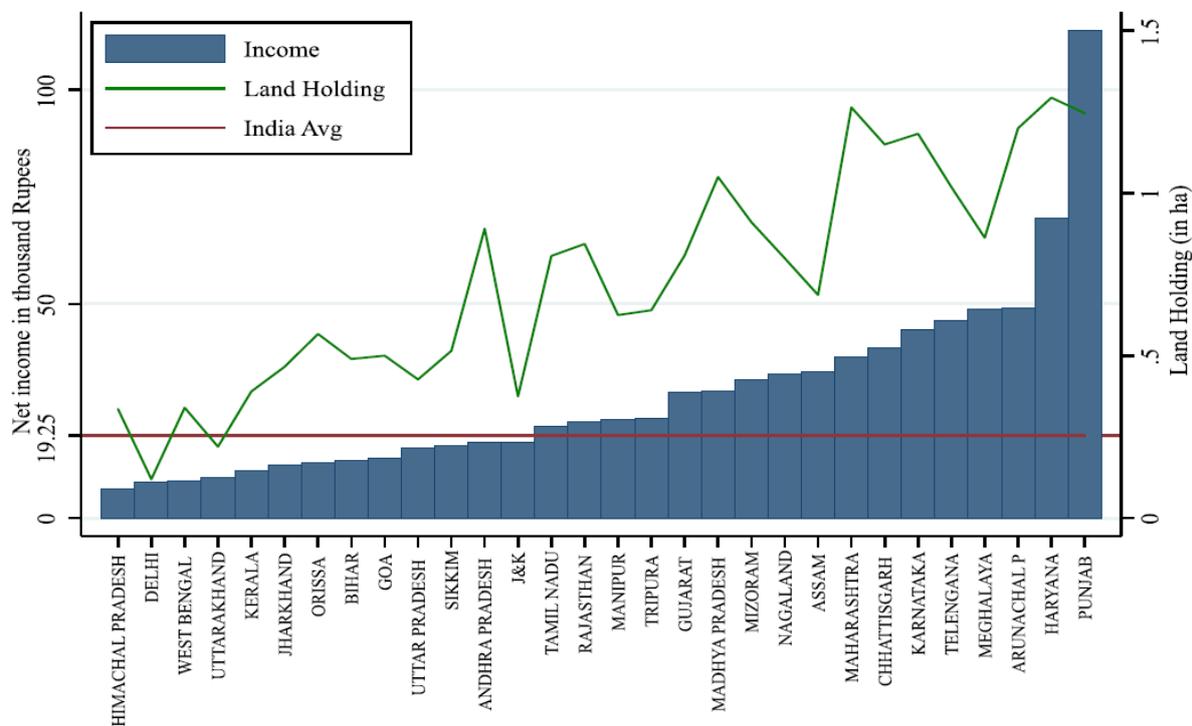
Table 9: Average income of agricultural households

Survey	Cultivation	Livestock	Non-farm Business	Wages and Salaries	Others/Govt./ Pvt. Services	Average Income of Agricultural Household (monthly)
Situation Assessment Survey of Agricultural Households under NSSO 70 <sup>th</sup> Round, 2012-13	3079	835	517	2067		6498
NABARD All India Rural Financial Inclusion Survey 2016-17	3140	711	489	3025	1566	8931
Growth in Income over 3 year period (%)						37.4%

Source: NSSO 70<sup>th</sup> Round, 2013-13; NABARD All India Rural Financial Inclusion Survey 2016-17

The average agricultural household income across states varies widely. The annual income of the median farmer across states along with their land holding is shown in the figure below

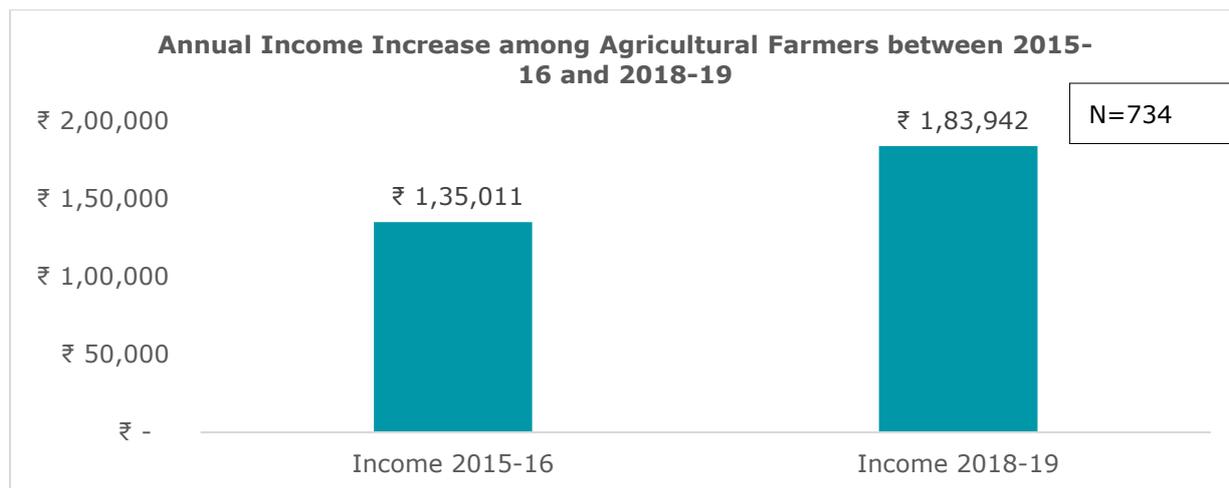
Figure 53: Annual Income of Median Farmer in India, 2012



Source: NSSO Situation Assessment Survey, 70th round

It has been reported in the HH Survey, that there has been around 36.2% increase in income among agricultural farmers between 2015-16 and 2018-19.<sup>31</sup> The findings have been depicted in the graph below.

Figure 54: Annual Income Increase among Agriculture Farmers between 2015-16 and 2018-19



Source: HH Survey, Deloitte Analysis

<sup>31</sup> The income level of 2015-16 is a recall data. Also, inflation adjustment has not been made between 2015-16 and 2018-19.

## Exports

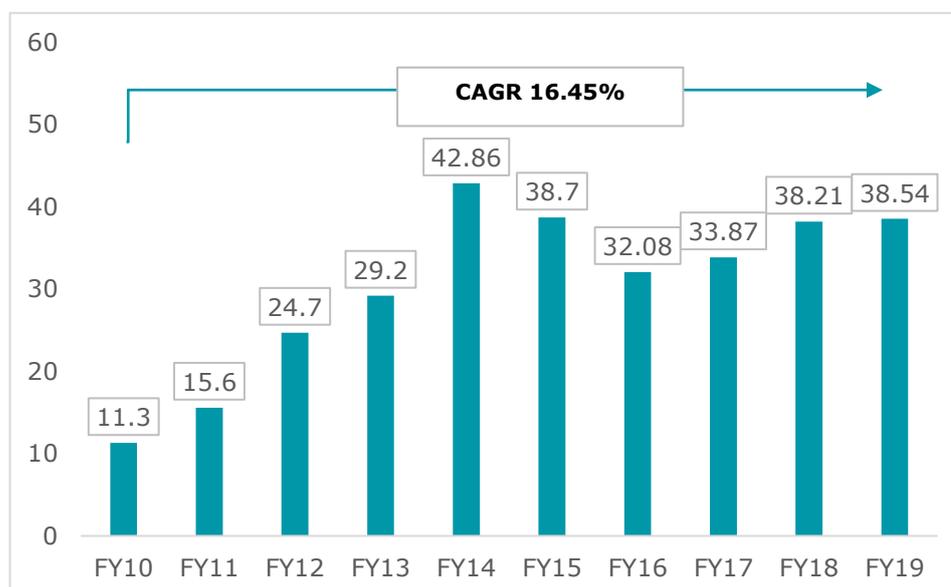
The agricultural exports in India constitutes of 11.76% of the country's total exports. Although the share of export for agricultural sector in total exports has decreased from 12.66% to 11.76% over the last year, the overall agricultural export has been showing an increasing trend. The table below shows the recent agriculture export statistics for India.

Table10: share of agricultural exports and overall trend in last 3 years

Year	2016-17	2017-18	2018-19
Share of agriculture sector in total exports	12.07%	12.66%	11.76%
Overall Agricultural Export (USD million)	33,283.41	38,425.52	38,739.10

Source: Import and Export from Agricultural Sector, PIB, 2019;  
<https://pib.gov.in/newsite/PrintRelease.aspx?relid=191170>

Figure 55: Agriculture exports from India (USD billion)

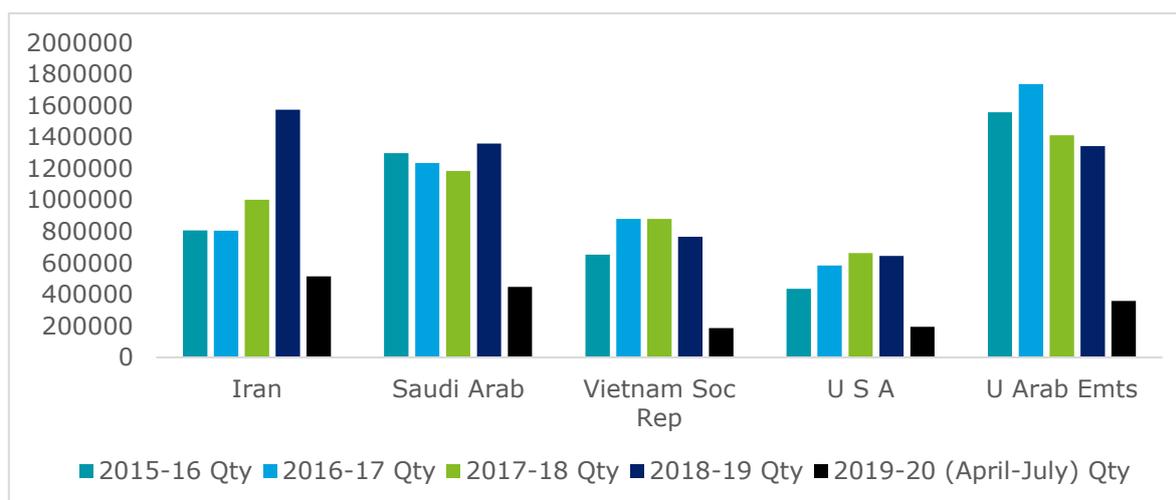


Source: Directorate General of Foreign Trade, Ministry of Agriculture & Farmers Welfare, Global Trade Atlas

The total agriculture exports from the country have grown at a CAGR of 16.5% between FY2010 and FY2019.

Indian agricultural/ horticultural and processed foods are exported to more than 100 countries/ regions. The major countries to where India exports include Iran, Saudi Arabia, Vietnam, United States of America and United Arab Emirates.

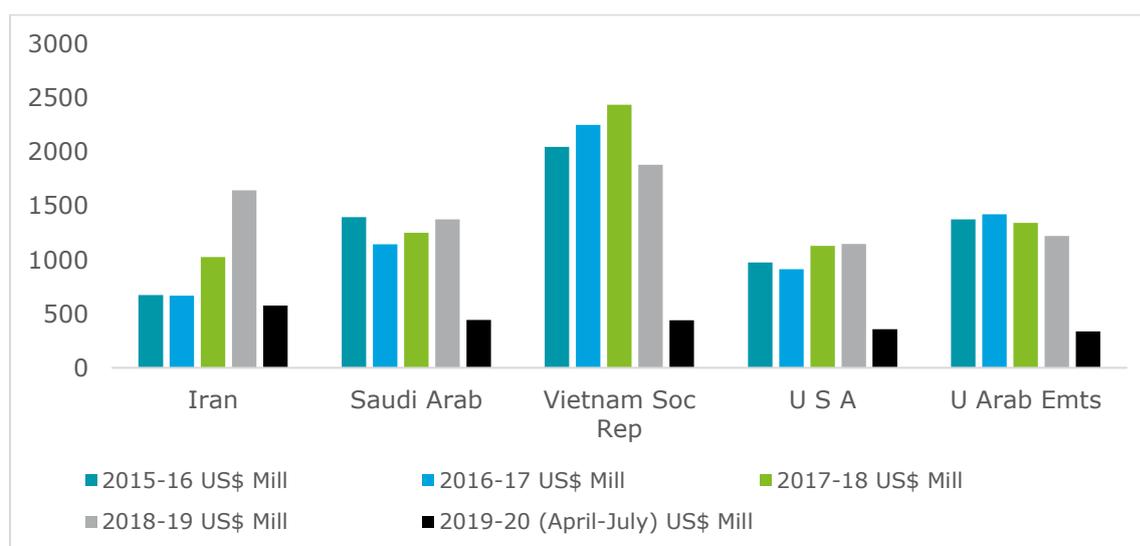
Figure 56: Global Export of Principal Commodities: All Agri (in MT)



Source: AgriXchange (APEDA)

Export volume to Iran have increased significantly from 808,009 MT in 2015-16 to 1,573,200 MT in 2018-19. While, exports to UAE have declined from 1,557,227 MT in 2015-16 to 1,343,197 MT in 2018-19.

Figure 57: India's Export of Principal Commodities: All Agri (USD million)



Source: AgriXchange (APEDA)

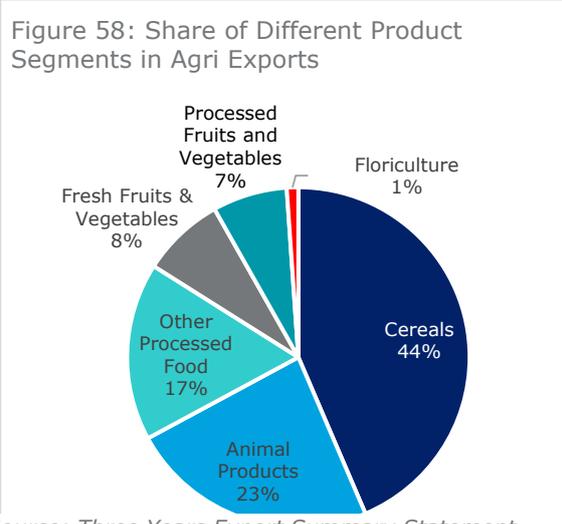
While we observe a significant increase in export value to Iran from US\$ 673.39 million in 2015-16 to US\$ 1,645.79 million in 2018-19, export value to Vietnam and UAE have declined to great extent from US\$ 2,046.14 million in 2015-16 to US\$ 1,879.93 million in 2018-19 and US\$ 1,376.65 million in 2015-16 to US\$ 1,220.41 million in 2018-19 respectively.

## Key agricultural export commodities

Key agricultural commodities that are exported from India comprise of basmati rice, castor oil, cereal preparations, coffee, fresh fruits and vegetables, oil meals, processed fruits & juices, sesame seeds, spices, sugar and tea.

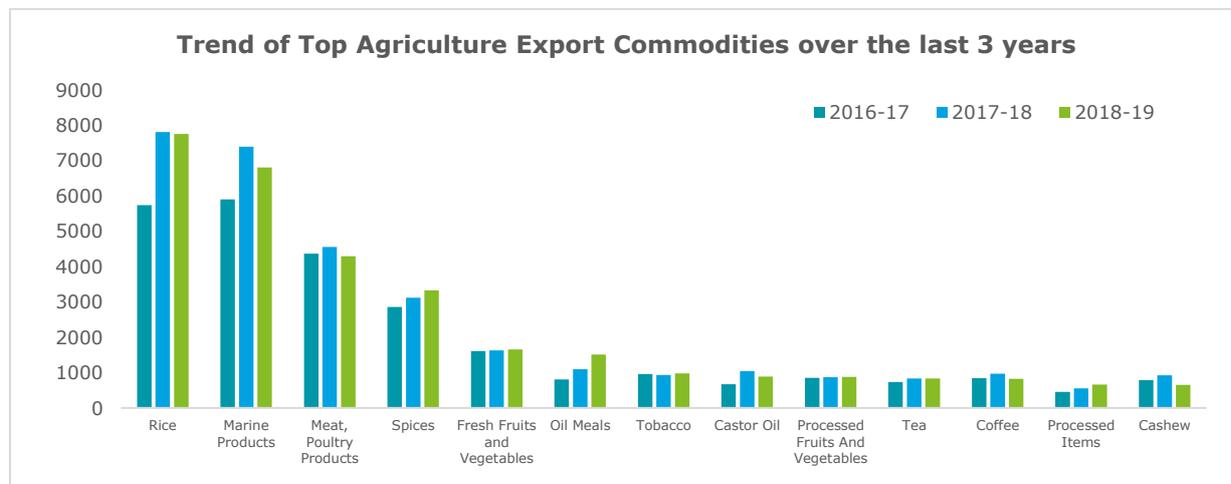
Between FY2010 and FY2018, Indian cereal exports claimed a total 44% of all agriculture exports, while livestock products accounted for 25%<sup>32</sup>. Other processed foods claimed 16%, leaving 8.2% and 6.3% to fresh and processed fruit and vegetables, respectively. The share of different product segments in the total agricultural exports from India as of 2018-19 is shown in figure alongside.

India is a major beef and rice exporter, and a net exporter of fish, coffee, tea, and spices. However, the country remains a net importer vegetable oils, wheat as well as sugar. The trend of the top agricultural commodities over the last 3 years has been shown the graph below.



Source: Three Years Export Summary Statement (2016-17 to 2018-19), APEDA Statistics

Figure 59: Trend of Top Agricultural Commodities between 2017 and 2019



Source: Import and Export from Agricultural Sector, PIB, 2019; <https://pib.gov.in/newsite/PrintRelease.aspx?relid=191170>

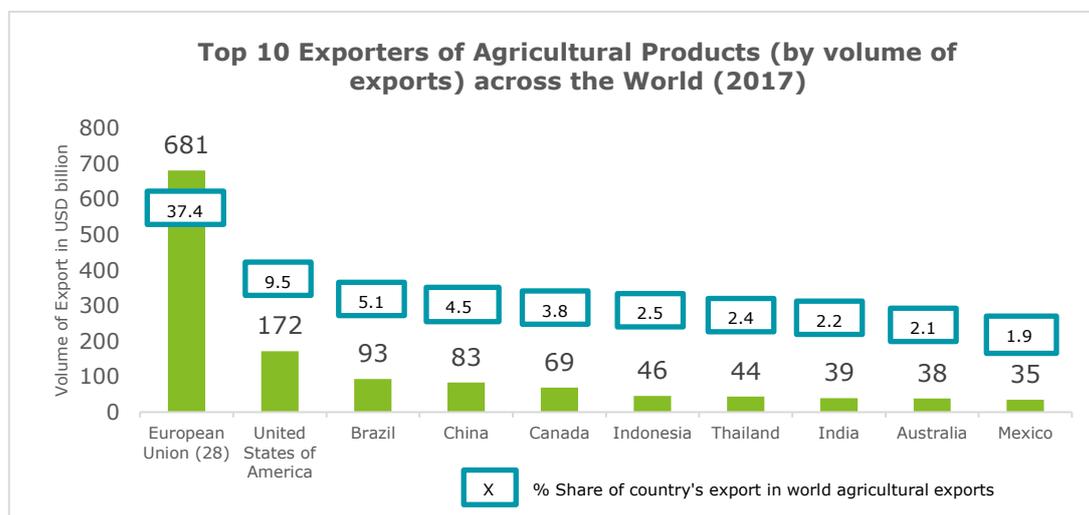
The exports of tea, spices and manufactured tobacco grew by 1.56%, 12.22% and 2.41% respectively while the exports of unmanufactured tobacco declined by 4.65% over last three years. Some of the major commodities, which registered a decline in exports were buffalo meat (-4.07%), basmati rice (-7.75%) and cotton (-16.38%).

<sup>32</sup> EMIS Insights. 2019. India Agriculture Sector Report 2019-2023. Retrieved from <https://www.emis.com>

## Global Scenario

At the global level, the total export of agricultural products grew by 5% in 2018 over the last year and is currently pegged at ~USD 1800 billion<sup>33</sup>. The volume of trade of the top 10 exporters of agricultural products (country/region) along with their respective share in the world agricultural export as of 2017 is shown in the following figure.

Figure 60: Top 10 Exporters of Agricultural Products across the World

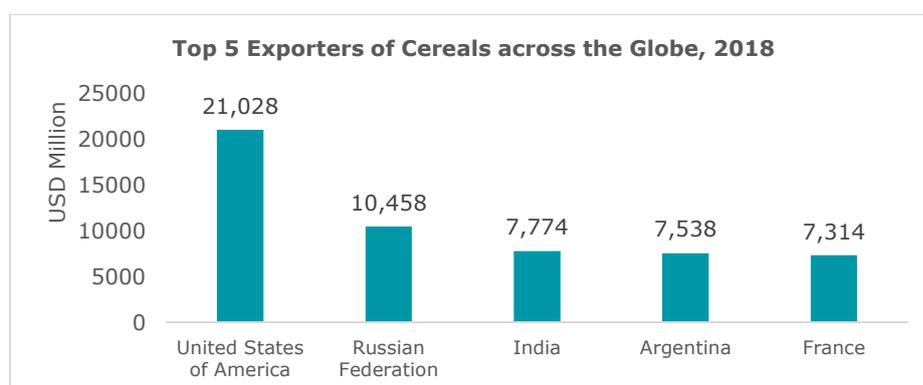


Source: World Trade Statistical Review 2018

The top 10 exporters represents 72% of the world exports of agricultural products as of 2017. European Union, USA and Brazil are the top exporters of agriculture and their rank has remained unchanged over last year, 2016. The highest increase in exports of agricultural products within the top ten exporters has been recorded by China (9%), Brazil (6%) and Mexico (6%) over the last year. India's share of agricultural export is 2.2% of the world's agricultural exports as of 2017 and the country has moved up from 10<sup>th</sup> position (2016) to 8<sup>th</sup> position (2017).

India is the 3<sup>rd</sup> highest exporter of cereals across the globe and its export value is pegged at 7774 million USD as of 2018. The top 5 exporters of cereals as of 2018 is shown in the following figure.

Figure 61: Top 5 Exporters of Cereals, 2018

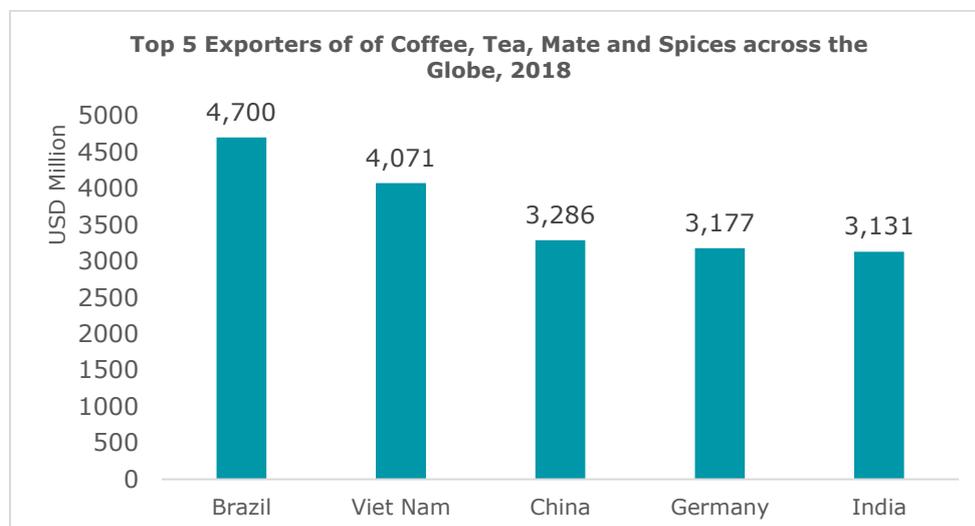


Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

<sup>33</sup> World Trade Organization. (2019). World Trade Statistical Review 2019 (Statistical Tables, Chapter VIII). Retrieved from [https://www.wto.org/english/res\\_e/statis\\_e/wts2019\\_e/wts19\\_toc\\_e.htm](https://www.wto.org/english/res_e/statis_e/wts2019_e/wts19_toc_e.htm)

India holds 5<sup>th</sup> position globally in exports of coffee, tea, mate and spices and its value is 3131 million USD as of 2018. The top 5 exporters of coffee, tea, mate and spices as of 2018 is shown in the following figure.

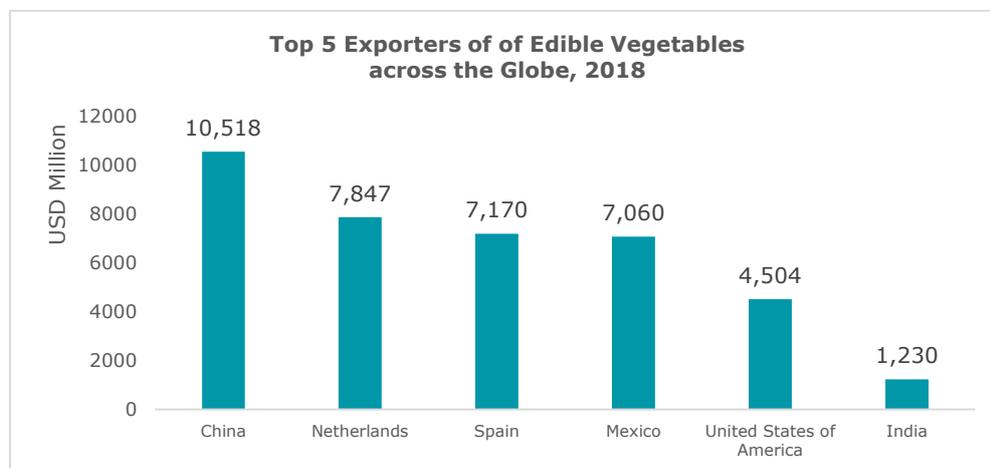
Figure 62: Top 5 Exporters of Coffee, Tea, Mate and Spices



Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

In global export of vegetables as well as fruits, India contributes 1.65% and 1.24% respectively. In edible vegetables, India's export value is pegged at 1230 million USD ranking 13<sup>th</sup> globally. The top 5 exporters of vegetables as of 2018 is shown in the following figure.

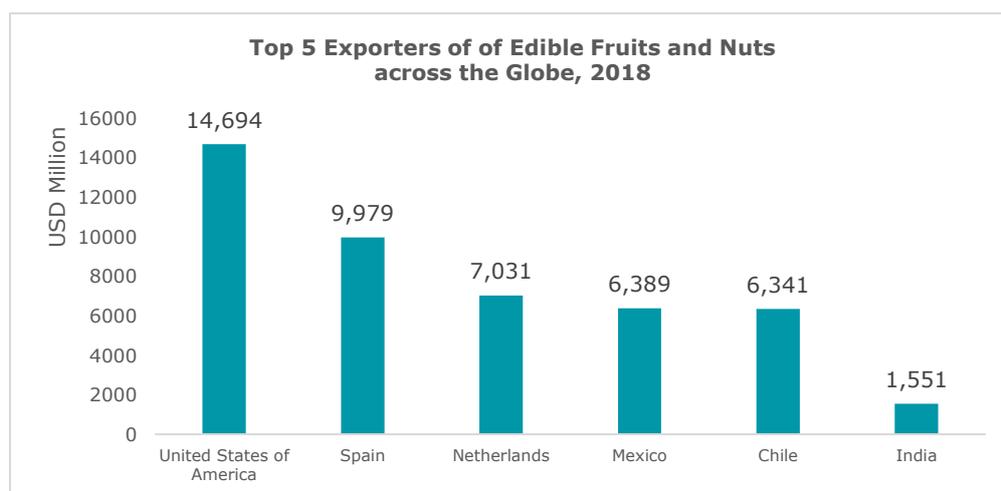
Figure 63: Top 5 exporters of Edible Vegetables, 2018



Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

In edible fruits and nuts, India's export value is pegged at 1551 million USD ranking 23<sup>rd</sup> globally. The top 5 exporters of edible fruits and nuts as of 2018 is shown in the following figure.

Figure 64: Top 5 Exporters of Edible Fruits & Nuts, 2018



Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

## Discussion on cross-sectional thematic areas

### i. Accountability and Transparency

The Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) is apex institution for providing assistance to all activities around agriculture, livestock and fisheries with its constituent Departments of the Ministry of Agriculture & Farmers Welfare assisting in agriculture related activities. The Department of Agriculture, Cooperation & Farmers Welfare coordinates with the State Governments assisting them with the continuous progress in agricultural production across the country. The Directorate of Economics & Statistics, an attached office of DAC&FW is responsible for providing important statistics on area, production, cost and yield of principal crops, minimum support prices, to implement schemes related to improvement of agricultural statistics, and carrying out agro-economic research. The production of major crops in the country are released in 4 Advanced Estimates followed by Final Estimates available State-wise and at the national level for the 28 identified crops including pulses.

In agriculture sector, 15 schemes are identified for DBT implementation, out of which around 10 centrally sponsored schemes are linked to the DBT portal to ensure transparent delivery of financial assistance to beneficiaries including individual farmers, entrepreneurs, and State Governments. The Management Information System of these schemes is linked with Central Agriculture Portal ([dbtdacfw.gov.in](http://dbtdacfw.gov.in)).

The details of the scheme-wise DBT fund transfers in 2018-19 are given in the table below:

Table 11: Table showing DBT Transfers in Agriculture CSS in 2018-19

Scheme Name	Benefit Type	DBT Fund Transfer (in ₹)
Agriculture Technology Management Agency (ATMA) - Extension Functionaries	Cash	2,52,36,63,000
Agriculture Technology Management Agency (ATMA)- Farmers	Cash and In Kind	2,68,35,16,400
Integrated scheme on agriculture cooperation	In Kind	0
Krishi Unnati Yojana (KUY)-MOVCDNER	Cash and In Kind	0
Mission for Integrated Development of Horticulture	Cash	4,19,49,70,440

Scheme Name	Benefit Type	DBT Fund Transfer (in ₹)
National Food Security Mission - NFSM	Cash and In Kind	49,20,83,036
National Mission on Oilseeds and Oil Palm	Cash and In Kind	0
NMSA-Rainfed Area Development	Cash and In Kind	5,87,46,399
Pradhan Mantri Krishi Sinchai Yojana	Cash and In Kind	19,83,18,58,078
Sub Mission on Agriculture Mechanization-Centrally Sponsored	Cash	5,53,48,55,948
Sub-Mission on Seeds and Planting Material	Cash and In Kind	0

Source: <https://dbtbharat.gov.in/page/frontcontentview/?id=NjU=>

The details of the scheme-wise DBT beneficiaries in 2019-20 in the agriculture sector have been shown below:

Table12; Scheme-wise DBT beneficiaries in 2019-20

Scheme Name	Total Beneficiary	Total Aadhaar	Total Mobile
Integrated Scheme on Agriculture Cooperation	25507	0	3678
Agriculture Technology Management Agency - Extension Functionaries	65038	53117	65016
Agriculture Technology Management Agency - Farmers	1354384	89147	528400
Krishi Unnati Yojna (KUY)-MOVCDNER	0	0	0
Sub Mission on Agriculture Mechanization	201147	201147	198017
Mission for Integrated Development of Horticulture	141067	141017	60367
National Food Security Mission	130225	47101	103378
National Mission On Oilseeds And Oil Palm	0	0	0
National Mission on Sustainable Agriculture-Rainfed Area Development	4182	3882	3517
Pradhan Mantri Krishi Sinchai Yojana	343240	343240	298382
Sub Mission on Seeds and Planting Material	426522	426522	426522

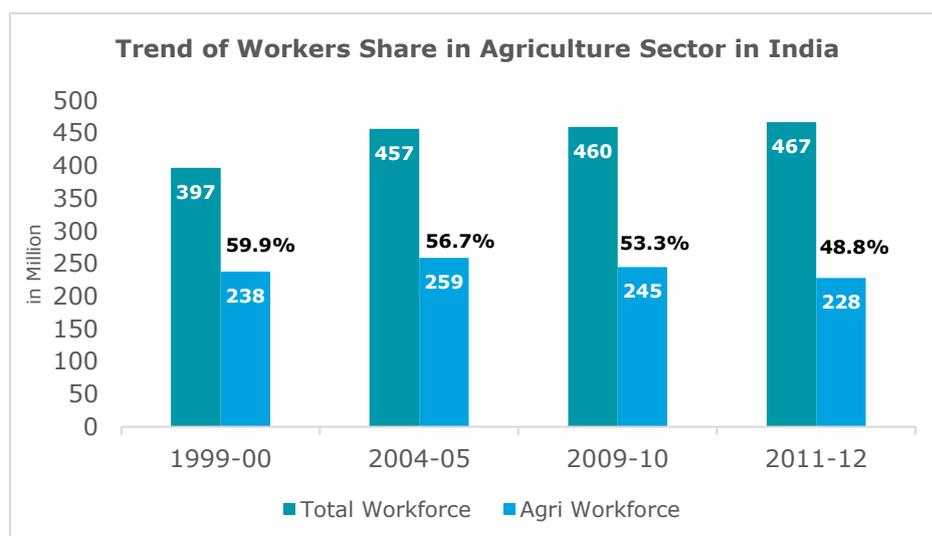
Source: <https://dbtdacfw.gov.in/DBTBharatSchemeDashboard.aspx>

## ii. Direct/indirect employment generation

Shortage of agricultural labour in the sector has emerged as one of major challenge for the agriculture sector. The workforce engaged in agriculture sector was pegged at 228.3 million in 2011-12 out of a total workforce in the country of 467 million, having the highest share of workers in the country<sup>34</sup>. However, the trend of workers engaged in agriculture has been decreasing over the years not just as a share in total employment but also in absolute numbers employed in the sector.

<sup>34</sup> FICCI, KPMG. 2015. Labour in Indian Agriculture: A Growing Challenge.

Figure 65: Trend of Workers Share in Agriculture Sector in India

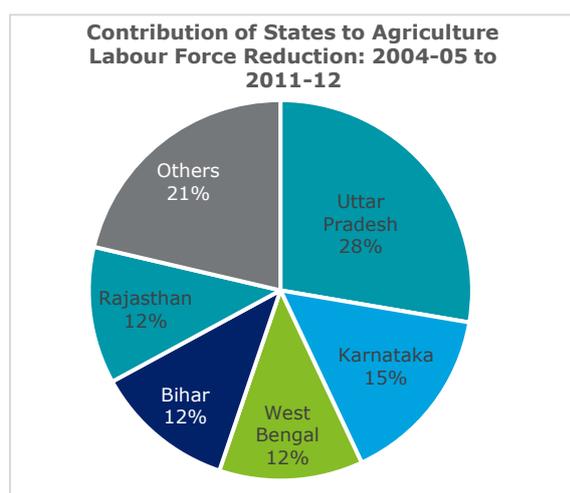


Source: FICCI, KPMG. 2015. Labour in Indian Agriculture: A Growing Challenge

The trend of declining workers share in agriculture depicts the growing problem of agriculture labour shortage with fewer people being added to the sector and many of the workers migrating to other remunerative sectors. It has been observed that around 2 million people were added to the workforce since 2004-05 compared to around 12 million people that were added to the workforce every year as an average between 1999-00 and 2004-05.

A state-wise analysis of agriculture labour productivity suggests that around 80% of the reduction in agriculture between 2004-05 and 2011-12 is attributed to the reduction in agriculture workers in five states, namely Uttar Pradesh, Karnataka, West Bengal, Bihar and Rajasthan.

Figure 66: Contribution of States to Agriculture Labour Force Reduction: 2004-05 to 2011-12



State	Agricultural Labour (million)		Reduction (million)
	2004-05	2011-12	
Uttar Pradesh	43.3	34.83	8.47
Karnataka	17.6	12.91	4.69
West Bengal	15.5	11.79	3.71
Bihar	21.3	17.67	3.63
Rajasthan	17.4	13.83	3.56
Others	143.83	137.31	6.52
<b>Total</b>	<b>258.93</b>	<b>228.34</b>	<b>30.58</b>

Source: FICCI, KPMG. 2015. Labour in Indian Agriculture: A Growing Challenge

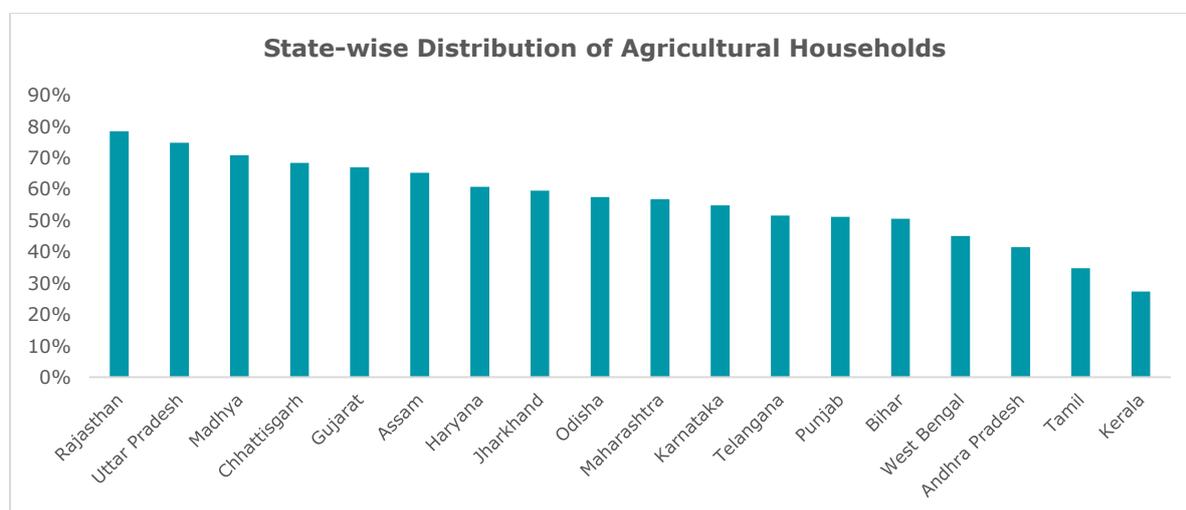
The graph shown above depicts that most of the agrarian states in the country experienced the drop in agriculture labour force during 2004-05 to 2011-12, with Uttar Pradesh having the maximum decline by 28% followed by states like Karnataka (15%), West Bengal (12%), Bihar (12%) and Rajasthan (12%). Some of the top reasons causing labour attrition is because

agriculture is less profitable than other occupations available in the secondary and tertiary sectors and there is preference for a permanent/ regular job compared to agriculture which is a seasonal occupation. The shift in rural employment under the primary sector has decreased from 71% and 64% while the employment in secondary sector gained from 15% to 20% between the period 2004-05 and 2011-12<sup>35</sup>.

Certain crops production which requires significant amount of labour hours per unit of area cultivated are also affected by scarcity of labour. Crops such as paddy, wheat, cotton sugarcane and groundnut are among the most likely to be affected by labour scarcity. As per the analysis of the FICCI-KPMG Study on Labour in Indian Agriculture, the states of Uttar Pradesh, Maharashtra, Andhra Pradesh, Punjab, Madhya Pradesh and West Bengal have substantial coverage under the labour intensive crops and consequently have higher propensity to face labour challenges in the near future.

In 2012-13, the number of agricultural households in India was pegged at 90.2 million which constituted around 57.8% of the total estimated rural households of the country.<sup>36</sup>

Figure 671: State-wise distribution of Agricultural Households



Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

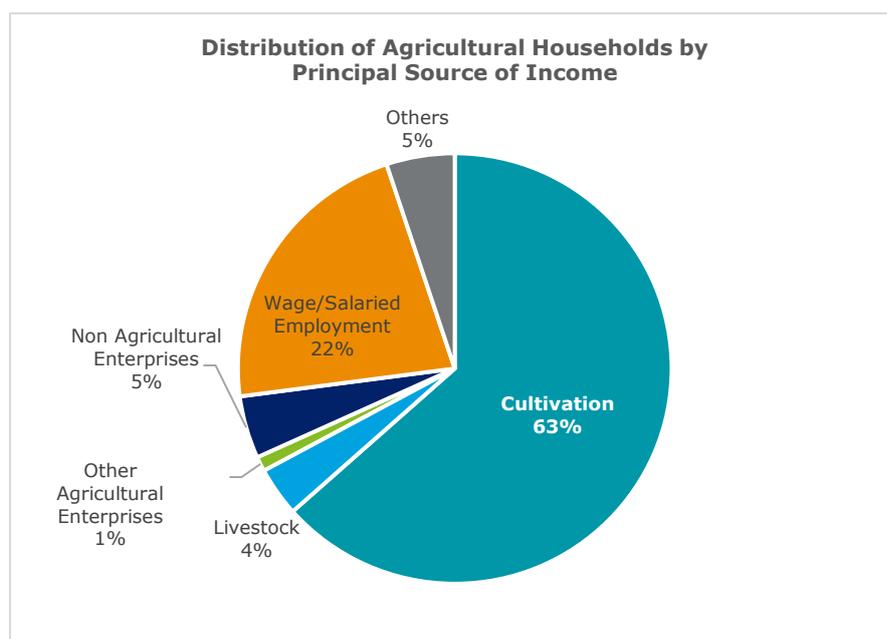
Among the major States, Rajasthan had highest percentage of agricultural households (78.4%) among its rural households followed by Uttar Pradesh (74.8%) and Madhya Pradesh (70.8%).

The principal source of income for the agricultural households has also been analysed and it reveals that agricultural households mainly depend on cultivation followed by wage/ salaried employment. The figure below shows the various sources of principal income for the agricultural households in the country as of 2012-13.

<sup>35</sup> FICCI, KPMG. 2015. Labour in Indian Agriculture: A Growing Challenge

<sup>36</sup> NSS 70<sup>th</sup> Round. 2013. Key Indicators of Situation of Agricultural Households in India Report

Figure 68: Distribution of Agricultural Households by Principal Source of Income



Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

Out of all agriculture based employment, cultivation has the highest share, with 63% of agriculture households depending on cultivation for their principal income generation and 4% of the agricultural households depending on livestock rearing for the same. When the classification of agricultural household's principal income generation is assessed according to their landholdings, it is found that households with larger landholdings are likely to be more dependent on cultivation.

Table 13: Table showing distribution of Agricultural Households by principal source of income, classified by land holdings

Size class of land possessed (ha)	Per 1000 distribution of households by principal source of income						Estimated no. of Agri. Households ('00)
	Cultivation	Livestock	Other Agricultural Enterprises	Non-agricultural enterprises	Wage/salaried employment	Others	
<0.01	16	229	27	108	564	55	23890
0.01-0.04	421	48	12	75	352	93	287663
0.04-1.00	692	23	9	36	200	41	314811
1.00-2.00	830	25	9	32	86	18	154577
2.01-4.00	859	24	11	16	71	18	84345
4.01-10.00	879	27	5	9	59	20	33019
10.01<	894	55	15	18	17	1	3709
All Sizes	635	37	11	47	220	51	902011

Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

The table above shows the share of agricultural households' dependency on cultivation across different landholdings. The households with very low land holdings, i.e. less than 0.04 hectare have lesser dependency on cultivation and their principal source of income comes from wages/salaried employment, livestock or even non-agricultural enterprises.

### iii. Gender Mainstreaming

Agriculture provides employment to the adult males as well as the adult females of a household. Women have a critical role in cultivation and have been engaged in production of major grains and millets, in land preparation, seed selection and seedling production, sowing, applying manure, weeding, transplanting, threshing, winnowing and harvesting.

Table 14: Change in Women Participation in India between 2001 and 2011

Work Participation Rate Statistics	2001	2011
Overall work participation rate in India	39.2	39.8
Work Participation Rate amongst women	25.6	25.5
Work Participation Rate amongst men	51.9	53.9
Women cultivators amongst total cultivators	32.3	30.3
Women Agri. Labourers (AL) amongst total AL	46.6	42.7

Source: <https://icar-ciwa.org.in/gks/index.php/information-and-statistics-section/90-gender-participation>

Globally, the rate of participation of women in agriculture has been pegged at 42% as of 2010, where as in India over 60% of women are engaged in agriculture<sup>37</sup>. The overall worker participation rate amongst women in India is only 25.5%, whereas the same among men is 53.9% (refer table given alongside). There has been no improvement in the worker participation rate amongst women between 2001 and 2011. In agriculture sector, share of women cultivators amongst total cultivators have decreased from 32.3% (2001) to 30.3% (2011). Women agricultural labourers have also decreased from 46.6% (2001) to 42.7% (2011) as seen from the table above. It is also observed that the share of women in total agricultural workers which continuously increased during last 50 years to 39% in 2001 declined to about 37% in 2011<sup>38</sup>. With the trend of agriculture accommodating lesser number of women workers in the future, it is important to take up suitable technological and policy initiatives for increasing the involvement of the women workers in agriculture.

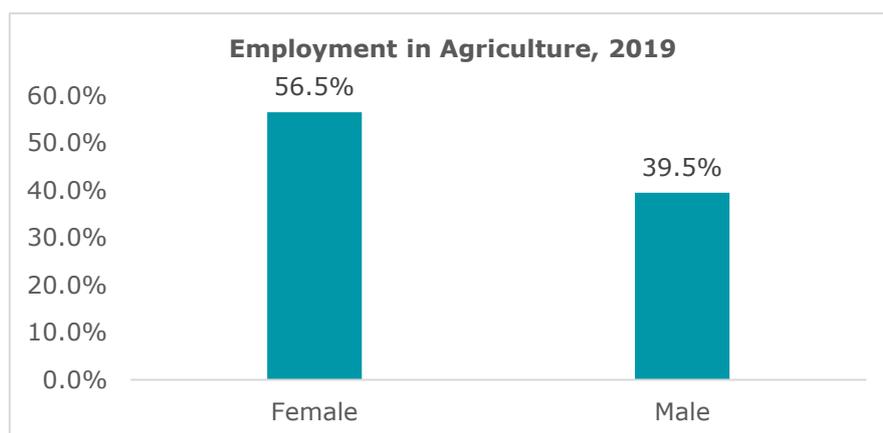
Female in the agriculture group represents a crucial demographic group. Rural women form the most productive work force in the economy for a majority of the nations, including India. Women in rural families can be considered as 'farmers' in some sense, working as agricultural labourers, unpaid workers in the family farm enterprises or combination of the two<sup>39</sup>. Women are mostly engaged in labour intensive work such as seed preparation for sowing, raising nurseries for seedlings, thinning, sowing, transplanting, weeding, preparation of fertilizers as well as application of fertilizer, in gap filling, winnowing, grading, shifting produce to threshing floor, cleaning and processing the grain etc. As of 2019, 56.5% of women vis-à-vis 39.5% men are engaged in agriculture, as highlighted in the figure below.

<sup>37</sup> ICAR-CIWA. Vision 2050.

<sup>38</sup> ICAR-CIWA. Vision 2050.

<sup>39</sup> NITI Aayog. 2017. Doubling Farmers' Income Report Volume 11, Chapter 6

Figure 69: Employment in Agriculture in India (2019) – male vs female, modelled ILO estimates



Source: World Bank Group, <https://data.worldbank.org/indicator/SL.AGR.EMPL.FE.ZS?locations=IN>

Women play an important role in agriculture during crop production, post-harvest operations, etc. The share of operational holdings cultivated by women has increased to 13.9% in 2015-16 from 11.7% in 2005-06.

Table 15: Operational Land Holding Operation by Women

Size Group	2005-06	2010-11	2015-16
Marginal (below 1.00 ha)	12.6	13.6	14.6
Small (1.00-2.00 ha)	11.1	12.2	13.3
Semi-Medium (2.00-4.00 ha)	9.6	10.5	11.5
Medium (4.00-10.00 ha)	7.8	8.5	9.6
Large (10.00 ha & above)	6	6.8	7.7
All Size Groups	<b>11.7</b>	<b>12.8</b>	<b>13.9</b>

Source: Agriculture Census 2015-16

The above indicates an increased participation of women in the management and operation of agricultural lands.

The growing inequity among the women engaged in agriculture is riddled with various issues. The problems faced by the women at the farm are<sup>40</sup>:

- Lack of Extension Services: Extension services seem to be biased towards men who are recognized as the owner of farms and pass on the extension information to women in the households. This often results in depriving women who are engaged as agricultural workers from obtaining key knowledge of improved farming practices.
- Land Ownership: Lack of ownership of land/ access to land for women continues to be major obstacle to increasing their contribution and benefits.
- Overburden: Women are often involved in labour intensive, monotonous, repetitive and drudgery prone work, which are carried out manually, leading to mental and physical exhaustion and occupational health hazards.

<sup>40</sup> ICAR-CIWA. 2018. Compendium of Training Programme on Gender Sensitization of Extension Functionaries for Engendering Agriculture. Retrieved from <https://krishi.icar.gov.in/jspui/bitstream/123456789/26136/1/01%20Compendium.pdf>

- Limited Access to Resources: Having no direct ownership of land, women face constraint of money and other resources required for cultivation. Women have limited access to markets as well. The current transport and marketing facilities also are not inclusive of the needs of the women farmers and traders.
- Migration of Men: Migration of spouses to cities to earn a living have led to increase in responsibilities for women in the rural agricultural households.
- Socio-Economic Status: It is observed that women's share of work in agriculture is greatest among small farmers. Women in landless households spend twice as much time working for wages in agriculture than women in families with land.
- Lack of Education: Due to illiteracy, women are forced to work as unskilled labourers. One of the studies showed that agricultural productivity increased with increase in primary education of at least 4 years.<sup>41</sup>

Incorporation of gender perspective in policies, plan, programmes and projects can effectively bring gender equity in farming. Some of the strategies that can help in mainstreaming women in agriculture are as follows:

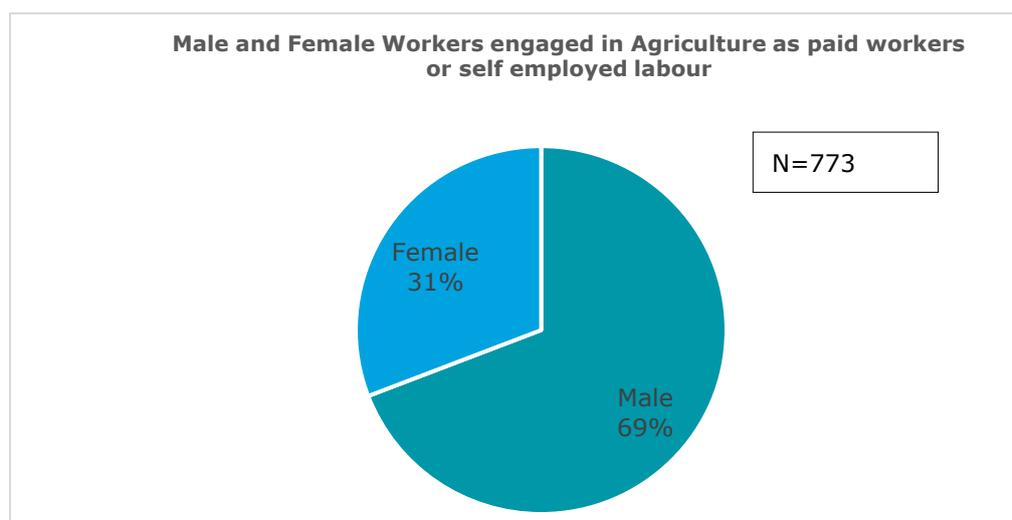
- Collation of gender based data and understand the requirement of women farmers to design women friendly farm equipment
- Sensitization of extension workers to include women farmers
- Training should be made available to women in the use of technologies
- Sensitizing public, private agencies, policy makers, planners on the gender perspective in environmental and developmental issues
- Planning at the local panchayat level should be gender-sensitive and should have gender/sex-segregated information

As observed in the HH survey, out of all workers engaged in agricultural activities as self-employed or paid workers, 31% are women. The analysis of male and female workers engaged in agricultural activities as self-employed workers or paid workers at farm households has been given in the graph below.

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<sup>41</sup> ICAR-CIWA. 2018. Compendium of Training Programme on Gender Sensitization of Extension Functionaries for Engendering Agriculture. Retrieved from <https://krishi.icar.gov.in/jspui/bitstream/123456789/26136/1/01%20Compendium.pdf>

Figure 70: Share of Male and Female workers in Agriculture households



Source: HH Survey, Deloitte Analysis

Box 1: Strengthening women farmers’ role in sugarcane value chain

**Case Study: Strengthening women farmers’ role in sugarcane value chain**

**Introduction:**

Globally, India is the second largest sugarcane producer, contributing to about 10% of its agricultural GDP (Solomon, S. 2016. Sugarcane Production and Development of Sugar Industry in India. Sugar Tech., 18(6)). Female employment in agriculture in 2018 stood at 55.38% (ILOSTAT database, September 2018). According to the 2011 census, the agriculture sector employs nearly 98 million women, with about 63% of them serving as agricultural laborers (DownToEarth, Defeminisation of Indian agriculture, 8 March 2018). Yet, their contribution remains undervalued – especially in sectors such as sugarcane farming, which are perceived to be male-dominated.

**Challenge:**

DCM Shriram Limited is one of India’s largest business conglomerates, with a strong focus on agribusiness in rural India. Much of its sugarcane produce comes from Hardoi, Uttar Pradesh, one of the poorest, most patriarchal, and most disadvantaged districts in the country, with 66% of its population living below the poverty line. Hardoi has an agriculture-based economy, with sugarcane as the main cash crop.

Although women actively participate in the sugarcane value chain, their work and contribution are often overlooked. Women’s work is labor-intensive and frequently concentrated at the very start of the value-chain, such as in weeding or planting. Sugarcane farming is often perceived to be a male-dominated activity--so training and programs that allow farmers to increase their yield and income are often not targeted at women. Male farmers typically have assets registered in their name, resulting in the exclusion of women farmers or farmers’ wives from accessing credit, markets, or becoming members of farmers’ networks. Women also tend to have limited economic access both within their community and outside because of restrictive social norms and care responsibilities toward the well-being of elders, children, livestock, and other assets.

**Solution:**

Under the Meetha-Sona-Unnati program, DCM Shriram and IFC, in collaboration with Solidaridad Network Asia and Coca-Cola India, developed an approach to build the capacity of farmers, to increase

agricultural yield and conserve water and soil health. DCM Shriram and IFC developed specific solutions to increase the visibility of the work done by women farmers and their impact on improving farm yields:

- DCM Shriram and IFC identified key operations where women laborers and farmers are the dominant workforce on ground. The project applied the Women's Empowerment Agriculture Index, an innovative measurement tool to diagnose areas of disempowerment of women in agriculture and design development programs to address those areas. This assessment marked a significant shift from earlier gender-blind analysis and enabled the project team to create targeted trainings for women farmers on improving their skills and knowledge.
- Based on the findings of the baseline on women's roles and crop yield barriers, the project team hired a female trainer to hold training sessions for women on mechanization, entrepreneurship, and financial literacy. To address low participation, wider outreach and convenience, especially for women farmers, the team brought in a mobile van to deliver the trainings closer to farmers' homes.
- This effort was further complemented by focus group discussions with women in the villages, to strengthen their role and participation in the sugarcane value chain.

**Impact:**

- Trainings for more than 1,000 women in the classroom and mobile vans on Good Agri Water Management Practices (GAWMP) have led to an increased yield (of 25 percent) in the DCM Shriram production catchments.
- The yield increase translated into increased income for the farmers, often doubling their existing income.
- The trainings encouraged women to take on larger and less labor-intensive roles in the agricultural value chain (such as, learning how to operate farm machinery).
- Some sessions were conducted for both women and men together. Such trainings demonstrated how they could work together despite the gender-segregated culture.
- DCM Shriram and IFC along with other key partners are now exploring how to enable more than 10,000 women farmers in the sugarcane growing region to participate in dairy farming, as an additional income generating activity.

Source: IFC, Gender Smart Business Solutions, Strengthening women farmers in DCM Shriram's Sugarcane Value Chain, May 2019

***iv. Climate change & sustainability including adoption of climate-change resilient practices & diversifications***

Climate change is a threat to agriculture productivity and could impact livelihood and income of farmers. According to the Intergovernmental Panel on Climate Change (IPCC), approximately a quarter of all anthropogenic GHG emissions worldwide are caused by agriculture, forestry and land use changes. Nearly 80% of poor population of the world who lives in rural areas and typically rely on agriculture, forestry and fisheries for their survival are affected.<sup>42</sup> The severity of climate change is likely to increase in future and there could be drop in crop yields by 10 to 25 percent by 2050 in the face of climate change.

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<sup>42</sup> FAO. 2019. Agriculture and climate change. Retrieved from <http://www.fao.org/climate-change/en/>

Effects of climate change can significantly affect major crops grown in India. A study<sup>43</sup> on the top grains grown in the country reflects that the national food supply (which is closely associated with grain production) is sensitive to the effect of climate variability on monsoon grain production. The research analysed data on yields of five major grain crops of India (finger millet, maize, pearl millet, sorghum and rice) over 46 years (1966-2011) and covering 593 of India's 707 districts. The findings revealed yields from rice, India's main crop experienced larger declines during extreme weather conditions and reliance on single crop like rice for food security can make India's food supply potentially more vulnerable to the effects of varying climate. On the other hand, yield of other crops included in the study such as millet, sorghum, and maize were found to be more resilient to the extreme weather. These alternative grains therefore offer promise for reducing variations in Indian grain production in response to climate shocks, but avoiding grain production shortfalls from increased alternative grains will require yield improvements that do not compromise their superior climate resilience. To address the issue, it is recommended to expand the area under the alternate grains like millet, sorghum, and maize during the monsoon season. This could potentially offer protection to the country's grain supply which has been varying during the episodes of extreme climate such as droughts and storms.

According to estimates of ICAR studies, yields of irrigated rice is projected to decrease by about 4% in 2020, 7% in 2050 and 10% in 2080<sup>44</sup>. Climate change is projected to reduce timely-sown irrigated wheat production by about 6% in 2020. In case of late sown wheat, however, the projected reductions are to the extent of 18, 23 and 25 percent in 2020, 2050 and 2080 respectively. Rainfed sorghum yields are projected to decline marginally (2.5%) in 2020 scenario and by about 8% in 2050.

In order to combat the impacts of climate change on agriculture, Government through Indian Council of Agricultural Research (ICAR) has initiated a network project on 'National Initiative on Climate Resilient Agriculture' (NICRA) to enhance resilience of Indian agriculture through Strategic Research on adaptation and mitigation (covering crops, livestock, fisheries and natural resource management), Technology Demonstration, Capacity Building and Sponsored/Competitive Grant Projects. The Centrally Sponsored Scheme, National Mission on Sustainable Agriculture (NMSA) aims at promoting sustainable agriculture through a series of adaptation measures focusing on ten key dimensions encompassing Indian agriculture namely; 'Improved crop seeds, livestock and fish cultures', 'Water Use Efficiency', 'Pest Management', 'Improved Farm Practices', 'Nutrient Management', 'Agricultural insurance', 'Credit support', 'Markets', 'Access to Information' and 'Livelihood diversification'. NMSA caters to key dimensions of 'Water use efficiency', 'Nutrient Management' and 'Livelihood diversification' through adoption of sustainable development pathway by progressively shifting to environmental friendly technologies, adoption of energy efficient equipment, conservation of natural resources, integrated farming, etc.

As analysed in the Doubling Farmer's Income Report, profiling of vulnerable districts across the country has been made by linking climate vulnerability with farmers' income. The vulnerability of agriculture to climate change at district level is drawn from three components such as Exposure, Sensitivity and Adaptive Capacity of the districts<sup>45</sup>. The same has been set against the poorest districts with lowest income status of farmers coming from crop sector as per NSSO-SAS

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<sup>43</sup> Davis. 2019. Sensitivity of grain yields to historical climate variability in India. Published by Environmental Research letters. Retrieved from <https://iopscience.iop.org/article/10.1088/1748-9326/ab22db>

<sup>44</sup> <https://pib.gov.in/newsite/PrintRelease.aspx?relid=98571>

<sup>45</sup> Niti Aayog. 2017. Doubling Farmers Income Report, Volume I

survey, 2013. Low income reduces the adaptive capacity of the farmers to withstand climate shocks and thus increases the risk of the small and marginal farmers further to the adversities of climate change effects. The identified Double stressed Districts in terms of Climate Vulnerability and Low Farm Income are given in the table below:

Table 16: Double stressed Districts in terms of Climate Vulnerability and Low Farm Income (Crop Sector)

<b>States</b>	<b>Districts</b>
Bihar	Madhubani, Araria, Bhagalpur, Gopalgunj, Saran, Saharsa
Chhattisgarh	Bijapur
Gujarat	Surendranagar
Himachal Pradesh	Hamirpur
Jharkhand	Godda, Sahibgunj
Madhya Pradesh	Ratlam, Mandla
Maharashtra	Jalna, Aurangabad
Rajasthan	Nagaur, Jaisalmer, Pali, Udaipur, Dungarpur, Banswara
Tamil Nadu	Ramanathapuram
Uttar Pradesh	Banda, Deoria, Ballia, Chamoli
Uttarakhand	Bageshwar, Almora

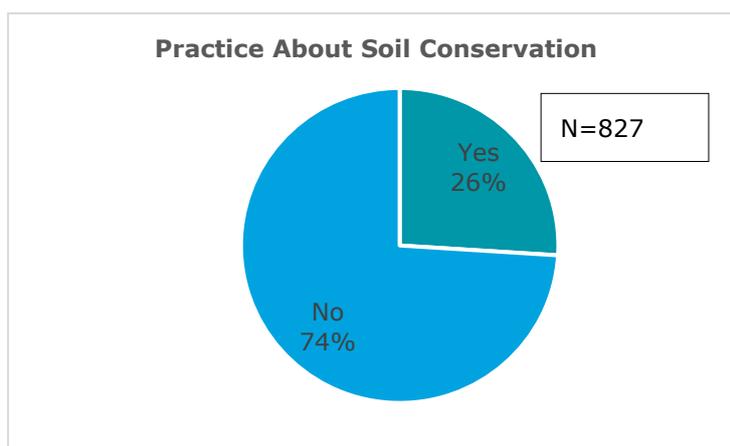
Source: Doubling Farmers Income Report, Volume I

These 28 districts are highly vulnerable and disadvantaged in terms of double stress created from low farm income as well as high climate vulnerability. These districts require priority attention in terms of area specific policy formulation as well as implementation to enhance income of farmers, thereby thus raising their adaptive capacity and reducing vulnerability of agriculture to climate change in these areas.

Among these identified double stressed districts, the land holdings of farmers are on the lower side with most farmers being small and marginal farmers. Also, the number of people depending on non-farm income are in minority in these states, thus the majority of people in all these states are largely dependent on agriculture. In these climate sensitive states, the percentage of gross irrigated area to total cropped area is less than 50% making these areas prone to rainfall fluctuations. It is also observed that the area under horticultural crops is also quite low in all these states. All these states are also marked by high population and low literacy level in rural areas. It is recommended to design programmes to ensure higher growth in these districts. Technological programs supported by agricultural science centres like ICAR, SAUs, KVKs etc. can mentor these districts in association with state governments.

The HH Survey has analysed the practice around soil conservation among agricultural farmers. The graph below shows the findings.

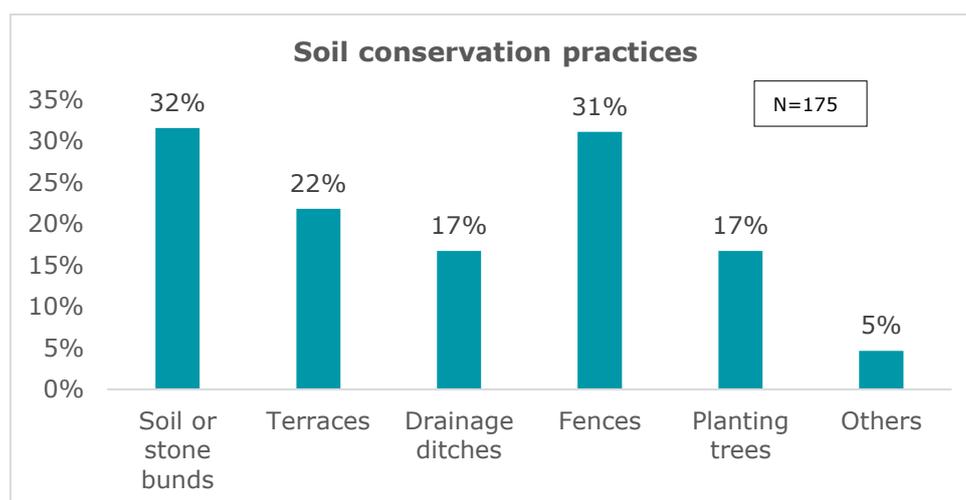
Figure 71: Practice of Soil Conservation



Source: HH Survey, Deloitte Analysis

As observed from the graph above, only around 26% of farmers practice soil conservation. The various practices of soil conservation have been also analysed and presented in the following graph.

Figure72: Soil Conservation Practices

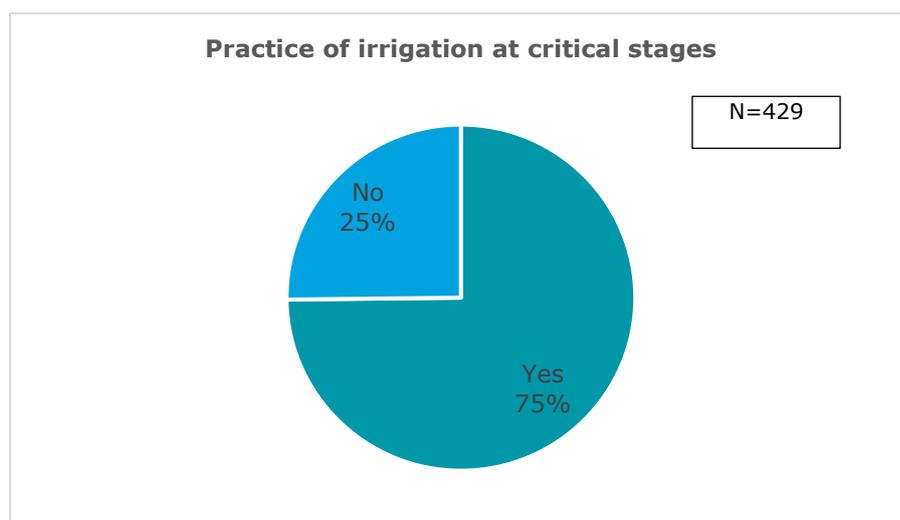


Source: HH Survey, Deloitte Analysis

Note: The total of all practices can be more than 100% as multiple options are being practiced by farmers

It can be seen from above that around 22% of farmer have practiced terrace farming. Around 32% of farmers practice soil conservation techniques like soil or stone bunds, 31% of farmers practice techniques like fencing and 17% of farmers opt for planting trees to prevent soil erosion. Around 17% of farmers use drainage ditches for soil conservation.

Figure 732: Practice of irrigation at critical stages



Source: HH Survey, Deloitte Analysis

Another important aspect with respect to sustainability of operations relates to practice of irrigation at critical stages for reaping maximum benefits. Some of the critical stages of irrigation includes tillering, crown root initiation, booting, heading and flowering, blooming and seed formation among others. As observed from the graph above, around 75% of farmers practice irrigation at critical stages of farming which is a healthy indicator.

### **Crop Diversity**

Diversification of crops helps in mitigating risks of price shocks and production losses. However, the agricultural systems in India have become increasingly reliant on rice and wheat impacting crop diversity. The crop diversification index in India has also fallen down from 0.907 in 2011-12 to 0.899<sup>46</sup> in 2015-16. A comparison between the total cropped area between 1985-86 to 2013-14 suggests that the increase in non-food crop (44%) was much higher than the increase in food crops (10%). This is seen as the case of technology led diversification which led to reduction in area of coarse cereals, oilseeds and pulses<sup>47</sup>. Furthermore, the Economic surveys of India as well as Doubling farmers' income reports have highlighted the need for improving crop diversification in country to improve, soil health, productivity and resilience of crops.

Multiple schemes by Government of India as well as state governments are trying to encourage crop diversification. NFSM which is one of the major schemes, targets increased production of pulses, coarse cereals, nutri-cereals and oil seeds along with rice and wheat to ensure food security in India. Interventions under NFSM have targeted increase in area under pulses through distribution of quality seeds, field demonstrations, promotion of micronutrients and creation of seed hubs. However, the scheme suffers from inadequate staff strength at field level for implementation as well as delay in disbursement of funds at state level. Promotion of coarse and nutri-cereals is an important component which requires increased attention. MIDH is another scheme which is promoting diversification through promotion of activities for increase in horticulture production and value chain development. The scheme has been successful in increasing horticulture area but is facing challenges in getting quality planting material, marketing of produce, delayed funding and variation in performance among states. Also, RAD is giving

<sup>46</sup> Economic survey of India, 2017-18

<sup>47</sup> Demand supply projections towards, 2033, crops livestock and Agricultural Inputs, NITI aayog, 2018

precedence to promotion of Integrated Farming Systems. However, majority of interventions are for promotion of dairy based integrated farming. In addition, RKVY has also supported interventions to shift area from paddy to alternate crops in Punjab, Haryana and Western UP<sup>48</sup>. In view of the above, there is need to provide more focus on interventions that aim to encourage diversification of crops.

### **Water Use Efficiency**

Indian agriculture is primarily rain-fed, Government of India is putting thrust on scaling up of irrigation projects through its various schemes. But variation in rainfall and depleting ground water level poses challenge to agriculture; especially when the cropping systems are becoming more resource intensive with focus on rice, wheat and sugarcane. To push for increasing water-use efficiency, major schemes such as PMKSY and MIDH, are promoting micro-irrigation through drip and sprinklers. However, the scale of these schemes is limited for required interventions. As can be seen that the progress of PMKSY-PDMC is limited largely to six states and mostly concentrated in southern and western region of the country. Penetration of these schemes for promoting drip irrigation in northern, eastern and central India remains limited. In addition, the impact from adoption of micro-irrigation systems is not being evaluated at field level, which can assist in bringing in efficiency and effectiveness. Also, the soil resource mapping and classifications are also not being utilised uniformly across all schemes in planning and proposing intervention areas.

Box 2: Floating Gardens - Climate smart agriculture production system in Bangladesh

#### **Case Study: Floating Gardens - Climate smart agriculture production system in Bangladesh**

##### **Introduction:**

Evidence of climate change in Bangladesh can be seen in an accumulation of heavy rains, frequent storms and rising sea levels that result in severe flooding. Due to continuous water-logged conditions, crops are often lost and land for agriculture has become scarce. The low-lying areas of the southern coastal – and southcentral – districts of Bangladesh remain submerged for 6–8 month periods every year, especially during the monsoon season. As a result, crop cultivation is not possible on land.

##### **Solution:**

A 2015 FAO study in Bangladesh revealed an innovative location-specific adaptation to climate change for improving the food security of the nation's vulnerable people. In the low-lands of Bangladesh, some farmers have converted the prolonged flooding season into an opportunity: "floating gardens". These are floating plots made from local organic material on which diversified vegetables are grown or seedlings are raised for marketing.

In this system, farmers prepare the rectangular-shaped beds during June and July and sow/transplant seeds eight to ten days after the last stacking to the garden bed. Around 30 species of vegetables, spices and other crops or seedlings are grown in this water-based production system. The major vegetable crops are okra, ribbed gourd, Indian spinach, brinjal, cucumber, red amaranth, stem amaranth, wax gourd and (in winter) turnip, papaya, cabbage, cauliflower, tomato and red amaranth. The spices, turmeric and chili are also grown. Mixed intercropping is the most prevalent system.

Recycling is an important component of this production system. Garden beds are made from local organic material (plants) that are almost free, recyclable and do not pollute. When the floodwater recedes, decomposed beds are used as compost on the ground to grow winter crops.

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<sup>48</sup> Demand supply projections towards, 2033, crops livestock and Agricultural Inputs, NITI aayog, 2018

**Impact:**

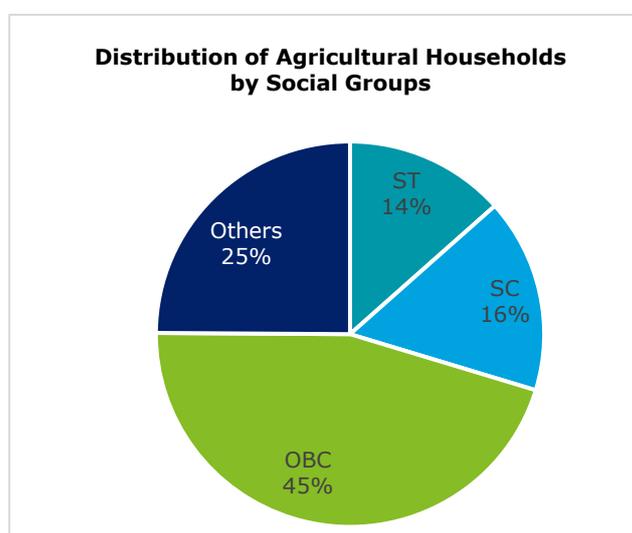
- The FAO study found that farmers operating the floating gardens system received an average gross return of USD 265 and a net return of USD 134 per season. In comparison, when cropping on plain land, farmers received an average gross return of USD 31 and a net return of USD 10. The floating gardens production system clearly increases the farmers' incomes and is more profitable than vegetable cultivation on plain land.
- The floating gardens led to a reduction of vulnerability to income of farmers in areas with heavy rainfall.

Source: FAO, Climate-Smart agriculture Case Studies 2018: Successful approaches from different regions

**v. Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population**

The share of socially disadvantaged groups among agricultural households in India have been given in the chart below.

Figure 74: Table showing distribution of SC, ST, and OBC among Agricultural Households



Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

Distribution of agricultural households by social group for each decile class of monthly per capita consumer expenditure (MPCE) reveals the economic status of the socially backward group in the country. According to the table given below, the bottom three decile classes had higher representation of ST and SC agricultural households compared to their shares in the all classes defined by MPCE. The percentages of SC and ST agricultural households in the top two deciles are very low. It can be observed that percentage share of ST agricultural households sharply declined from about 31 % in the lowest class to little more than 6 % in the highest class. Among the SC agricultural households, percentage share of SC households is around 20% in the first six classes (except the 5th class) and near about 15 % in the next three classes.

Table 17: Per 1000 distribution of agricultural households by social group for each decile of MPCE

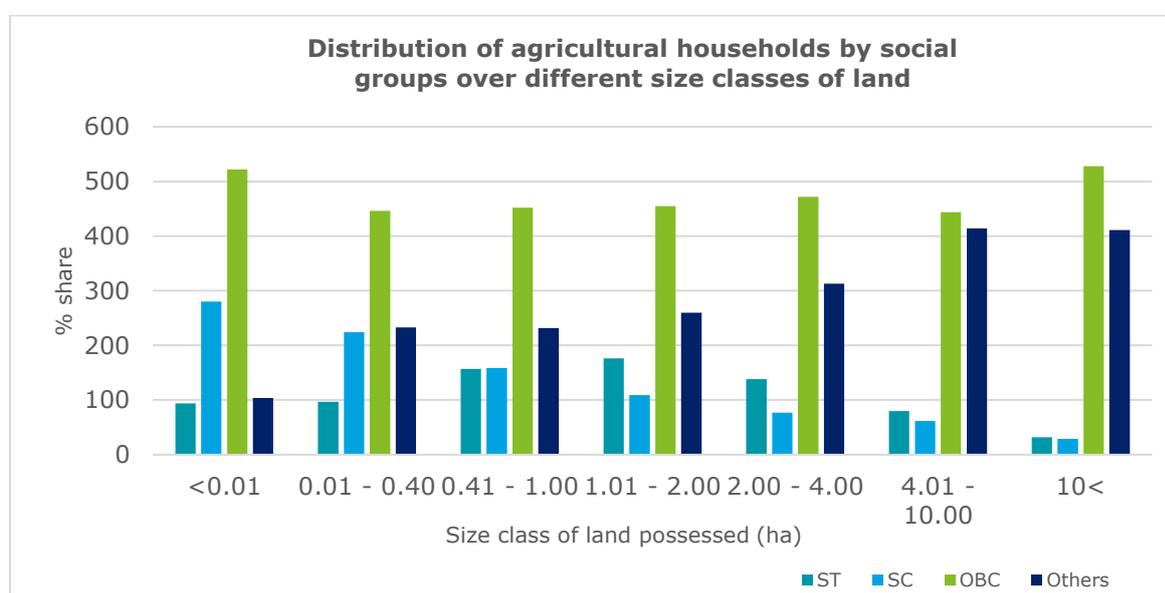
MPCE (monthly per capita consumer expenditure)	ST	SC	OBC	Others
1	306	206	375	113

2	205	184	444	168
3	173	199	465	163
4	126	184	484	205
5	144	147	474	235
6	106	184	474	235
7	123	164	480	232
8	108	157	475	260
9	83	140	479	298
10	65	105	388	442

Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

The similar picture is reflected in the distribution of agricultural households by social groups over different size classes of land holdings.

Figure 75: Distribution of agricultural households by social groups



Source: NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India

As it can be seen from the graph above that the percentage share of ST agricultural households increased from the lowest size class of land possessed and reached its maximum in the 4<sup>th</sup> size class (1.01-2.00 hectare) and then gradually decreased to its lowest level at the highest size class. The percentage share of SC agricultural households decreased gradually from 28 percent in the lowest size class to about 3 percent in the highest size class of land possessed.

The findings depicted above implies that there is a persisting economic disparity across different disadvantaged social groups. Farmers belonging to the castes and communities that are located on the lower rungs of the social hierarchy—henceforth the ‘socially-marginalized castes’—are found to have limited access to the factors of agricultural production, which could further result in lower farm income.<sup>49</sup> These socially marginalized classes often remain excluded from benefiting from rural development programs. The exclusion of the marginalized social groups from access to agricultural resources have led to reduction in farm productivity as well as

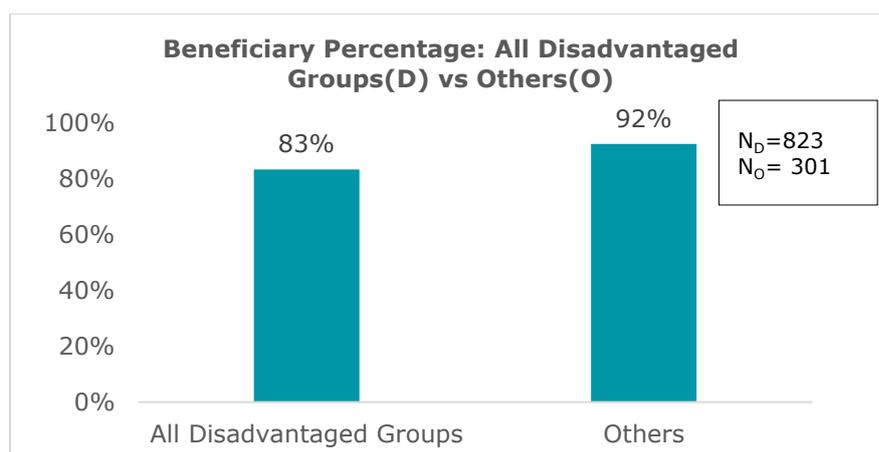
<sup>49</sup> Krishna. 2019. Does caste determine farmer access to quality information?. Retrieved from <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0210721#sec012>

household income potential of the marginalized communities. According to a study<sup>50</sup> based on NSSO Survey of Key Indicators of Situation of Agricultural Households in India, it has been observed that economic inequalities among farm households of various social groups in rural India emerge largely from caste inequalities in ownership and access to means of production and technology. Farmers of the socially-marginalized castes are economically-disadvantaged due to three factors: (1) inferior resource endowment status, (2) exclusion from public extension networks, and (3) and regional differences in the quality of extension services and infrastructure.

To address the issue of disparities among the socially disadvantaged groups in India and support them in their livelihoods associated with agriculture, it is important to analyse the inter-caste inequities among farm households of various social groups given there is a dearth of information on inter-caste differences in the quality of production resources managed by the farm households, which might also contribute to the lower marginal returns to extension services. Policies and agricultural extension services focusing on ecosystem, health and natural resource conservation alongside improving yield rates is relevant for marginalized farm households.

Analysis of HH Survey reveals the beneficiary percentage among all disadvantaged groups<sup>51</sup> as part of Green Revolution scheme. The graph below shows the findings.

Figure 76: Beneficiary Percentage: All Disadvantaged Groups vs Others



Source: HH Survey, Deloitte Analysis

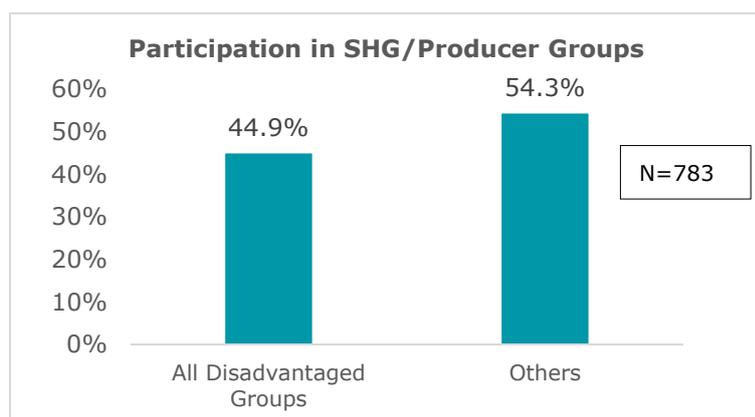
As observed from the graph above, among all agricultural farmers from all disadvantaged groups, around 83% of farmers are Green Revolution scheme beneficiaries. Among agricultural farmers from other social groups<sup>52</sup>, around 92% farmers are Green Revolution scheme beneficiaries. Further analysis of the HH Survey brings out the participation of all disadvantaged groups in Self Help Groups or Producer Groups.

<sup>50</sup> Krishna. 2019. Does caste determine farmer access to quality information?. Retrieved from <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0210721#sec012>

<sup>51</sup> All disadvantaged group includes Scheduled Castes, Scheduled Tribes and Other Backward Classes

<sup>52</sup> Other groups indicate social groups other than Scheduled Castes, Scheduled Tribes and Other Backward Classes

Figure 3: Participation of All Disadvantaged Groups in SHG/Producer Groups



Source: HH Survey, Deloitte Analysis

While 44.9% of all disadvantaged groups are part of SHG or producer groups, 54.3% of other<sup>53</sup> social groups are part of SHG or producer groups.

**vi. Use of IT/Technology in driving efficiency**

Information technology has been a major driving force for growth in business sectors. In a similar way, IT can also influence growth in agriculture by addressing issues around poor access to markets and financial services, low levels of human and physical capital, poor access to education and weak information flows. With application of ICT, transaction costs can be brought down, market reforms and market intelligence can be improved thus increasing efficiency of the food value chain. The digital technology can promote efficiency and inclusion alongside, catering to the needs of the socio-economically marginalized population.

Information and Communication Technology can contribute in agriculture sector by providing accurate information on weather, inputs, markets, and prices; by feeding information into research and development initiatives; by disseminating knowledge to farmers; by connecting producers and consumers, and through many other avenues<sup>54</sup>. The role of ICT in agriculture can cater to the following areas<sup>55</sup>:

- Agricultural extension and advisory services by bridging information gap between agricultural researchers, extension agents and farmers
- Promote environmentally sustainable farming practices by improving access to climate change solutions
- Disaster management & early warning system by providing actionable information to communities on disaster prevention in real time
- Enhanced market access for inputs as well as product marketing
- Food safety and traceability through reliable data complying with international standards
- Financial inclusion, insurance & risk management

<sup>53</sup> Other groups indicate social groups other than Scheduled Castes, Scheduled Tribes and Other Backward Classes

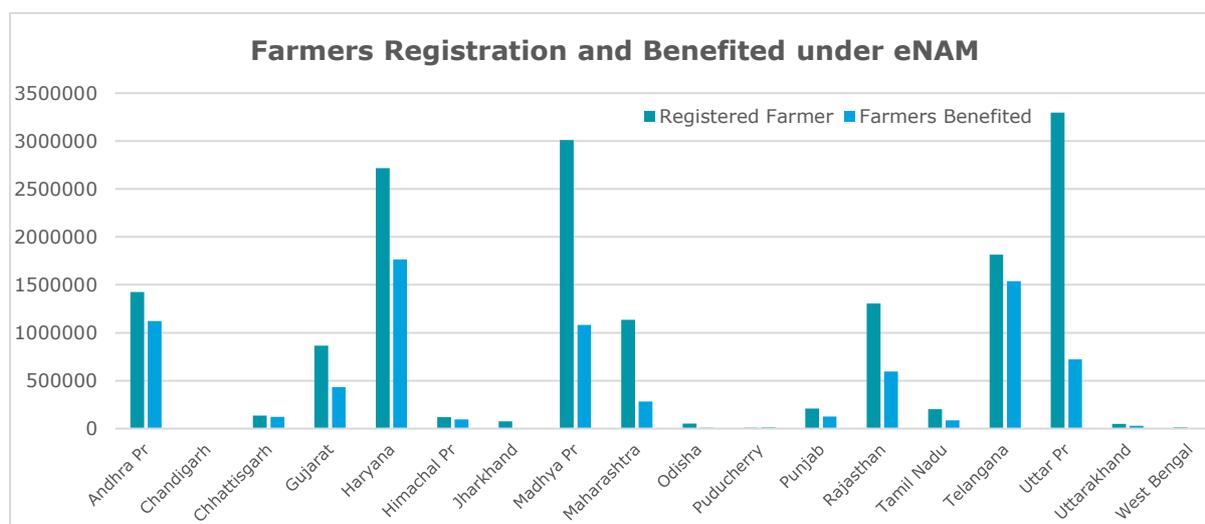
<sup>54</sup> FAO. 2017. Information and Communication Technology in Agriculture- A Report to the G20 Agricultural Deputies

<sup>55</sup> FAO. 2017. Information and Communication Technology in Agriculture- A Report to the G20 Agricultural Deputies

- Capability building & empowerment by providing new business opportunities enhancing livelihoods
- Regulatory policy and methodology to monitor progress

One of application of ICT in agriculture in India aimed at improving market access for all farmers is e-NAM, a pan-India electronic trading platform, which was launched by the government in 2016. The portal has been designed to create a transparent and competitive price discovery system to help farmers get remunerative prices for their produce. There are 585 wholesale regulated markets of 16 States and 02 Union Territories (UTs) who have been integrated with e-NAM platform. As on 30.06.2019, more than 1.64 crore farmers & more than 1.24 Lakhs traders have registered on e-NAM platform.<sup>56</sup>

Figure 78: Table showing Farmer Registration and Farmer Benefitted under e-NAM portal



Source: <https://pib.gov.in/newsite/PrintRelease.aspx?relid=191393>

As it can be seen from above, the use of the portal has been high in states like Andhra Pradesh, Haryana, Madhya Pradesh, Rajasthan, Telangana and Uttar Pradesh. Since there are nearly 26.31 crore workers engaged in the farm sector<sup>57</sup>, eNAM is yet to reach to the majority of farmers.

Agricultural marketing system can be further strengthened by introducing market intelligence collating relevant information on the future demand, price and production scenario which would benefit the farmers greatly in minimizing their risk and augment their income. This necessitates a framework for precise forecasting of agricultural prices, supply and demand, by developing proper mechanisms for collection, compilation, analysis of the appropriate data and the dissemination of the information. Currently in India some project mode interventions are being conducted for forecasting and projections of different crops.

1. National Council of Applied Economic Research (NCAER) has been implementing the project to forecast prices of key commodities for short and medium term using Auto Regressive Integrated Moving Average (ARIMA) modelling to monthly wholesale price index. Price forecast covers 17 commodities and sub-groups namely rice, wheat, jowar, bajra, maize, pulses, gram, tur, onion, potato, groundnut seeds, rapeseed & mustard, soyabean, edible oil, and food products.

<sup>56</sup> <https://pib.gov.in/newsite/PrintRelease.aspx?relid=191393>

<sup>57</sup> Census 2011

2. Indian Council of Agriculture Research (ICAR) has been implementing a network project on market intelligence by creating the grid of Agricultural Market Intelligence Centres in India. The aim of this project is to help farmers in taking sowing and marketing decisions based on scientific information and to get better prices for their produce ultimately. Two types of price forecasts on agriculture commodities were generated and disseminated. 'Pre-sowing forecasts' are released to help farmers on sowing and area allocation decisions and 'pre-harvest-forecast' to take decisions on whether to sell the produce immediately or store for some period for price advantage in the future. The intervention included 34 mandatory crops and the required data was collected from regulated markets identified in each state to represent the crop. The price forecasts generated were validated by interacting with traders, farmers, other commodity specific websites and also in futures platform. The adoption of market advisory has led to higher income among traders than non-adopters.

The use of technology to create commodity reports thus helped in knowledge sharing and information dissemination among beneficiary farmers. Farmers could understand the current knowledge on market information and market intelligence, access current source of market demand and generate better revenue from their produce. However, forecasting of commodity prices and demand is not under the purview of any department, in spite of several ongoing interventions involved in compilation, monitoring and release of prices/price indices by various organizations. Implementation of market intelligence in the country would require robust data collection mechanism for crop forecasting. Information on harvested quantity, demand of commodities along with projections is required to be evaluated. Engagement of private IT sector can add value to the endeavour of establishing market intelligence system.

Box 3: Grading agriculture produce through artificial intelligence to boost farmer income

### **Case Study: Grading agriculture produce through artificial intelligence to boost farmer income**

#### **Introduction/Challenge:**

Standardization and grading are the first steps in the value-chain of an agricultural produce as it travels in a market channel to the consumer. Variations in quality of agricultural produce has led to incommensurate prices for farmers. The assessment of produce quality depends on a responsive system of grading and standardization, which can be quite subjective in absence of a good grading mechanism.

Every consumer wants high quality fruits and vegetables, which are not over-ripe, discoloured, or damaged. The process of quality testing is done manually, with inspectors physically checking a sample from every lot. This makes the testing subjective, allowing errors to creep in.

#### **Solution:**

Bengaluru-based start-up Intello Labs set out to provide advanced image recognition technology that can recognize objects, flora, fauna and tag them in any image. The company uses deep learning algorithms on which a new generation of intelligent applications are built for applications in agriculture.

Intello's AI can generate instantaneous quality metrics based on a photo taken on a basic smart phone. This enables Agricultural Product Grading, which entails automated quality analysis of images of food products, which is an accurate and reliable method for grading fresh products (fruits, grains, vegetables, cotton etc.) characterized by color, size and shape. Its tools help in bringing transparency

and standardization to quality assessment, reducing value risk and wastage in the agriculture supply chains. It has developed a ready-to-use solution for fruits, vegetables and spices.

**Impact:**

- The company claims that its image analytics and AI testing can give B2B players savings of between three and five percent.
- Standardisation and digitisation of produce can go a long way in making e-Mandis and digital agri markets successful.

Source:

1. Your Story, AI to test and grade fruits and vegetables? These Amazon and Snapdeal ex-staffers are doing just that, 3 April 2019
2. Economic Times, AgriTech startup Intello labs raises \$2mn seed round from Nexus Venture Partners and Omnivore

**vii. *Development, dissemination & adoption of innovative practices, technology & know-how***

Agriculture in India is practiced across different climatic zones and to increase the productivity of the agricultural commodities an entire range of innovative cultivation technology is applied. Various technological innovations have been developed in order to adapt to the local needs, optimally use the naturally available resources and cater to the needs of the changing market demand. In the wake of climate change and rising stress on all natural resources, sustainable growth in agriculture can be only ensured through constant improvisation of production processes. Climate smart agricultural technologies can sustainably improve production, resilience of production systems, and reduce greenhouse gas emissions to ensure food security.

Precision farming increases agricultural productivity while decreasing production cost and minimizing environmental impacts. Precision agriculture is based on information technology, which enables the producer to collect information and data for better decision making. This system of farming includes application of Global Position System (GPS) in the agriculture fields, close monitoring of crop, soil and climate information and finally analysis of the data to understand the accurate agricultural inputs required for optimum and sustainable output. However in India, most farmers are small and marginal farmers with small field size, making precision farming an unviable option. The small size of farms and fields in most of Indian agriculture limits economic gains from currently available precision farming technology, but other factors in Indian agriculture such as concerns for the environment, food safety and need to increase productivity stresses on immense potential and benefits of precision agriculture.

In India precision farming is yet to evolve and practiced by most farmers. However, some of the early adoptions of the practice show desirable results. The Tamil Nadu Precision Farming Project was implemented over three years (2004-2007) in the districts of Dharmapuri and Krishnagiri in the northern part of Tamil Nadu.<sup>58</sup> The project focused on increasing the yield of horticulture crops in areas which were considered to be backward, impoverished and water-scarce dominated by traditional agricultural practices. The precision farming technology inputs applied to the project were drip irrigation using Class 3 fertigation units along with water soluble fertilizers (WSF), the use of community nurseries, use of remote sensing technologies to develop a fertigation schedule according to crop and soil type, grading and sorting techniques and detailed

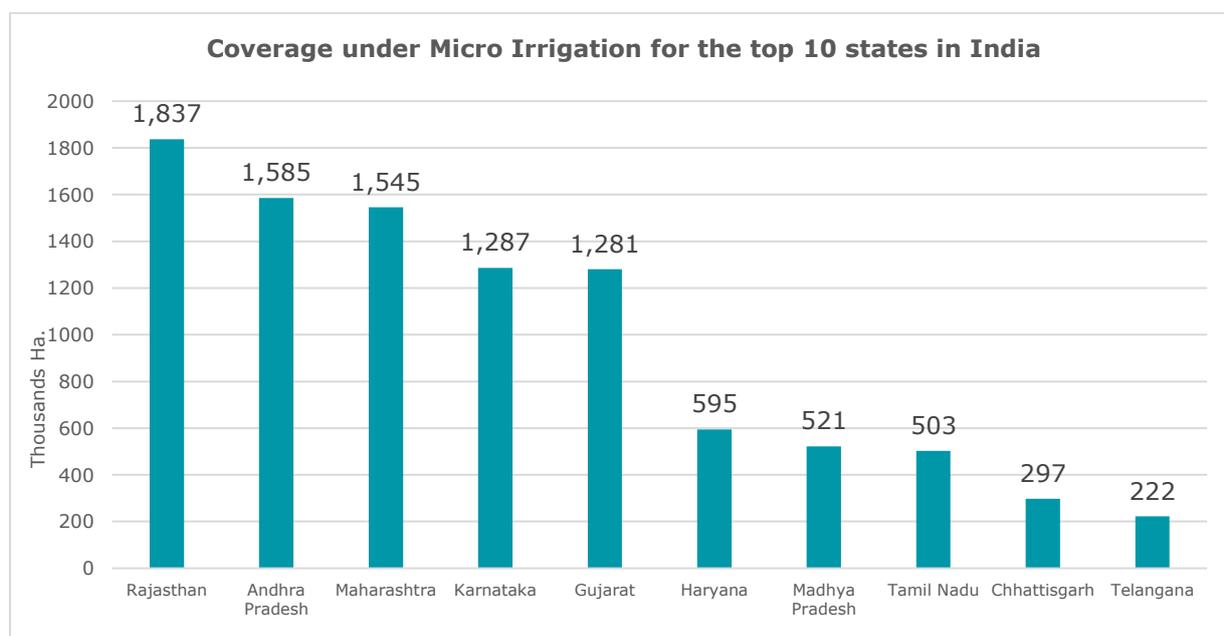
<sup>58</sup> <http://agritech.tnau.ac.in/tnpfp-ENG/ep.html>

documentation of farm activities. The impact of the farming showed evidences of increased yield and also increased level of income.

Currently Precision Farming Development Centres (PFDCs) have been established in India to promote “Precision Farming & Plasticulture Applications for hi-tech horticulture” and located in State Agricultural Universities (SAUs); ICAR Institutes such as IARI, New Delhi; CIAE, Bhopal & CISH, Lucknow and IIT, Kharagpur<sup>59</sup>. National Committee on Plasticulture Applications in Horticulture (NCPAH) conducts the adoption of precision farming practices in horticulture through various trials, demonstrations and extension programs. There are around 22 such PFDC have been operating to promote various plasticulture applications in horticulture. Plasticulture is one of the precision farming practices which uses plastics in agriculture and horticulture for moisture conservation, water saving, reduction in fertilizer consumption, precision in application of nutrients as well use of innovative packaging solutions help in increasing shelf-life and during collection, storage & transportation of fruits and vegetables.

Practices around Micro Irrigation in India have been discussed earlier in the section on Irrigation. Appropriate technology interventions like drip & sprinkler irrigation systems are being promoted across the country under the scheme Prime Minister Krishi Sinchai Yojna- Per Drop More Crop. However the current coverage of micro irrigation has only reached 10.25 million hectares<sup>60</sup> which constitutes 15% of the total potential area of 69 million hectares<sup>61</sup>. The coverage of micro irrigation has been presented for the top 10 states in the graph below.

Figure 79: Coverage under Micro Irrigation for the top 10 states in India



Source: Indiastat, Report on Selected State-wise Area Covered under Micro Irrigation as on 31.03.2018, Retrieved as of 21<sup>st</sup> December 2019.

Currently, the practice is taken up widely in the water stressed states. However, agrarian states like Uttar Pradesh, Bihar and West Bengal have much lower achievement in micro irrigation. The same is also observed in the hilly states like Himachal Pradesh and states of the North East. Difficulty in constructing drip and sprinkler irrigation is one of the main challenges behind the

<sup>59</sup> <https://www.ncpahindia.com/faqs#second>

<sup>60</sup> Indiastats report on Selected State-wise Area Covered under Micro Irrigation (data till 31.03.2018)

<sup>61</sup> FICCI, GT, IAI. 2016. Accelerating Growth of Indian Agriculture: Micro Irrigation an Efficient Solution.

poor performance despite having additional financial support from micro irrigation schemes like PMKSY –Per Drop More Crop.

In India, Tata Kisan Kendra (an initiative under Tata Chemicals) applied technological innovations to support the conventional farming system (i.e. tilling the soil to prepare for planting, and heavy reliance on chemical inputs, such as pesticides and fertilizers). Use of remote sensing technology to analyze soil, inform about crop health, pest attacks and coverage of various crops predicting the final output are put into practice to reap healthier crops, higher yields and enhanced incomes for farmers. Trainings are imparted from the centers to farmers through workshops and screening of films related to good practices. The crop clinics under Tata Kisan Kendra (TKK) access information from the geographic information system (GIS) and advise farmers on what to grow, where and when to grow it, and how much urea and nutrients to use. At the soil-testing laboratory, technicians analyze soil samples to determine their composition and confirm what the satellite maps have indicated. Additionally, the TKK network operates experimental farms where scientists conduct agricultural research and development. Tata Kisan Kendra has been replicated successfully in the states of Uttar Pradesh, Haryana and Punjab.

As observed in HH Survey, around 76% of farmers have awareness about soil health and around 38% of farmers own soil health card. The findings have been displayed in the graph below.

Figure 804: Awareness about Soil Health and Ownership of Soil Health Card

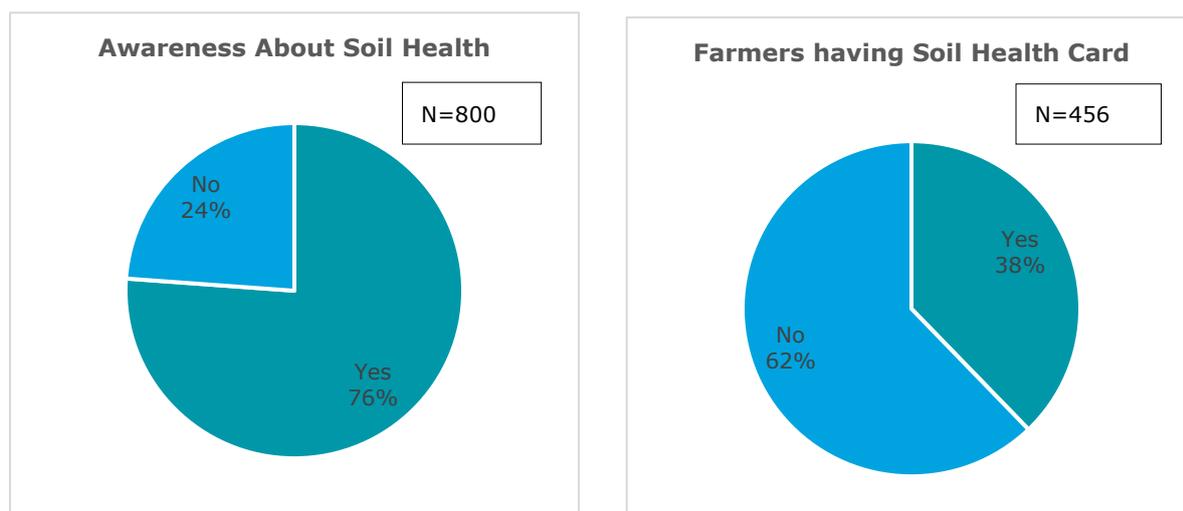
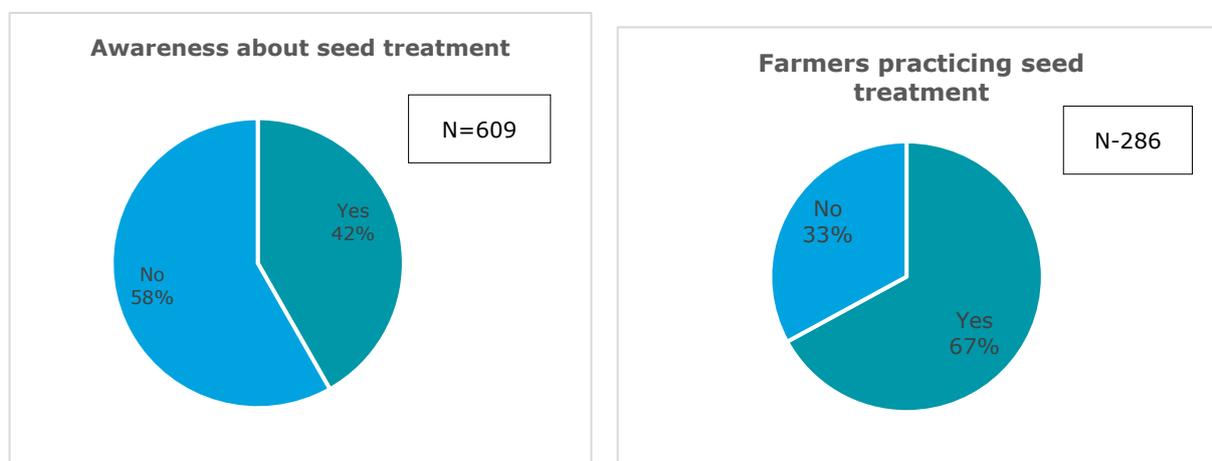


Figure 81: Awareness and Practice around Seed Treatment



Similarly the HH survey has also revealed knowledge level and practices of seed treatment by farmers. The graphs above display the awareness and practice around seed treatment by agricultural farmers. It can be observed from the graphs above that 42% of agricultural farmers have awareness of seed treatment. 67% of farmers practice seed treatment methods.

Box 4: Use of predictive analytics in agriculture

### **Case Study: Use of predictive analytics in agriculture**

#### **Introduction/Challenge:**

Typically, farmers in India use age-old methods to predict the right sowing date for their crops. While these methods had worked well in the past, the changing weather patterns in the past decade have led to unpredictable monsoons, causing poor crop yields. This impacted farmers' incomes and increased their vulnerabilities, causing many to commit suicides as they could not repay their loans on time.

#### **Solution:**

Microsoft partnered with International Crops Research Institute for Semi-Arid Tropics (ICRISAT) and Andhra Pradesh government to develop the Sowing App, a mobile application that uses predictive analytics to advise Indian farmers on the best time to sow crops, depending on weather conditions, soil, and other key indicators. The app aims to reduce failures and increase yield by arming farmers with information helpful in making critical decisions.

To calculate the crop-sowing period, historic climate data spanning over 30 years, from 1986 to 2015 in Andhra Pradesh was analyzed using AI. To determine the optimal sowing period, the Moisture Adequacy Index (MAI) was calculated. MAI is the standardized measure used for assessing the degree of adequacy of rainfall and soil moisture to meet the potential water requirement of crops. The real-time MAI is calculated from the daily rainfall recorded and reported by the Andhra Pradesh State Development Planning Society. The future MAI is calculated from weather forecasting models for the area provided by USA-based aWhere Inc. This data is then downscaled to build predictability, and guide farmers to pick the ideal sowing week.

Sowing advisories are then initiated and disseminated until the harvesting is complete. The advisories contain essential information including the optimal sowing date, soil test based fertilizer application, farm yard manure application, seed treatment, optimum sowing depth, and more. In tandem with the app, a personalized village advisory dashboard provides important insights into soil health, recommended fertilizer, and seven-day weather forecasts.

#### **Impact:**

In 2017, the program touched more than 3,000 farmers across the states of Andhra Pradesh and Karnataka during the Kharif crop cycle (rainy season) for a host of crops including groundnut, ragi, maize, rice and cotton, among others. The increase in yield ranged from 10% to 30% across crops.

Source: FAO, Climate-Smart agriculture Case Studies 2018: Successful approaches from different regions

### **viii. Stakeholder & Beneficiary Behavioural Change**

Agriculture sector in India is deterred by the problems of low yield in the agricultural produce which mostly stems from the lack of knowledge among farmers and poor access to good quality inputs. The recent study assessing the conditions of farmers called "State of Indian Farmers" by Centre for Study of Developing Societies (CSDS) throws light on the prevailing practices and problems faced by the farmers. The study included more than 5000 samples from 137 districts of the country in 2014. As per the findings, around 76% of the farmers wanted to give up farming.

Farmers reported issues of repeated losses in farming and have been affected by unseasonal rains, droughts, floods and pest attacks.

Good Agricultural Practices in India are being promoted under the certification called INDGAP<sup>62</sup> which is being implemented by the Quality Council of India. In line with the recommendation of World Trade Organization, INDGAP incorporates concepts of globally accepted Good Agricultural Practices (GAP) within the framework of commercial agricultural production for long term improvement and sustainability. INDGAP takes into account not only the quality and quantity of the produce obtained from a unit area but also care is taken in integrating pre-harvest practices like soil & water management, nutrient management and pest management, harvesting, post-harvest handling and other logistics. The areas around good agricultural practices focused under the scheme INDGAP aims to cater to the following aspects<sup>63</sup>:

- quality and quantity of the produce obtained from a unit area
- various aspects of food safety
- pre and post-harvest practices including workers health and safety
- sustained supply of produce of the desirable quality

Development of the voluntary sustainability standard such as INDGAP focuses on the adoption of certification by small and marginal farmers under the accreditation of National Accreditation Board for Certification Bodies under the scheme component INDGAP Basic<sup>64</sup>.

In the global scenario of certified agriculture and good agricultural practices, International Trade Center provides insights into the progress on the widely accepted sustainability standards for select agricultural products (namely bananas, cocoa, coffee, cotton, oil palm, soybeans, sugarcane, tea, and forestry products). Complying with the United Nations 2030 Agenda, the voluntary sustainable standards have been set to address the issue of unsustainable consumption and production as flagged under United Nations Sustainable Development Goal 12. The report “State of Sustainable Markets 2019”<sup>65</sup> uncovers the expansion in sustainably certified agricultural and forestry commodities. Two of the 14 voluntary sustainability standards discussed in the aforementioned report, Global G.A.P and Organic have been considered to discuss the progress of India in comparison to the top performers across the globe.

Global G.A.P. or the Global Partnership for Good Agricultural Practices includes 40 standards set for entire agro food sector that covers food safety, environmental aspects, as well as worker health and safety. It covers crops, livestock and aquaculture production and also ensures product segregation and traceability of certified products. The top countries with highest certified area under Global GAP has been depicted in the graph below.

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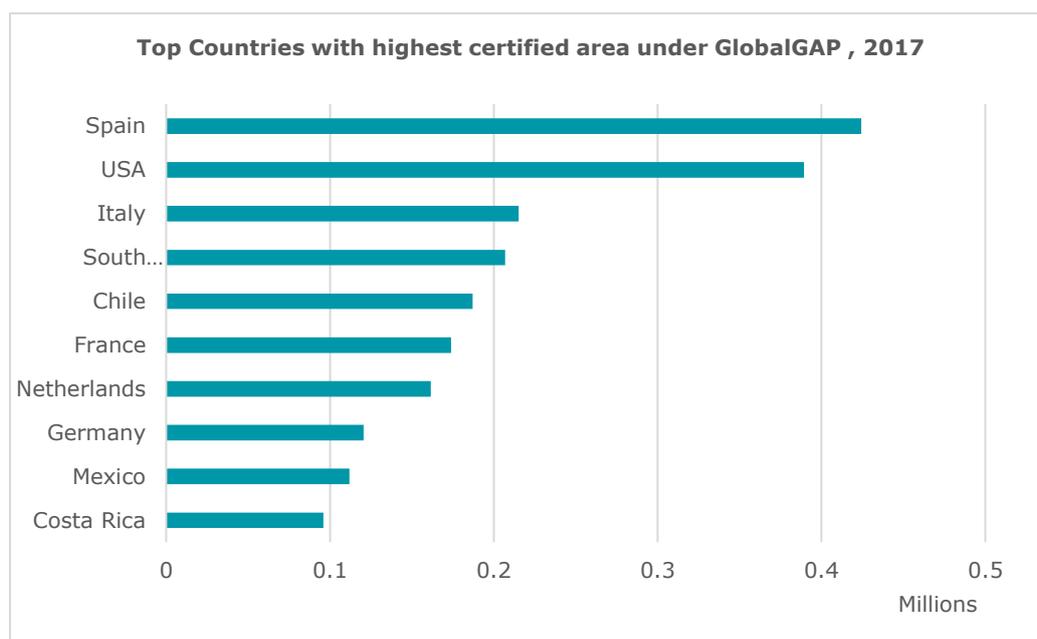
<sup>62</sup> <https://www.qcin.org/documents/GAP/INDIAGAP-FINAL.pdf>

<sup>63</sup> <https://icfa.org.in/assets/doc/asp/asp-5.pdf>

<sup>64</sup> <https://icfa.org.in/assets/doc/asp/asp-5.pdf>

<sup>65</sup> <http://www.intracen.org/publication/Sustainable-Markets-2019/>

Figure 82: Top Countries with highest certified area under GlobalGAP

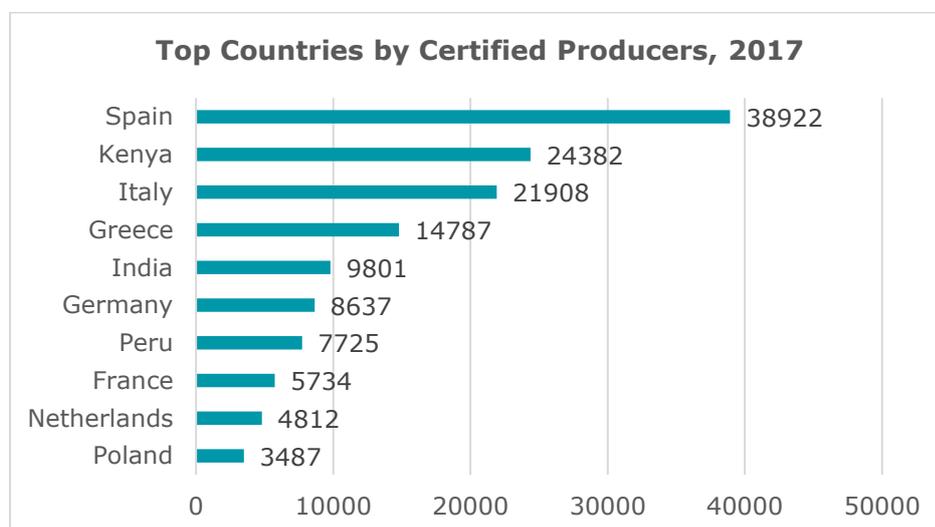


Source: <https://www.sustainabilitymap.org/trends>

India has around 22,647 hectares of certified area under GlobalGAP, ranking 22 globally.

In terms of top countries by their presence of certified producers under GlobalGAP, India ranks 5<sup>th</sup> with 9,801 producers in the country.

Figure 83: Top Countries by Certified Producers, GlobalGAP



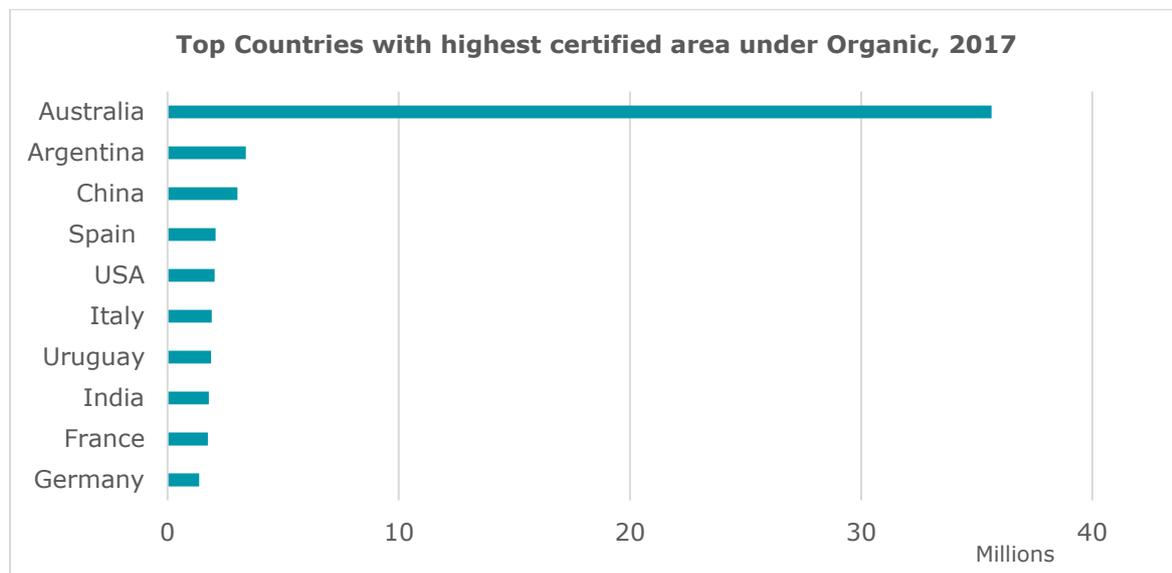
Source: <https://www.sustainabilitymap.org/trends>

Similar to the GlobalGAP certification, Organic certification is implemented across the globe. More than 69.8 million hectares were organic-certified in 2017 (including land that is in the process of becoming certified as organic), representing 1.4% of all agricultural land worldwide<sup>66</sup>. The multiple commodity sustainability standard has the largest variety of agricultural products

<sup>66</sup> International Trade Centre. 2019. State of Sustainable Markets 2019. Retrieved from <http://www.intracen.org/publication/Sustainable-Markets-2019/>

covered under its certification program. The top countries under certification are presented in the chart below.

Figure 845: Top Countries under Organic certification globally, 2017

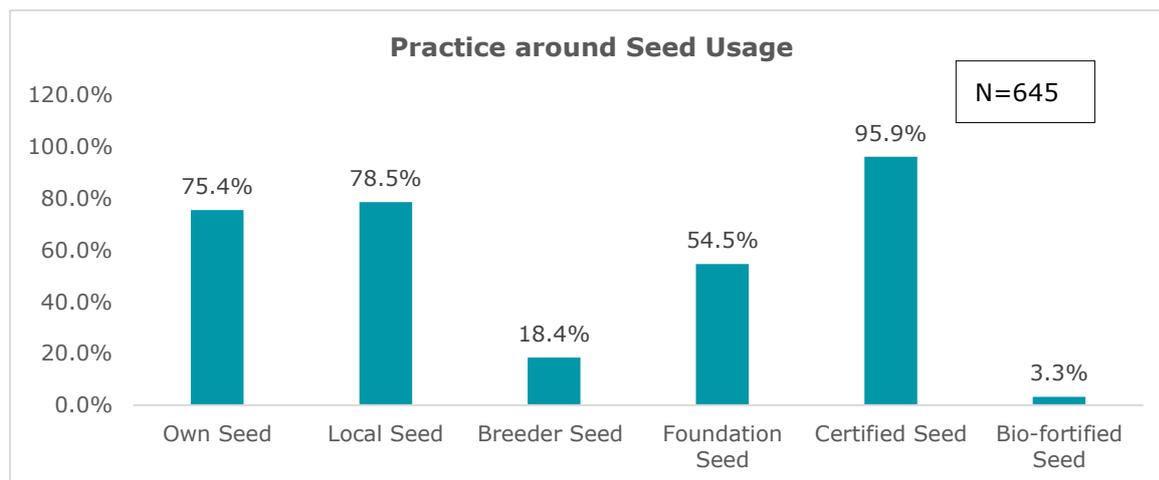


Source: <https://www.sustainabilitymap.org/trends>

As it can be seen from the chart above, India ranks 8<sup>th</sup> globally in terms of coverage of Organic certification of agricultural land. It may be noted that the agricultural commodities covered in this include 8 commodities. The organic certification in India covers cotton, soybeans and sugarcane. India consists of nearly 835000 Organic producers which is highest in the world followed by Uganda (210352 certified producers) and Mexico (210000 certified producers).

Practices around seed usage has been analysed in the HH Survey. The findings throw light on the seed usage among farmers and the same has been shown in the graph below.

Figure 85: Practice around Seeds by Farmers



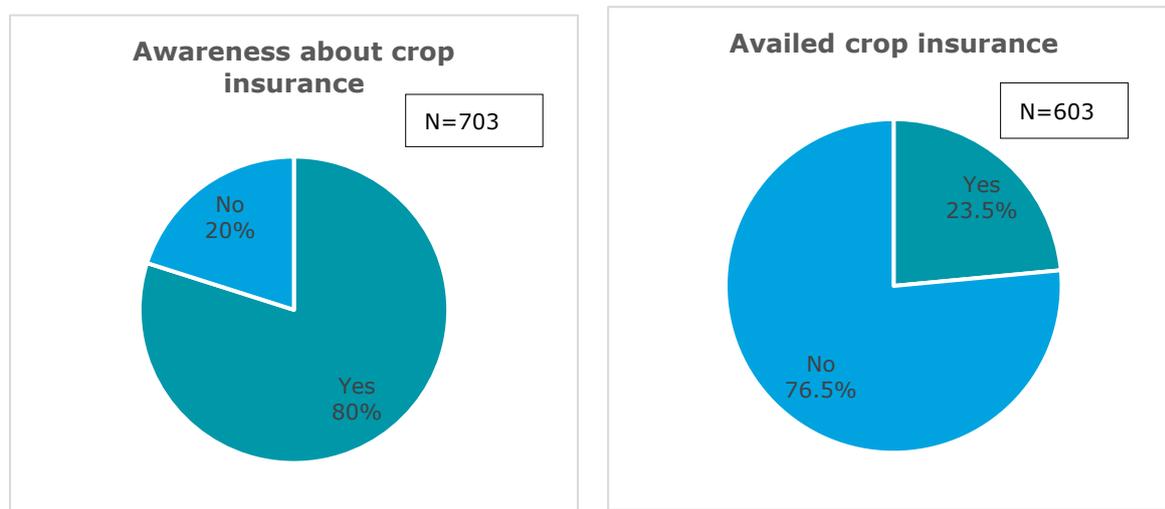
Note: Respondent adopted more than one practice. Hence total percentage may exceed 100%

Source: HH Survey, Deloitte Analysis

It can be observed from the graph that 96% of farmers prefer using certified seeds, and around 75% farmers use own seeds and local seeds. Use of breeder seeds and bio-fortified seeds is low among farmers.

As observed in HH Survey, around 80% of farmers have awareness about crop insurance and around 23.5% of farmers have availed crop insurance. The findings have been displayed in the graph below.

Figure 86: Awareness and Adoption of Crop Insurance by Farmers



Source: HH Survey, Deloitte Analysis

Under the Good Agricultural Practices in India, Integrated Pest Management (IPM) is practiced among farmers to keep pest population at below economic threshold levels by employing all available alternate pest control methods, especially bio-pesticides and pesticides of plant-origin like Neem formulations. Chemical fertilizers are used as last resort. This technique has helped to control the indiscriminate and unilateral use of pesticides and contain ill effects like human and animal health hazards, ecological imbalance, development of resistance in the pests to pesticides, pests resurgence and environmental pollution. Under the Sub Mission on Plant Protection and Plant Quarantine introduced in 2014-15, strengthening and modernization of Pest Management Approach in India is being promoted and IPM is being popularized through training and demonstration in crops inter-alia promotion of biological control approaches in crop protection technology. Several Central Integrated Pest Management Centres<sup>67</sup> (31 Centers) have been setup for pest/disease monitoring, production and release of bio-control agents/ bio-pesticides, conservation of bio-control agents by imparting training to Agriculture / Horticulture Extension Officers and farmers at Grass Root Level by organizing Farmers Field Schools (FFSs) in farmers' fields.

The 31 Central Integrated Pest Management Centers (CIPMCs) located in 28 States and one Union Territory undertakes the programme with following activities:

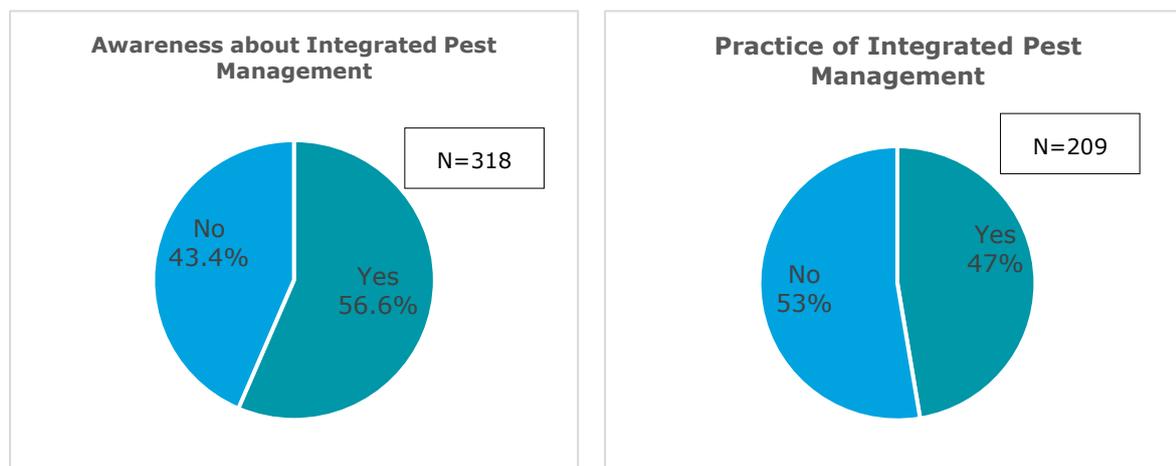
- Surveillance & Monitoring of insect-pest & diseases.
- Augmentation and Conservation of Natural enemies.
- Production and release of bio-control agents.

<sup>67</sup> <https://pib.gov.in/newsite/PrintRelease.aspx?relid=110364>

- Human Resource Development (HRD) through Farmers' Field Schools (FFSs) Season-long training programmes, orientation training programme and refresher courses.

The HH survey also throws light on the level of awareness around Integrated Pest Management (IPM) and practices around it. The graph below depicts the awareness and practice among agricultural farmers.

Figure 87: Awareness and Practice around Integrated Pest Management



Source: HH Survey Deloitte Analysis

It can be observed from the graphs above that around 56.6% of agricultural farmers are aware of Integrated Pest Management. However, 47% of farmers have been practicing Integrated Pest Management in their farms.

### Low adoption of technology and recommendations

Concerns have been raised in NSSO surveys about the reach of the extension services and level of technology adoption. Similarly, a study on level of adoption of Drip irrigation in Tamil Nadu highlighted that the level of adoption of drip irrigation has been low among small and marginal farmers, as it has high initial costs and requires regular maintenance. It was also highlighted that the large farmers are more likely to shift to drip irrigation as they can afford the initial costs and know its benefits in optimising the water use and reduction in labour costs<sup>68</sup>. It was also observed during the field surveys and KIIs that adoption of micro-irrigation is more in water scarce areas where farmers intend to grow water intensive agricultural and horticultural crops. Therefore, while the adoption of micro-irrigation may help in efficient use of water it may not prevent loss of ground water, and the micro-irrigation activities needs to be supported by interventions for ground water recharge.

In addition, the need for a scientific approach by providing customized input recommendations specific and suitable to crops, weather and soil fertility as well as advice on financial viability of crops and marketing trends has been observed. Soil health card is one such initiative that can be helpful in transforming agriculture but is facing infrastructural and implementation challenges leading to reluctance in adoption of recommendation of SHC. Apart from soil health card other aspects such as crop specific use of pesticides, integrated pest management, advisory on weather fluctuations, disease control, water use, etc. are not adequately covered in current set of schemes.

<sup>68</sup> A Study on Understanding the Adoption of Water Saving Technology: A Case Study of Drip Irrigation, International Journal of Recent Technology and Engineering (IJRTE), March 2019

In addition, the knowledge about market related information and existing trends is very poor among farmers, because of which many suffer losses even when the production is good. Farmers need to be provided customized solutions which include recommendations on productivity and marketing of produce.

### **Lack of remunerative prices and MSPs impact on production**

It is important to note that despite the increase in agricultural production, the contribution of agriculture and allied sector in overall GVA has been consistently declining since 2012-13. This diminishing trend is a concern, as agriculture still is the primary source of livelihood for more than 58% HHs in rural India and provides employment to 43.9% of country's total workforce. One of the primary reasons towards this reduction may be attributed to increasing cost of production and wide gap between farm-gate price and consumer prices, as only a small share of consumer price reaches farmers. The prices further slump during the peak arrival season when there is good production. Therefore, procurement made by the government at MSP of select crops ensures that the farmers get a better value for their produce, moreover, if procurement is done at right time it prevents the prices of the commodity to fall below MSP level and help in stabilising the prices. That is why, the farmers prefer to go for crops which are more likely to be procured by the government at MSP. MSP is more appealing as many state governments also announce bonuses on top of the MSP which make growing of these crops a better proposition. However, both central and state agencies only procure select crops at MSP and majority of state and central level procurement are for rice and wheat, so farmers prefer to grow rice or wheat as the risks are limited. Therefore, in order promote crop diversification the immediate need is to improve the marketing and storage facilities for alternative crops. Reforms in marketing and risk management are crucial to change the mind-set of farmers to make more investments in alternative crops especially in rainfed regions<sup>69</sup>.

### **Making extension activities more effective**

The increasing cost of production and wide gap between farm-gate price and consumer prices has called for increased focus of government towards making agriculture more remunerative. Agriculture extension plays a key role in facilitating the same. While the state agricultural department and schemes such as SMAE, MIDH, etc. are trying to promote good practices among farmers, they face constraints in terms of availability of extension workers and resources. One of the flagship initiative under SAME is ATMA which is seen as a good programme, however, has not been effectively implemented. The report of the Committee on Doubling Farmers Income highlighted that capacity building of extension functionaries was not sustained, leading to achievement of less-than-potential outcomes. This, combined with attrition-ridden and unstable contractual manpower has been responsible for non-achievement of targets. The report also pointed out that both public and private extension systems highlight on "what to do", rather than also educating on "what not to do". The latter is equally critical for farmers who are practising agriculture from generations and are thus sticking to traditional practices. The farmers, thus, need to be sensitized not only on new practices but also on the need or ineffectiveness of ongoing habits to pre-empt risks and failures. ATMA which has been envisioned to facilitate linking farmers to market has been restricted to advisory on production aspects, without catering to marketing concerns.

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<sup>69</sup> Demand supply projections towards, 2033, crops livestock and Agricultural Inputs, NITI aayog, 2018

## **ix. Research and Development**

Advancement in agriculture can be ensured through continuous research and development in the domain impacting climate change concerns, food insecurity, the growing relevance of agri-food chains, and demands for greater rural producer empowerment. The research studies along with the applications of the innovative solutions and providing extension services such as policy advise, technical support, projects/ programmes, studies and workshops shall lead to accelerated development of the sector.

In India, the Indian Council of Agricultural Research (ICAR) is an apex research organization of the country, spearheading agricultural research, education and extension activities for productivity enhancement and diversification of Indian agriculture. Along with ICAR, the National Agricultural Research and Education System (NARES) is also one of the top research institutes contributing to transformative changes in this domain. ICAR has a vast network<sup>70</sup> of 96 ICAR institutes, 77 All India Coordinated Projects/Networks, four deemed universities, two Central Agricultural Universities and 641 Krishi Vigyan Kendras (KVKs) spread across the country. In addition, there are 62 state Agricultural/ Veterinary/ Horticultural/ Fishery universities and 4 general universities with agricultural faculty, as part of the NARES. The research programs under the umbrella of ICAR are designed to harnessing the power of science and technology that promotes food, nutritional and livelihood security of vast population of our country. In the past, ICAR had been instrumental in ushering Green Revolution in agriculture. The ICAR along with its partners in the NARES through research and technology developments, enabled the country to increase the production of foodgrains by 5-fold, horticultural crops by 6-fold, fish by 12-fold (marine 5-fold and inland 17-fold), milk by 8-fold, and eggs by 27-fold since 1950-51<sup>71</sup>.

In the recent years<sup>72</sup> there has been significant effort towards improving crop yield through producing high yielding crop varieties. In the year 2018, ICAR has developed 372 HYV crops comprising of 200 of cereals, 49 oilseeds, 47 of pulses, 47 of commercial crops and 29 of forage crops. Eight bio-fortified varieties of rice, wheat, maize, pearl millets, and lentils having high iron, zinc, selenium and protein has been developed. Research on genetic augmentation, and conservation is being pursued intensively across crop varieties and also in various geographies in an attempt to build a genebank. In crop improvement, there has been considerable focus on seed technology research and production of breeder seeds. In the year 2017-18, around 5,97,992 quintals of quality seeds had been produced against the target of 3,66,059 quintals which comprised of foundation seeds, certified seeds, truthfully labelled seeds and planting materials. Extensive research has been made in zero-budget farming and other indigenous agricultural technologies to control pest population using pheromones in fruits. Impact of climate change in wheat is being pursued along with designing adaptation technologies for the same. Agroforestry system for sustainable crop yields in rainfed areas are being evaluated in various horticulture and agriculture crops such as amla, fingermillet, custard apple, maize, tamarind among others.

The application of the innovative solutions has been ensured through continuous extension activities by the Krishi Vigyan Kendras. In 2018, a total of 3354 technologies of various crops were assessed in 2981 locations by KVKs under the thematic areas of drudgery reduction, farm machineries, integrated crop management, integrated disease management, integrated nutrient

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<sup>70</sup> ICAR Vision Document 2050, Retrieved from <https://icar.org.in/node/117>

<sup>71</sup> ICAR Vision Document 2050, Retrieved from <https://icar.org.in/node/117>

<sup>72</sup> Annual Report of DARE-ICAR 2018-19. Retrieved from <https://icar.org.in/content/dare-icar-annual-report-2018-19>

management, pest management, agro-processing and value addition. The capacity building programmes included various front line demonstrations and trainings were provided to farmers, farmer groups, and other practitioners.

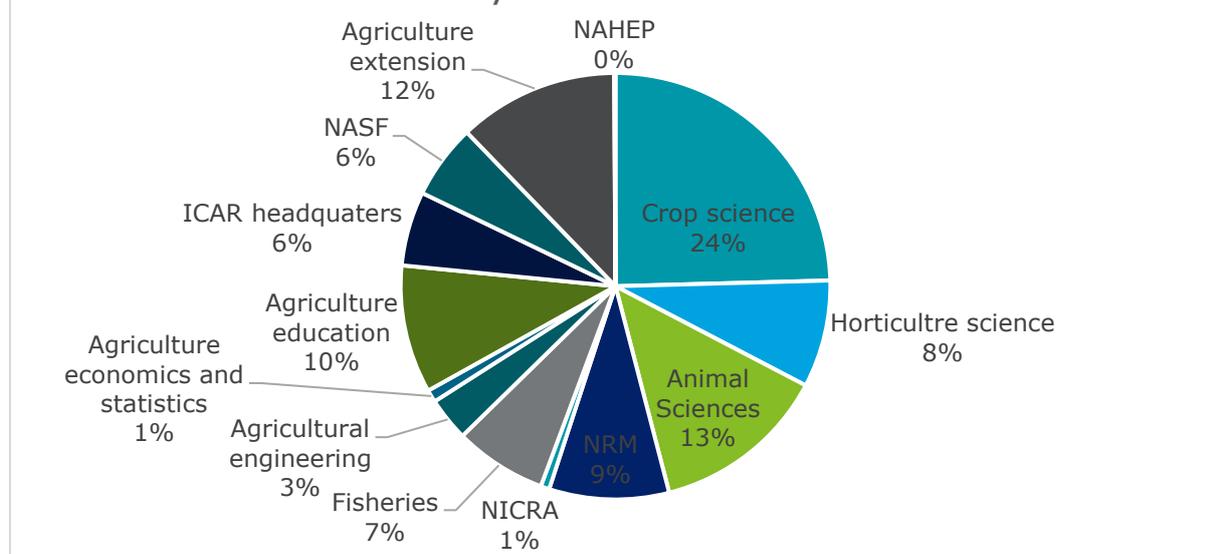
As stated in the ICAR Vision 2050, the institute accords highest priority to changing needs of farmers, which would provide the direction of future research and education investment areas. The focus areas of research laid by the institution for the country include:

- Genetic potential enhancement of agricultural commodities
- Agricultural productivity, efficiency and profitability improvement
- Resilience to climate change and abiotic and biotic stresses
- Improve nutritional food, and health security
- Risk management against climate change and market stressors
- Agricultural value chains
- Sustainability of natural resources base of agriculture
- Valuation of ecosystem services
- Agricultural markets, policies, and institutions
- Bio-security, especially the one emerging from gene piracy and cross-border vector-borne diseases
- New products and uses (e.g., bio-energy, new crops, synthetic foods, special foods)
- New educational and learning systems and environments

### **Need for Public Private Partnership in Research and development**

The Indian Council of Agriculture Research is an autonomous organisation under the Department of Agricultural Research and Education. It has more than 100 institutes under its purview. ICARs play a critical role in agricultural education and research in India and is supported through central funds. There are 27 institutes that deal with the crop sciences, 23 deal with horticulture sciences and 19 Institutes that deal with Animal Sciences under ICAR in India. In addition, it has 8 fisheries institutes, 4 Agricultural engineering institutes and 15 institutes under its NRM division. These institutes primarily deal with aspects such as crop science, animal husbandry, dairying, fisheries and horticultural sciences. Apart from these, ICAR also controls institutions that deal with agricultural education and extension institutes. The ICAR institutions receive funding from central government, they also earn income through education, research and extension activities. The BE for ICAR during 2018-19 was Rs 7514.14 crores, which increased by nearly 14.7% from 2017-18. The BE allocation for various types of institutes under ICAR is provided in the figure below.

## BE for various types of institutes under ICAR for year 2018-19



Source: ICAR Budget Book (2018-19)

As can be seen that the highest budget allocation is for Crop Science Institutes, followed by Animal Sciences Institutes and Agricultural Extension Institutes. The lowest budget is being allocated to Agricultural economics and statistics. In addition to these, there are projects like NAHEP and NICRA, which receive separate funding.

The table below shows expenses on research and operations as a percentage of revenue and capital expenses across different types of institutes in 2017-18.

Table 18: Expenses on research and operations by ICAR institutes (2017-18)

S. No.	ICAR Institutes	Revenue plus capital (in Rs lakh)	Research and operations (in Rs lakh)	Research as % of revenue and capital expenses
1	Crop sciences	146558	11727.29	8.0%
2	Horticulture science	58865	7180	12.2%
3	Animal sciences	10188.85	86977	11.7%
4	NRM	64217	4392	6.8%
5	Fisheries	2761	44469	6.2%
6	Agri engineering	1697.8	20954	8.1%

Source: ICAR Budget Book (2018-19)

As can be seen that the overall budget allocated for research and operations among these ICAR institutes is very small and ranges between 6 to 12.2%. Among these institutes, NRM institutions are focusing very little on research, while horticulture and animal science institutes are giving higher priority to research. It may be noted that higher funds are allocated to these institutions.

NITI Aayog in its report on raising farmers' income<sup>73</sup> pointed out that the Indian agricultural R&D system suffers from lack of clarity and inefficient use of financial resources. The land to lab

<sup>73</sup> Raising Agricultural Productivity and Making Farming Remunerative for Farmers, NITI Aayog, Government of India, December 2015

connect is weakening and most of the scientific energy is being spent on mundane research across the institutions. It was highlighted that the collaboration of institutions needs to be strengthened and the research should be targeted towards solving problems. The report calls for overhaul of public sector R&D institutions and create favourable environment agricultural research and technology development. It recommended to put in place performance indicators for institutions and individuals and need for modifying the existing rules and regulations to facilitate public private partnerships in agriculture research.

#### **x. Reforms and Regulations**

Reforms in agriculture sector in India is one of the important factor for driving faster growth and ensuring better remunerations from agriculture as an option of livelihoods. The agriculture sector contributes around 14.4% to the economy of the country in terms of Gross Value Added from agriculture, forestry & fishing sector. This sector has been aiming to achieve higher growth through notable changes such as diversification from grains towards pulses, fruit, vegetables and livestock products, along with a greater focus on exports of agricultural supplies.

With government impetus on food and nutritional security over the past decades, India has been able to transform from a food deficit country to a major exporter of agriculture and allied products such as rice, meat and meat products, cotton, oilcakes, vegetable extracts, fish and fish products. The demand for agriculture products have shifted from cereal consumption towards pulses, fruit and vegetables as well as meat and meat products. The share of cereals in calorie intake decreased from 61% in 2000 to 55.7% in 2013, with livestock products increasing from 12.8% to 17.1% and fruit and vegetables from 24.5% to 28.7% over the same period.<sup>74</sup> In order to support the dietary shift, structural changes are required to be brought in through organizing the private sector and modernizing the retail sector.

One of the critical factors to foster growth in agricultural production is by enabling access to farm credit, under which Kisan Credit Card scheme had been introduced in 1998 to ensure farmers could purchase agricultural inputs such as seeds, fertilizers, pesticides etc. and draw cash for their production needs.<sup>75</sup> However, institutional credit, especially long and medium term credit availability is still inadequate compared to the demand. Small and marginal farmers face difficulties in accessing agricultural credit since it is linked to holding of formal land titles.

Along with growth in food production, the agro-food supply chain has been increasing consistently over the last few decades. The growth in the supply chain requires establishment of physical infrastructure and logistics creation. However there has been inadequate progress in developing road transport services and freight services to support the food supply chain in the country. Government regulated markets wholesale markets (mandis) do not have the facilities needed for handling, grading and storing perishable agricultural products and the regulatory environment has deterred private sector involvement<sup>76</sup>. The current regulation, Agricultural Produce Marketing (Regulation) Acts empowers the state to establish regulated wholesale markets, construct and manage agricultural markets and regulate all aspects of marketing,

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<sup>74</sup> OECD-ICRIER. 2018. Report on Agricultural Policies in India. Retrieved from: [https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india\\_9789264302334-en](https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india_9789264302334-en) as accessed on 10th January 2020

<sup>75</sup> <https://www.nabard.org/auth/writereaddata/Flipbook/2017/Publication/NABARD-Study-on-Implementation-of-KCC-Scheme/HTML/files/assets/basic-html/page22.html>

<sup>76</sup> OECD-ICRIER. 2018. Report on Agricultural Policies in India. Retrieved from: [https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india\\_9789264302334-en](https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india_9789264302334-en) as accessed on 10th January 2020

including the levy of user fees. However, there are several constraints to this Act concerning highly fragmented market structure, insufficient number of markets, inadequate physical marketing infrastructure, high incidence of marketing fees and charges, high post-harvest waste, restrictions in licensing, low remuneration to farmers and high intermediation costs, market information asymmetry, and inadequate credit facilities.<sup>77</sup> To address this issue, the model Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 is underway to include reforms such as issuing single or trading within the State and at the National level, and including new private players and traders to establish wholesale agri-markets among others. The new Act intends to ensure better price realization through a transparent system.

The agro-food trade as share of agricultural GDP in India is pegged at 16% as of 2016 and has increased significantly post the economic reforms after 1990. However, the sector has potential to grow further given the strong growth of merchandise trade in the country (pegged at 42% of the GDP as of 2016) and plausible improvements in the currently challenged domestic agro-food value chain structure. The trade regulations set by India's Foreign Trade Policy every five years drive the growth in agro-food trade sector. Some agricultural products have been subject to export prohibitions, export quotas, and minimum export prices. State trading is required for some products, and export subsidies are provided. The government provides financial assistance to exporters for market development, infrastructure development, quality development and transport assistance. Certain export prohibitions imposed in 2014 on pulses (not chickpeas) and to all edible oil, have now been removed (except for mustard oil)<sup>78</sup>. However, tightening of the rules on marketing buffaloes for slaughter is likely to negatively affect the production of buffalo meat for exports and for producing milk.

### **Policy and Legislative Reforms Related to Marketing<sup>79</sup>**

The Directorate of Agricultural Marketing was first established to keep the prices of agriculture-based raw material for industries and food items in check. Since marketing of agricultural produce is a concurrent subject, most states enacted the Agricultural Produce Market Regulation Act (APMR Act) and all primary wholesale markets operating in the state were bought within the ambit of these acts. The legislation prevented private players from setting up markets. Over the years, the markets became more localised with limited infrastructure which curtailed the free movement of commodities and resulted in the fragmentation of markets. Over time large number of intermediaries established their foothold which led to multiple levels of charges; resulting in the escalation of costs for consumers and lower margins for farmers. Realising this, Government of India introduced a series of reforms to increase efficiency in market transactions to commensurate benefits for farmers. Key reforms introduced in the past two decades are illustrated as follows.

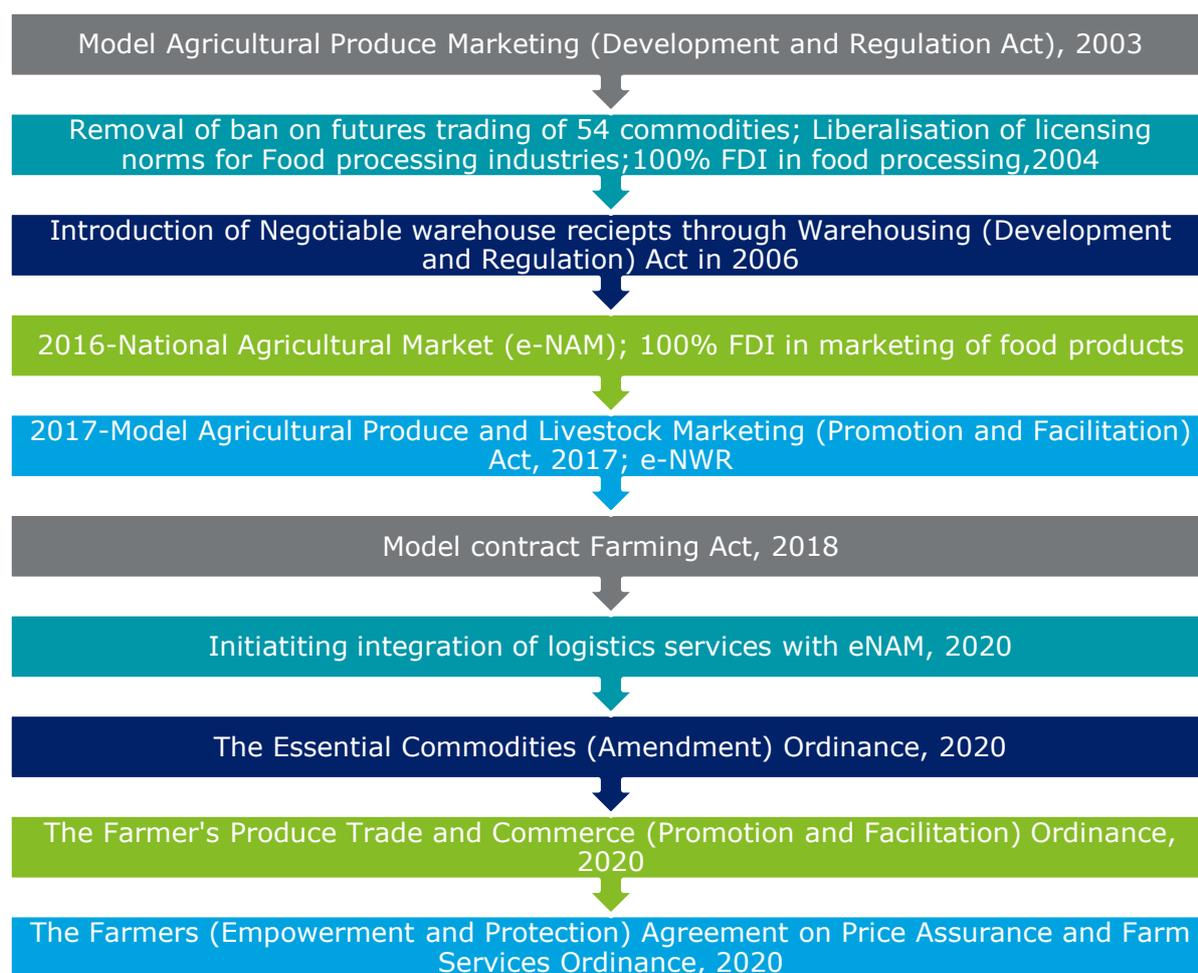
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<sup>77</sup> OECD-ICRIER. 2018. Report on Agricultural Policies in India. Retrieved from: [https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india\\_9789264302334-en](https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india_9789264302334-en) as accessed on 10th January 2020

<sup>78</sup> OECD-ICRIER. 2018. Report on Agricultural Policies in India. Retrieved from: [https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india\\_9789264302334-en](https://www.oecd-ilibrary.org/agriculture-and-food/agricultural-policies-in-india_9789264302334-en) as accessed on 10th January 2020

<sup>79</sup> The report on doubling farmer's income volume IV: Post-production interventions: Agricultural Marketing; latest ordinances; The Essential Commodities (Amendment) Ordinance, 2020; The farmer's produce trade and commerce (promotion and facilitation) ordinance, 2020; The Farmers (Empowerment and protection) agreement on price assurance and farm services, ordinance, 2020

Figure 88: Key Reforms Introduced in the Sector



The Model Agricultural Produce Marketing (Development and Regulation Act) in 2003 was introduced to encourage private investment in agricultural marketing. It created a window of opportunity for private players for entering in agricultural marketing. Alternate market channels were developed in few states as a result of these reforms.

Direct marketing, contract farming and private markets are three major marketing channels which have evolved after these reforms. The model act also had the provision for private wholesale markets. Further, liberalisation took place in 2004 as ban on future trading of 54 commodities was lifted and licensing norms for food processing industries were liberalised.

The registration rules under the Warehousing (Development and Regulation) Act, 2006 introduced Negotiable Warehouse Receipt (NWR) in 2010. The NWR is issued in token of acceptance of the produce and provides an assurance that it will remain safe up to the end of storage period mentioned in the receipt. NWR enables transfer of ownership of the commodity without having to deliver the physical commodity. It is also eligible as collateral for short term finance. The rules were amended in 2017 to allow the issuance of e-NWR as part of the next level reforms. It is now compulsory for all WDRA registered warehouses to issue e-NWR warehouse receipts. An e-NWR minimizes risks in transactions and ensures better transparency.

Government of India launched the ambitious National Agricultural Market scheme in 2016 as an effort towards market integration of various APMCs functional across India. Its initial phase targeted the integration of 585 markets across India. The scheme is aimed at the integration of

agricultural markets across India to facilitate pan-India trade. This will help in price stabilisation and better marketing opportunities for farmers and sellers. The scheme also provides for the development of infrastructure and quality assaying facilities for selected commodities at market level<sup>80</sup>.

The states are also required to take following mandatory reforms in their APMC Acts.

- Provision for single trading license which is valid across the State
- Single point of levy of market fee across the State; and
- Provision for e-auction / e-trading as a mode of price discovery to be facilitated by the State Agriculture Marketing Department / Board / APMCs / Regulated Market Committees (RMCs), as the case may be.

The challenges related to e-NAM and direct marketing are elaborated in ISAM scheme analysis and issue and challenges sections of the report.

The model APML act has also been introduced in 2017. The new act allows more players to set up markets; it also introduces other reforms such as a cap on market and commission agents fee and introduces provisions for declaration of warehouses/silos/cold storage as market sub-yards. The Act allows farmers to sell their produce to preferred buyers at a place of their choice. The model act also has provisions on livestock marketing, e-trading, contract farming and standardization and quality certification. It also sought states to put restrictions on mandi tax limits. However, many are yet to adapt the model act and have adopted only some of its provisions.

The lack of integration in existing marketing infrastructure from aggregation, assaying, transportation, storage and distribution and lack of differentiated approach in infrastructure development with mere focus on only storage of excess produce were highlighted as key bottleneck in appropriate price realisation for farmers<sup>81</sup>. The interventions for increasing price realisation to farmers needs to be supported by stable trade regime and a more farmer oriented policy shift<sup>82</sup>. A need to liberalize stock limits and control regulations has also been highlighted in multiple reports<sup>83</sup> to promote agribusiness and exports of key agricultural commodities.

In view of this, the recent ordinances have been introduced which further liberalise the amendment acts, the new set of ordinances introduced in 2020 have also proposed new set of reforms, some of which are in-line with the some of the key bottlenecks highlighted in sectoral analysis and scheme analysis marketing schemes. For instance, the recent ordinance amends the Essential Commodities Act, 1955 and eases the restrictions on stock limits imposed by the older versions of the act. The ordinance also restricts the imposition of stock limits on essential commodities to instances wherein substantial rise in retail price of the commodity is recorded. The Farmer's Produce Trade And Commerce (Promotion and Facilitation) Ordinance, 2020, states that no market fee or levy shall be levied for scheduled produce in a trade area, it also includes state APMC act or other state laws. This is similar to the model APLM act, however, the key difference is that the ordinance has defined the scheduled produce and also exempted the transaction from levy under other state acts. This reform is likely to ease transactions of

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<sup>80</sup> Operational Guidelines for Promotion of National Agricultural Market (NAM) through Agri-Tech Infrastructure Fund

<sup>81</sup> Doubling farmer's income-Volume III, Post production Agri-logistics, maximising gains for farmers

<sup>82</sup> Import export policy for agriculture is mainly used for price stabilisation tilted more towards consumers (Volume IV, Doubling farmer's income)

<sup>83</sup> Economic survey of India, 2016-17 and Doubling farmer's income report Volume IV

commodities in the state and help in controlling the price of commodity. However, the impact of ordinance has to be evaluated carefully, considering that the farmers do not pay mandi taxes but the traders or commission agents have to pay. In addition, it has been observed that farmers tend to get better price realisation in market yards due to regulation and competition, trading in markets also help them in getting price related information. Many states have already made amendments so that the farmers are able to sell their produce anywhere in state. After the ordinance, the waiving off of market fee for trade outside market premises may encourage the traders to purchase the produce outside of the market premise. This may make the market yards and premises less useful and regulation of trade difficult, resulting in farmers may not receiving the right price due to absence of regulation.

The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Ordinance, 2020 as the name suggests seeks to promote price assurance for farmers by providing a national framework on farming agreements. This will enable farmers to engage with agri-business firms, retailers, wholesalers, exporters for farm services and sale of produce.

***xi. Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme***

Agricultural cooperatives are socio-economic organizations which have played a significant role across the world in organizing the small farmers who are responsible for 80% of the world food production<sup>84</sup>. With a presence of 85% small and marginal farmers in India, it is critical to enhance the impact of the cooperative sector and create opportunities and income for marginal farmers in the country. Various grass-root institutions have been formed to represent the farmers' community, facilitated by state / national level Boards, Cooperatives and Corporations. Some of the formal decentralized organizations are Gram Sabhas, Watershed Committees, Forest Management Committees, Milk Societies, PACSs (Primary Agriculture Cooperative Societies), APMCs (Agricultural Produce Marketing Committees), and WAUs (Water User Associations). Voluntary institutions like SHGs (Self Help Groups), JLGs (Joint Liability Groups), Commodity Interest Groups (CIGs), FPOs (Farmer Producer Organizations – both cooperatives and companies) have been formed across the country and brought under the purview of NABARD, SFAC and NRLM for further structured facilitation, capacity building and nurturing.

Presently, around 5000 FPOs (including FPCs) are in existence in the country, which have been formed under various initiatives of the Govt. of India (including SFAC), State Governments, NABARD and other organizations over the last 8-10 years. Of these, around 3200 FPOs are registered as Producer Companies and the remaining as Cooperatives/ Societies, etc.

In India, FPOs are supported primarily by two organizations namely,

1. NABARD (National Bank for Agriculture and Rural Development)
2. SFAC (Small Farmers' Agribusiness Consortium)

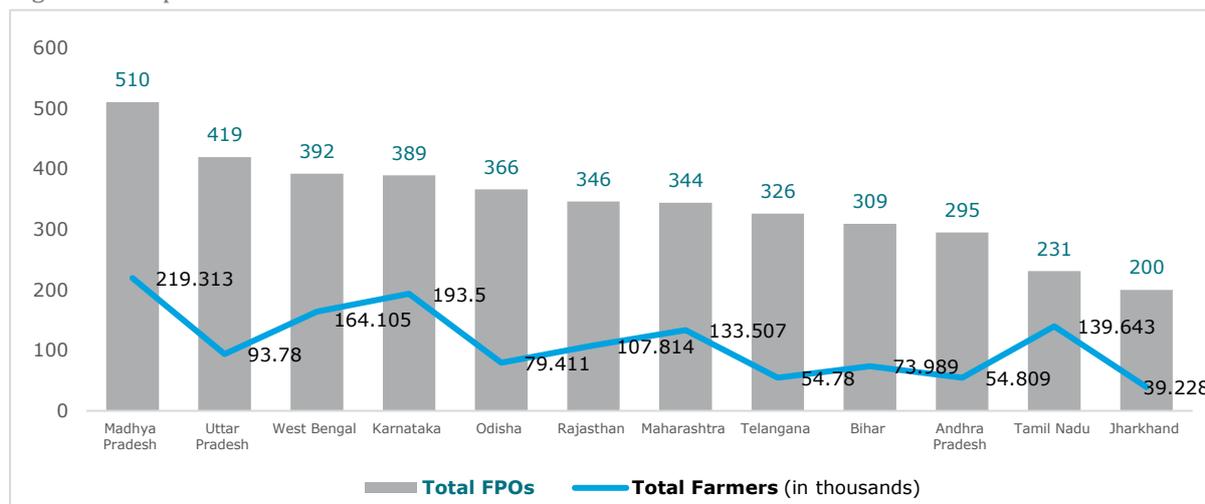
The total state-wise bifurcation of FPOs supported by NABARD as well as by SFAC as on 15<sup>th</sup> August 2019 are highlighted below on the map of India:

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<sup>84</sup> Press Information Bureau, Government of India. 2018. Cooperatives have the potential to revive agriculture and make it sustainable: Vice President. Retrieved from <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1536474>

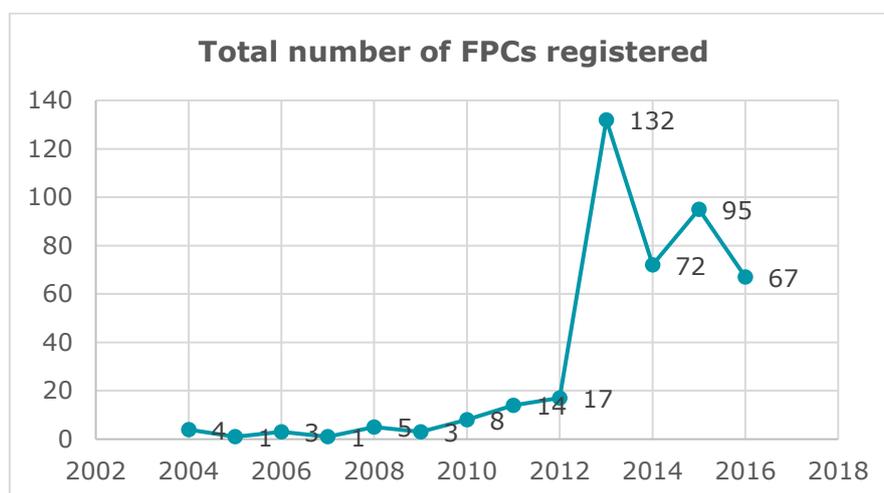


Figure 90: Top States with FPOs and Enrolled Farmer Members



Source: SFAC (<http://sfacindia.com/List-of-FPO-Statewise>), and NABARD (<https://www.nabard.org/ftcontent.aspx?id=708>)

Figure 91: Total number of FPCs registered

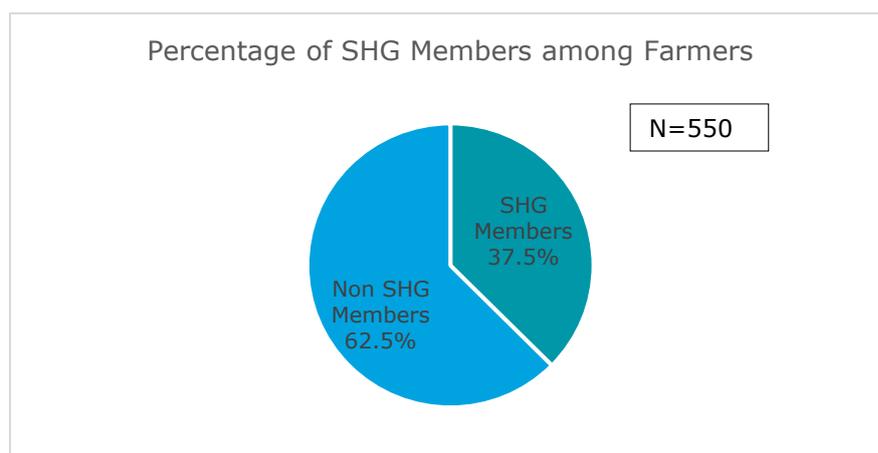


Source: Status of farmer producer companies in India, Navaneetham, Mahendran, Sivakumar, Senthilkumar, (2017)

Majority of these FPOs (including FPCs) in India are at a nascent stage of their operations with shareholder membership ranging from 100 to over 1000 farmers and require not only technical handholding support but also adequate capital and infrastructure facilities including market linkages for sustaining their business operations.

According to the HH Survey, around 37.5% of farmers are part of a Self Help Group or producer group. The findings of the HH analysis has been provided in the graph below.

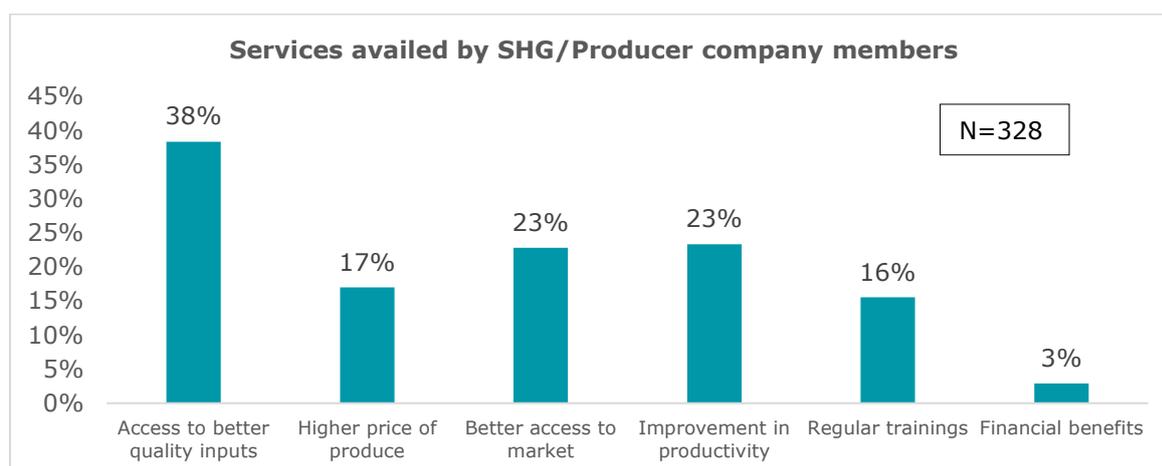
Figure 92: Percentage of Farmers who are part of SHG/Producer group



Source: HH Survey, Deloitte Analysis.

Further analysis from the HH Survey reveals the access to various services that have been availed by the farmers who are part of an SHG or producer group.

Figure 93: Services availed by SHG/Producer group members



Note: Respondent opted more than one service. Hence total percentage may exceed 100%.

Source: HH Survey, Deloitte Analysis.

Around 37.5% of farmers who were part of some SHG, producer group or cooperative have been able to access better quality inputs, 23% of farmers have experienced improvement in productivity, and 23% of farmers could avail better access to markets.

### **Leveraging start-up eco-system for strengthening value chains by engaging private players**

Private sector participation under various schemes has been quite limited. Private sector engagement can help in driving technology led innovation, extension, logistics and forward linkages.

India is supporting agri-tech start-ups that are engaged in diverse set of activities and strengthening of value chain creation. Incubator support programs targeting agri-startups have been launched through Startup India. In addition, all Indian states also have policies and incentives that support agri-startups in India. Government supported institutions such as MANAGE, PUSA, NIAM are also engaged in supporting agri-tech entrepreneurs. Many IIMs and

IITs also provide incubation support to agri-tech firms. Among the schemes, RKVY is encouraging innovative practices through encouragement to agri-entrepreneurship. It supports agri-business incubation by encouraging innovations and technologies for value chain development in agriculture. In addition, it provides grants to the existing institutional agri-business incubators on a need basis. Nearly 10% of the annual outlay under RKVY is earmarked for encouraging innovation and agri-entrepreneurs. Additionally, under the flexi-funds component, states can support projects as per their local needs, preferably for innovative activities in agriculture and allied sectors. The scheme also promotes coordination of ICAR/ SAUs with private players for providing improved varieties of seeds/ seedlings and introducing innovative technologies. RKVY-RAFTAAR is also supporting the UPJA 2020 program by PUSA Krishi which offers grant in aid of up to Rs 25 lakh to the start-ups and also provides mentoring support for developing industry connects and piloting the initiative.

Currently, agri-incubators are driving agri-tech sector in India. The new start-ups and ventures are offering range of technology driven services including, personalised advisory, early warning crop protection, decision support systems through analytics, input-supply, aggregation, tech-support, logistics, affordable infrastructure, precision agriculture and irrigation services, credit, value addition and marketing etc. Thus, catering to the entire agriculture value chain. Many are engaging with farmer groups, FPOs and micro-entrepreneurs. They are also connecting farmers and groups to institutional buyers who procure agricultural produce for processing, value addition and self-consumption.

Farming in India needs to shift from one size fits all approach, and go for a flexible region specific precision agriculture. Agri-tech firms can help in creating this awareness by promoting resource efficient site-specific farming practices. This will help in reducing productivity losses and encourage efficient utilisation of farm inputs thereby optimizing cost of production. Private sector can also help in developing 'farm to fork' value chain by providing integrated services, on demand integrated infrastructure and marketing support. This will help in mitigating risks of sudden price fall during a good harvest.

The growth of start-ups provides an opportunity for the sector, they can be utilised for technical support and development of programme implementation. Many emerging start-ups and agri-tech firms have technical expertise and can provide range of services that can complement existing schemes and fill gaps. They can be engaged for advisory and extension services, input supply and production of key inputs, farmer mobilisation, logistic supply, tech support, logistics, post-harvest solutions for food losses and development of farm-gate low cost infrastructure.

The engagement of agri-tech firms and involvement will help in technology transfer, this will also enable and motivate private players to come forward in sectoral growth and make agricultural more profitable.

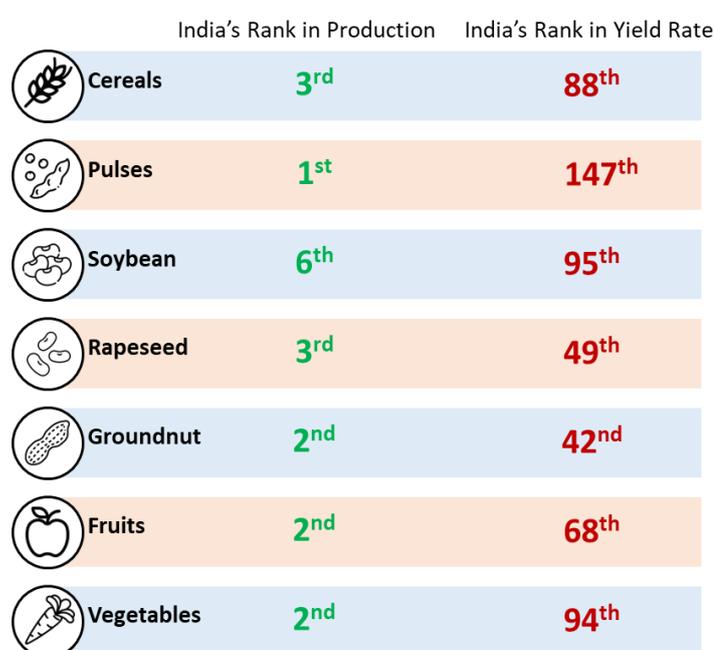
Apart from FPOs and agri-tech startups, the impact and role of private players has been highlighted in scheme level analysis, for example, the role Participatory Irrigation Management and Water User Associations and Private Public Partnership Model in Integrated Micro Irrigation has been described in-detail for PMKSY-PDMC.

However, it is important to note that the current set of schemes do not have sufficient provisions for private sector engagement for research, implementation and collaboration. Most of the interventions are being implemented through state departments or government agencies, only few scheme components support engagement with entrepreneurs or FPOs.

### 1.3 Issues and Challenges

**Food Security Concerns:** Agriculture in India contributes significantly to the economy of the country. India is world largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as owns the largest area under wheat, rice and cotton, making the nation a global agricultural powerhouse. However, global benchmarking of most agricultural commodities bring out the issue of low productivity of agricultural produce in India. As depicted in the figure given alongside the rank of India in yield rate is much poor although it happens to be one of the top producers of the agricultural commodities across the globe. Raising the productivity of agricultural commodities per unit of land have remained one of the top concerns in the sector and all agricultural policy framed since 1960 have been taking measures to address it. The low yield rate is attributed to the low level of mechanization in agriculture coupled with large sections of rural population resorting to subsistence farming. Despite its continuous endeavour to attain self-sufficiency in crop production, India has to import significant amount of wheat and is still a net importer of vegetable oil.

Figure 94: Position of India's Agricultural Produce in terms of Yield Rate and Aggregate Production



Source: FAO Data, 2017

**Slow Growth in Farmers' Income:** Income of farmers has been one of the major challenges in this sector leading to a constant decrease in the agricultural labour over the years. As per the current trend in income of farmers over the last decade it is evident the growth rate has not been consistently growing over the period. While farmers' income declined at 0.55% per annum between 1999–2000 and 2004–05, it increased at 7.46% per annum during the period between 2004–05 and 2011–12. The growth rate of farmers' income between 2004–05 and 2011–12 has been observed to be the highest since the beginning of economic reforms.<sup>86</sup>

Table 19: Growth Rate of Farmers Income

Time Period	Growth Rate
1993-94 to 1999-00	4.11%
1999-00 to 2004-05	-0.55%
2004-05 to 2011-12	7.46%
2011-12 to 2016-17	0.44%

However, as discussed in the Doubling Farmers' Income Report, the ambitious target of doubling farmers income by 2022-23 would require farm income growth rate of 10.4 per cent per year for

<sup>86</sup> Himanshu. 2018. Too Little, Too Late Apathy towards the Rural Sector. Economic & Political Weekly.

the nation.<sup>87</sup> The farmer's income from farm and non-farm activities is pegged at Rs 96,703 per annum as of 2015-16. The targeted income of farmers from farm and non-farm activities is aspired to be Rs 172694 as of 2022-23 (in 2015-16 prices)<sup>88</sup> and this can be possible only with an accelerated growth rate of farmers' income consistently over the period. The farmer's income which consists of farm activities and non-farm activities is estimated to grow at 10.36% per annum and 5.66% per annum respectively during the period 2015-16 and 2022-23. However, wages from non-farm activities have been observed to be declining sharply in the recent years. As analysed from the Labour Bureau series, Wage Rates in Rural India (WRRRI), shows that the wage rate had been increasing until 2012-13, post which it has been decelerating and has declined in real terms for both agricultural and non-agricultural labourers.<sup>89</sup> Real wages of agricultural labourers have declined at 0.3% per annum between 2013 and 2017, whereas non-agricultural wages have declined by 1.1% during the same period. This trend has been a bottleneck for the revival of farmer's income in recent years.

**Lack of Agricultural Credit:** The rural economy has slumped post 2014-15 with the growth rate of agriculture<sup>90</sup> declining to 1.86% between 2014-15 and 2017-18 as against a comparatively stronger growth of 3.5% per annum between 2011-12 and 2013-14 as shown in the table below.

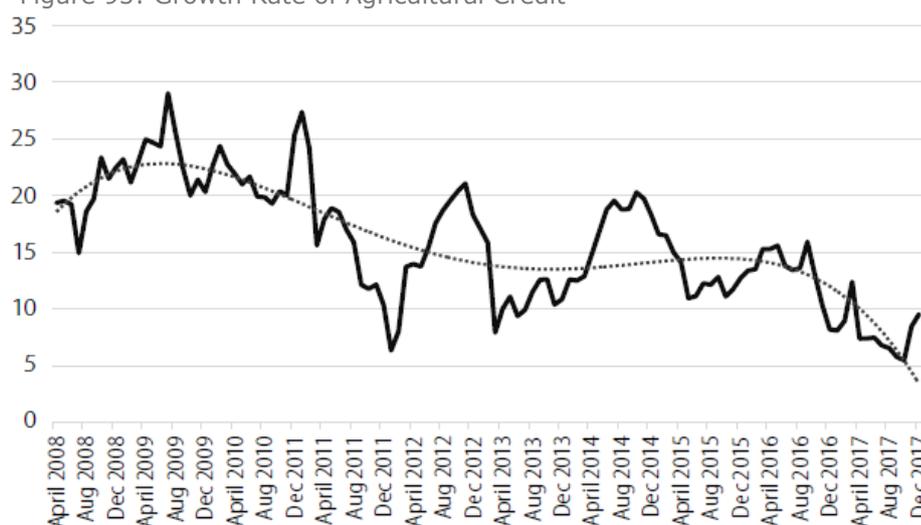
Table 20: Growth Rate of Value Added in Agriculture

Growth Rate of Value Added in Agriculture (GDP Series 2011-12 Prices)	
2011-12 to 2014-15	3.5%
2014-15 to 2017-18	1.86%

Source: Himanshu. 2018. Too Little, Too Late Apathy towards the Rural Sector. Economic & Political Weekly.

The stagnation in agriculture sector had been further distressed with the decline in in agricultural investment. The trend of growth rate in agriculture credit has been depicted in the figure shown below.

Figure 95: Growth Rate of Agricultural Credit



Source: Himanshu. 2018. Too Little, Too Late Apathy towards the Rural Sector. Economic & Political Weekly

below.

As shown in the graph, the real investment of agriculture has been declining at 2.3% per annum between 2013-14 and 2016-17. The growth in agricultural credit slowed down to 12.3% between 2014-15 and 2016-17, as compared to 21% per annum in

<sup>87</sup> Doubling Farmers' Income – Volume XIV

<sup>88</sup> In 2022-23 the targeted income of farmers is estimated to be Rs 242998 at current prices.

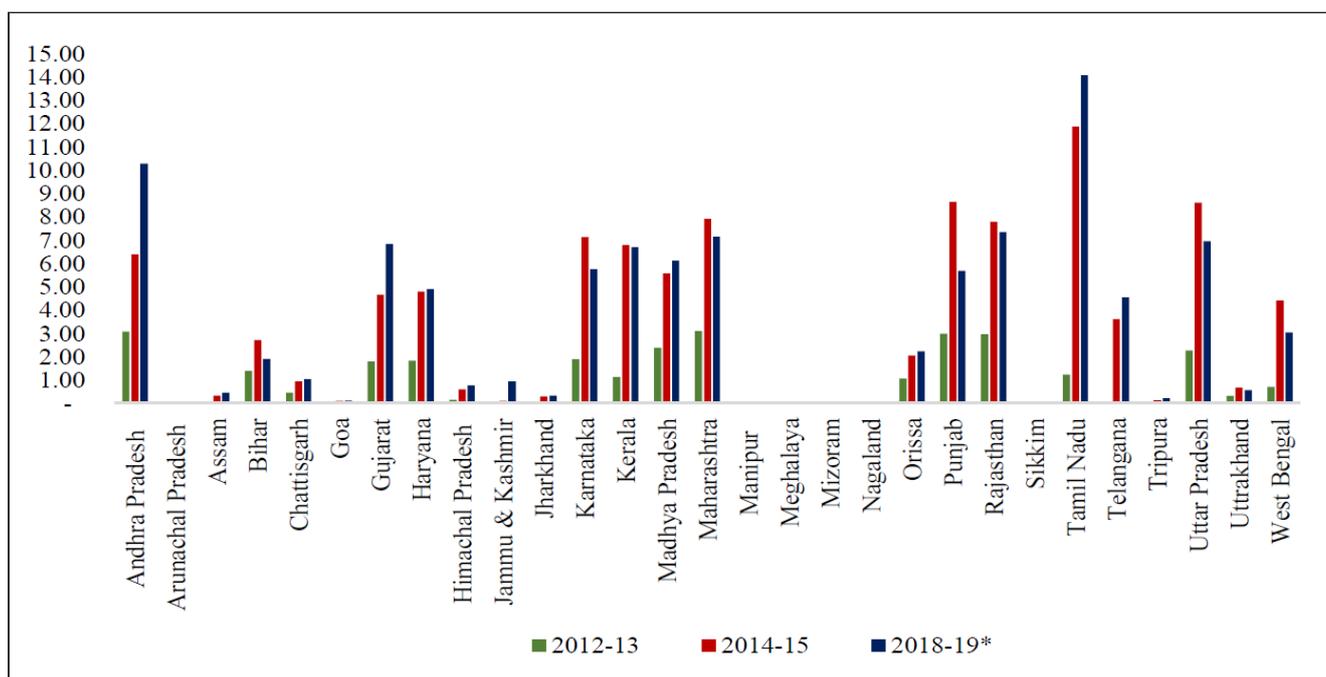
<sup>89</sup> Himanshu. 2018. Too Little, Too Late Apathy towards the Rural Sector. Economic & Political Weekly

<sup>90</sup> Growth rates of agricultural gross value added (GVA) is referred here based on 2011-12 GDP Series

nominal terms between 2004–05 and 2014–15. The lack of access to credit has negatively impacted the agriculture sector which direly needs investment on mechanization of agricultural operations and the shifting cropping pattern towards high value agriculture which includes farming of cash crops and horticulture. Availability of farm credit is one of the key components to enable increase in productivity through ensuring substantive investment in irrigation, seeds and fertilizers and new technology. Development of post-harvest infrastructure and value addition in agrarian activities also requires monetization and hence is likely to be affected due to the gradual declining trend in agricultural credit.

Distribution of agricultural credit is also observed to be highly skewed across different states. The regional distribution of agricultural credit disbursement is shown in the figure below.

Figure 96: Percentage of Agricultural Credit Disbursement (till September 2018)



Source: Economic Survey 2019-20, Chapter 07 Agriculture and Food Management

As it can be seen from the figure above, the distribution of agricultural credit is low in North Eastern, Hilly and Eastern States. The share of North Eastern States has been less than one per cent in total agricultural credit disbursement.<sup>91</sup>

**Water Reduction and Irrigation Strengthening:** India accounts for only about 4 per cent of global water resources, but supports 18 per cent of the World’s human population. India’s per capita water availability is steadily declining due to population growth. According to estimates of Doubling Farmer’s Income report, India will be a water stressed country<sup>92</sup> on the basis of per capita water availability in 2050 with only 686 cubic meter per year<sup>93</sup>. Water required for irrigation purpose is estimated at around 75-85 per cent share in the total demand by the Standing Sub-Committee of MoWR.

<sup>91</sup> Economic Survey 2019-20, Chapter 07 Agriculture and Food Management

<sup>92</sup> Per capita per year availability of less than 1700 cubic metres (m<sup>3</sup>) is termed as water stressed condition while if it falls below 1000 cubic meters, it is termed as water scarcity condition. (Doubling Farmers’ Income – Volume I, Chapter 3 Technology and Cultivation Practices)

<sup>93</sup> Niti Aayog. 2017. Doubling Farmers’ Income – Volume I, Chapter 3 Technology and Cultivation Practices

Table 21: Water Requirement for various Sectors in terms of Water Demand in BCM or km<sup>3</sup>

Year	Standing Sub-Committee of MoWR			NCIWRD		
	2010	2025	2050	2010	2025	2050
Irrigation	688	910	1072	557	611	807
Drinking Water	56	73	102	43	62	111
Industry	12	23	63	37	67	81
Energy	5	15	130	19	33	70
Others	52	72	80	54	70	111
<b>Total</b>	<b>813</b>	<b>1093</b>	<b>1447</b>	<b>710</b>	<b>843</b>	<b>1180</b>

Source: NITI Aayog. 2017. Doubling Farmers' Income – Volume I, Chapter 3 Technology and Cultivation Practices

With over 80% of the total water in the country being used in agriculture, measures need to be taken for sustainable usage.

The vulnerability of crop production due to water stress is also aggravated by the high dependence of the country's agriculture land on rainfall. Around 52% of India's cultivated land is dependent on monsoon rains. The rainfed areas constitute about three fourth of land mass under arid, semi-arid, and dry humid situations and are characterized by low levels of productivity and low input usage. The variations in rainfall and water availability in different parts of the country proves to be a problem for region-specific water scarcity. While average annual rainfall of the country is about 1,170 mm, it varies from an average high of 10,000 mm per year in North East and a low of just 100 mm per annum in some parts of Western Rajasthan. The Ganga-Brahmaputra river basin contributes to more than 50 per cent of total annual water availability, whereas, Southern and Western basins account for only about 15% each.<sup>94</sup>

There is also sub-optimal utilization of irrigation in the country. Inadequate maintenance of canal system, lack of participatory management, changing land use pattern, deviation from the designated cropping pattern, soil degradation and delay in command area development attribute to the issue of under-utilization of irrigation potential. While there is around 35%-40% of overuse in surface irrigation systems, and 65 per cent in case of ground water use, water efficient irrigation like micro irrigation has not penetrated in many parts of the country.

The issue of water availability in agriculture is aggravated owing to the current cropping system in the country. High proportion of cultivated area under water intensive crops like rice, sugarcane etc. is not well managed through water efficient irrigation systems. Diversification from rice and sugarcane to low duty crops such as millets, maize, pulses and oilseeds are not opted by farmers. There is lack of promotion of low water duty crops like maize, pulses & oilseeds replacing rice, sugarcane, banana, cotton etc. especially in over-exploited regions. As per assessment of Central Ground Water Board, the over-exploited regions are significantly higher in Delhi, Haryana, Himachal Pradesh, Karnataka, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh.<sup>95</sup> There is lack of awareness generation among farmers on proper use of irrigation water at critical stages of crop growth under different soil and environment conditions.

**Problem of Pests and Diseases:** One of the main threats to agriculture are from pests and diseases that destroy crops. In India, the farmer's crop yield losses range from 15 to 25 per cent

<sup>94</sup> NITI Aayog. 2017. Doubling Farmers' Income – Volume VII, Chapter 2

<sup>95</sup> NITI Aayog. 2017. Doubling Farmers' Income – Volume VII, Chapter 2

owing to the presence of weeds, pests, diseases and rodents. Although India uses an average of 0.5 kg per ha of pesticide (which is much lower compared to USA, South Korea, Japan or Europe), within the country there are wide variations between regions, crops and across irrigated-rainfed status. The intensity of pesticide usage is high in case of certain crops, particularly when raised in irrigated systems.<sup>96</sup> High usage of chemical pesticides also impacts health and safety of other flora and fauna, including humans which needs to be replaced with organic solutions to prevent diseases. Sale of spurious and misbranded pesticides is one of the biggest challenges faced by the agriculture community posing danger to the crop, human health and environment. Lack of monitoring of bio-pesticide registrations and lack of comprehensive data on dealers and pesticides being sold in the market are some of the underlying reasons of the problem. In addition there is need to sensitize farmers adequately along with increasing the reach of Integrated Pest Management techniques. There is lack of effective pest surveillance mechanism in Integrated Pest Management and in adequate availability of IPM inputs like bio-control agents, bio-pesticides, light traps, rodent traps, pheromone traps, sticky traps, seed treatment drums etc. which needs to be addressed. The price of pesticides (both branded and generic) is uncontrolled and is observed to be increasing affecting the cost incurred by farmers.

**Low Level of Farm Mechanization:** Farm mechanization helps in efficient utilization of all farm inputs like seeds, fertilizer and water, thus increasing the productivity of land and labour. It also helps in cost minimization by arresting the rising wages of labour being used in the farm. Agricultural mechanization mitigates farm drudgery, increases the pace of work at farm and aids in enhancing farmers' income. In India, lack of access to farm power is one of the primary reasons for slow uptake of farm mechanization, particularly among small and marginal farmers. Farm mechanization is varied across different states. The level of farm mechanization is high at about 40%-45% in states like UP, Haryana and Punjab, but extremely low in north-eastern and hilly states<sup>97</sup>. The level of farm mechanization in India is still low as compared to the countries such as the U. S. (95 %), Brazil (75%) and China (57%). The percentage of agricultural workers in total work force is expected to drop to 25.7% by 2050 from 58.2% in 2001 and farm mechanization can be the solution to address this challenge. As highlighted earlier, agricultural mechanization demands supply of farm power which is currently a challenge in Indian context. The available farm power is 2.02 kW/Ha as of 2016-17<sup>98</sup> which is still low to introduce tractors and power tillers. Availability of credit for power tillers and tractors also pose a critical issue. The procedure to avail agriculture term loan is known to be cumbersome and the rate of interest is higher for farm mechanization based loans<sup>99</sup>.

**Lower Adoption of Good Agricultural Practices:** The concept of Good Agricultural Practices in agriculture has emerged as a solution catering to the challenges of improving food security, manage increasing demand and conserve the natural resources. A GAP approach intends to address the demand-side priorities of consumers and retailers, as well as the supply-side priorities of producers and labourers. In the era of declining factor productivity and degradation of natural resource base of agricultural production system, there is an urgent need to develop GAPs. In India, adoption of GAP is at a nascent stage. To promote good agricultural practices,

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<sup>96</sup> Niti Aayog. 2017. Doubling Farmers' Income – Volume VII, Chapter 4

<sup>97</sup> NABARD. 2018. Farm Mechanization. Retrieved from <https://www.nabard.org/auth/writereaddata/tender/1803194512NSP%20Farm%20Mechanisation.pdf>

<sup>98</sup> NABARD. 2018. Farm Mechanization. Retrieved from <https://www.nabard.org/auth/writereaddata/tender/1803194512NSP%20Farm%20Mechanisation.pdf>

<sup>99</sup> NABARD. 2018. Farm Mechanization. Retrieved from <https://www.nabard.org/auth/writereaddata/tender/1803194512NSP%20Farm%20Mechanisation.pdf>

India Good Agricultural Practices (INDGAP) certification scheme has been developed by Quality Council of India. INDGAP aims to cover small and marginal farmers and enable them to adopt in a phased manner. The Indian Good Agricultural Practices (INDGAP) takes into account not only the quality and quantity of the produce obtained from a unit area but also the care is taken in integrating preharvest practices like soil & water management, nutrient management and pest management, harvesting, post-harvest handling and other logistics. INDGAP has been implemented in harvesting rice, zero-till wheat and other crops. However, there are several challenges in implementing Good Agricultural Practices in aspects such as seed and sowing, seed priming, precision planting techniques, and using improved farm machinery. Studies have revealed lack of awareness about critical GAPs among farmers<sup>100</sup>.

**Post-Harvest Losses and Challenges of Infrastructure:** One of the growing challenges in the agriculture sector is the problem of food loss and food waste. Reducing food loss and waste is the key to reduce production costs, increase the efficiency of the food system, improve food security and nutrition, and contribute towards environmental sustainability. Globally around 14 percent of the world's food is lost from the post-harvest stage up to, excluding, the retail stage. In Central and Southern Asia, the percentage of food loss is as high as 20%-21%.<sup>101</sup>

The need for warehousing and cold chain development is a critical step for prevention of post-harvest losses. Inadequate storage conditions, and climatic factors like heat and moisture cause biological deterioration especially without proper storage and transportation. In India, loss of perishable food items like fruits and vegetables, meat and fish are attributable to poor infrastructure and in adequate cold storage facilities. According to Global Cold Chain Alliance<sup>102</sup>, India has an average of 0.34 cubic meters of refrigerated warehousing space per urban resident and is in the 8<sup>th</sup> place globally as of 2018<sup>103</sup>. This indicates there is potential to improve cold chain infrastructure in the country in order to handle its agricultural produce better.

**Challenges in Food Processing:** Contribution of agriculture to the economy can be enhanced by improving the food processing industry. High production level of agricultural inputs provide immense opportunity to improve its processing sector and at the same time create employment opportunities as well. India currently processes less than 10%<sup>104</sup> of its agricultural output (only around 2% of fruits and vegetables, 6% of poultry, 21% of meat, 23% of marine and 35% of milk) and most of the processing that is done in India can be classified as primary processing – done through rice, sugar, edible oil and flour mills etc. Primary processing offers lower value-addition compared to secondary processing that includes processing of high value items viz fruits and vegetables, dairy, bakery, meat and fish items etc. Despite being the second largest producer of the fruits and vegetables in the world, the processing levels in fruits and vegetables currently stand at a low of 2%. The current processing levels in poultry are 6%, while for meat it stands at 21%. With scope of improving exports in the processing sector, this industry also needs to standardise the mandatory requirements of Sanitary and Phytosanitary Measures<sup>105</sup> to ensure quality control and food safety. Agricultural exports from the country often face bans due to non-

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<sup>100</sup> Pandit. 2017. Adoption of Good Agricultural Practices (GAPs) in Basmati (Scented) rice: A study of prospects and retrospect

<sup>101</sup> FAO. 2019. The State of Food and Agriculture 2019

<sup>102</sup> In order to facilitate comparisons across countries, Global Cold Chain Alliance has created a market development index that compares the total refrigerated warehouse capacity of a country to its urban population.

<sup>103</sup> FAO. 2019. The State of Food and Agriculture 2019

<sup>104</sup> CII, FoodPro, FACE. 2019. Food Processing Report, Trends and Opportunities 2019

<sup>105</sup> Application of Sanitary and Phyto-sanitary Measures' (the "SPS Agreement") which came into force with the establishment of the World Trade Organization on 1 January 1995.

compliance of Sanitary and Phytosanitary Measures. Food processing levels vary significantly across states of India. Southern region has the highest numbers of registered factories with Andhra Pradesh accounting for about 14.75% followed by Tamil Nadu accounting for about 12.77% and Telangana accounting for about 9.99% of the total registered factories. There is much lower penetration of FPI industries in Eastern states. In terms of the equipment of processing, there is a huge deficit of pack houses at the farm gate, cold storage facilities across the value chain, multi - modal logistics, government certified labs and mechanised handling and loading. The sector is also affected by the lack of demand-based innovations as well as efficient and reliable marketing networks.

**Issues in Agricultural Marketing:** An efficient agricultural marketing system ensures transparent price discovery maintaining operational efficiency resulting in proper remuneration to the farmers as well as offer affordable rates to consumers. Extent of price dispersion for the same produce, across multiple markets in the country is indicative of the efficacy of the agricultural marketing system. As discussed in Figure, farm gate price dispersion is found to be high among all crops in India, especially among perishable crops like potato, onion and groundnuts. The variation in prices between farm-gate and consumer is attributed to factors like lack of logistics connecting farm-gate with the wholesale market at consumer end, connectivity, degree of private sector competition, propensity of regional exposure to shocks, local storage capacity, mandi infrastructure and farmers access to them, storage life of the crop and crop specific processing cost<sup>106</sup>. There is lack of market intelligence system that monitors and analysis other economic signal for the purpose of marketing efficiency. Some of the key policy instruments that have been adopted to streamline marketing system includes regulation of markets through the APMC Act, input subsidies for producers, minimum support prices (MSP), and food subsidies for consumers. However, the current APMC Act has several shortcomings in terms of prohibitive license fee, high commission, marketing fee, and APMC cess levied to farmers. The penetration of agricultural markets varies across states with the density of regulated markets being 118 sq km. in Punjab to 11,214 sq km. in Meghalaya. The current regulated markets lack most of the essential marketing infrastructure such as auction platforms, common drying yards, electronic weigh-bridges, grading facilities and cold storage units. While covered and open auction platforms exist only in two-thirds of the regulated markets, only one-fourth of the markets have common drying yards, one-tenth of the markets have cold storage units and grading facilities are there in less than one-third of the markets<sup>107</sup>. The current agricultural marketing system lacks efficient supply chain having large number of marketing channels and adding up more of costs without adding significant value. Lack of developed alternative marketing channels like direct marketing, contract farming has resulted in low farmer's price realization. Reforms in the agricultural marketing system is hence required to build an efficient and robust marketing system.

**Gaps in Research and Development:** Green Revolution-I sought to bring food security to the nation. The next revolution, Green Revolution-II was launched to ensure income security of the farmers by applying science and technology to all sub-sectors of agriculture such as agriculture, horticulture, dairy & livestock, fishery and aquaculture. Research and development in agriculture requires to focus on income-guided ventures to ensure applicability of the interventions. Some of the domains in agriculture that lack research gaps are irrigated ecosystems, hill agriculture, coastal agriculture, seed production system. There is a wide gap in irrigation potential created and its utilisation which needs to be bridged through use of potential technologies such as

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<sup>106</sup> NITI Aayog. 2017. Doubling Farmers' Income Report Volume IV

<sup>107</sup> NITI Aayog. 2017. Doubling Farmers' Income Report Volume IV

breeding water use efficient varieties, adopting water use efficient cropping system (crop alignment), water use efficient technologies like micro-irrigation, sensors etc. In rainfed agriculture as well, management of natural resources needs to be supported by technology led sustainable development systems. Soil and water conservation methods are required to be supported by evolution & promotion of appropriate technologies including crop diversification, developing crop genotypes, and alternate land use systems. There are gaps in applying modern technology in developing improved varieties of crops and hybrids, refinement of seed-production technologies and production of breeder seeds. The agriculture sector needs a robust seed production system which would address low seed replacement rate, low varietal replacement rate, lack of seed grid and seeds resistant to abiotic and biotic stresses. High value agriculture crop sector like horticulture is highly dependent on advanced research and development on genetic resource enhancement, enhancing the efficiency of production and reducing post-harvest losses. Research and developmental gaps exist in respect of effective management, enhancing the shelf life of perishable fruits, vegetables, flowers, product diversification and value addition for better profitability. Technology and automation is also key to food processing sector to address the required levels of quality control, production speed, labor shortages and overall profitability.

## Chapter 2 : Sector Level Recommendations: Agriculture

### 2.1 Recommendations at Sectoral Level

Post consultations with the department officials at central, state and district level; sector experts; and our analysis of the issues and challenges faced by the agriculture sector, the recommendations and solutions have been provided below across the Value Chain.

#### **Production**

- Quality seeds, planting material, fertilisers, pesticides, insecticides and bio-fertilisers are critical for sustained production of agriculture and horticulture activities. Non availability of quality seeds has been a major constraint which impact production and yield of key agricultural commodities. Thus, ensuring availability of quality inputs is critical which needs to be addressed. This should be supplemented by capacity building of farmers on various aspects of seed treatment, time of sowing and treatment of soil before sowing, etc. to ensure disease free production of crops. More focus is also necessary on enhancing quality seed production and development of nurseries to ensure timely availability of quality planting materials. Optimal use of fertilizers (including micro-nutrients) and pesticides should also be encouraged based on soil testing before the start of every crop season. Bio-fertilizers and bio-pesticides should be promoted considering the high environmental impacts of chemical fertilizers and pesticides.
- As mentioned, majority of FPOs (including FPCs) in India are at a nascent stage of their operations. They mostly assist the member farmers in input supply although some are also engaged in aggregation of the produce from the members. However, there is a need to assist the development of these FPOs into a functioning business enterprise. The FPOs may be encouraged to widen their scope of services in the lines of agribusiness centres which should operate as an one stop destination for all the production and marketing needs of the member farmers including sale of agri inputs and services, procurement and primary processing, storage and marketing.

### **Abhinav Farmers' Club**

A group of 12 progressive farmers formed the Abhinav Farmers' Club in Pune district of Maharashtra under the guidance of National Bank for Rural Development (NABARD), in the year 2004. These farmers were involved in cultivation of roses and carnations under protected conditions of a poly house. The Farmers' Club enabled the individual farmers to aggregate the produce and market it effectively in Mumbai and Delhi. The functions of production, logistics, marketing, branding were divided among the different members of the group. Gradually more farmers started becoming members of the club and the membership grew to more than 300. However, all the member farmers practiced floriculture, which resulted in excess supply and eventually led to reduced margins for the member farmers.

Abhinav Farmers' Club then developed an innovative 1-acre hi-tech integrated organic farming concept, in which the farmers would grow different types of fruits, leafy vegetables, exotic vegetables and pulses. Abhinav Farmers' Club has also tied up with women Self Help Groups, who help in grading, packaging and delivery of the produce at the doorstep of the consumers. This is an integrated model, which focuses on growing a diverse set of products (in smaller quantities) needed every-day by the consumers and supplying them directly to the end-consumers. The USP of this model is that the high quality organic produce is directly marketed to the retail consumers, thereby eliminating all the intermediaries. This ensures higher margins to the member farmers.

The current membership of Abhinav Farmers' Club is not just limited to Pune, but has spread to six states of the country, viz. Maharashtra, Telangana, Andhra Pradesh, Gujarat, Madhya Pradesh and Karnataka. The total membership is close to 1.5 lakh farmers, who produce organic fruits, vegetables, pulses on a 1-acre plot each and directly supply to end consumers. The coordination amongst these member farmers is facilitated through farmer leaders from each group (257 farmer leaders across the country), which are connected through a WhatsApp group and meet once in three months. Abhinav Farmers' Club provides the technical expertise regarding production and marketing of the produce to the new member farmers through the farmers' leaders. Thus, it has been able to reach a membership of around 1.5 lakh farmers.

(Source: <https://www.abhinavfarmerclub.org/>, last accessed on 28<sup>th</sup> July 2020)

- There is a sub-optimal utilization of irrigation in the country. Adequate maintenance of canal system, participatory management, changing land use pattern, following the designated cropping pattern, reduction of soil degradation and timely command area development would increase the utilization of irrigation potential. Promotion of water efficient irrigation such as micro irrigation should be actively promoted especially in the water scarce areas.
- As discussed earlier, the issue of water availability in agriculture is aggravated owing to the current cropping system in the country. High proportion of cultivated area under water intensive crops like rice, sugarcane etc. is not well managed through water efficient irrigation systems. Diversification from rice and sugarcane to crops such as millets, maize, pulses and

oilseeds are recommended considering the low water requirement of the later crops. Low water consuming crops such as maize, pulses & oilseeds should be promoted replacing rice, sugarcane, banana, cotton etc. in over-exploited regions.

- Awareness generation among farmers on proper use of irrigation water at critical stages of crop growth under different soil and environment conditions should be undertaken.
- In India, there has been slow uptake of farm mechanization, particularly among small and marginal farmers. Considering the expected drop of percentage of agricultural workers in total work force in India, it is critical that farm mechanization is actively promoted. Considering the cost involved in farm mechanization, it is recommended that the FPOs can also be promoted as equipment banks which would enable small and marginal farmers to have access to such equipment at a low cost. Moreover, the private sector can be roped in for provision of such services. Innovative business models such as digital sharing platforms of farm equipment (Uber model) may be promoted. This will not only provide easy access to farm equipment for the smaller farmers but would also increase the utilization of equipment owned by the farmers when not being used in their own farms.

Box 6: Digital Platforms for Farm Equipment

### Digital Platforms for Farm Equipment

The total market size of agri-machinery renting is stated to be over \$5 billion, while the total agriculture market size is over \$250 billion.

The players in this market include EM3 Agribusiness, Zamindara farm solutions, Trringo and government cooperatives.

EM3 buys their own machinery and leases it, with around 15 centres in MP, east UP and Bihar. Zamindara also follows a similar model as EM3 and operates in a few locations in Punjab.

Trringo is a Mahindra (M&M) internally incubated startup and has a twin business model - franchise and farmer to farmer.

[https://yourstory.com/2016/06/farmart?utm\\_pageLoadtype=scroll](https://yourstory.com/2016/06/farmart?utm_pageLoadtype=scroll)

### Processing and Value Addition

- Upgradation of Storage and Transparent Price Discovery Infrastructure at Mandi level can assist in processing, value addition and marketing. There is a need to upgrade and promote modern dry storage to cater to various agricultural crops linked with the warehouse receipt financing facility. This would enable the smallholder farmers to store their produce and take advantage of the increased rates after few months of the harvest season. This would prevent the distress selling and help them get better gains from the market. Also, due to the warehouse receipt facility the farmers would be able to avail loans at affordable rates for their different financial needs.
- In case of most crops, the prices are determined by the moisture and foreign material content and oil content in oilseeds. However, scientific testing facilities are mostly not available at the markets and the traders rely on visual methods and physical handling to estimate the

moisture, foreign material and oil content. Thus, the price discovery mechanisms are skewed in favor of the traders and the farmers end up getting less price for their produce. Thus, in order to promote transparent price discovery, it is recommended that enabling infrastructure in the form of Cleaning Grading Machines, Moisture Meters, Oil Content Analyzer, etc. are established in major markets. For instance, in case of milk, dairy farmers are able to get fair price realization through milko-testers installed at the point of sale and the process is transparent. It is proposed to create such transparent price discovery infrastructure in major agricultural produce markets in the country.

- Similarly, grading machines can be installed for horticultural products. After grading and sorting, the table grades can be transported to the retail markets/ retailers and processing grade can be moved to processing centres.
- Moreover, irradiation facilities can also be established to increase the shelf life of both grains, pulses and some of the horticulture crops to reduce/ eliminate storage pests.
- Encourage appropriate/ innovative packaging (for instance, modified atmosphere packaging, biodegradable packaging, etc.) to minimize losses.
- Capacity building of farmers and farmer collectives on improved harvest and post-harvest practices. For example, in the case of Bananas, farmers need to be trained on the use of foam padding/ bubble wraps to prevent injury to the harvested banana bunch. Similarly, the hands need to be dipped in alum solution for prevention of sap flow on the peels to prevent black spots. Similarly, farmers need to be trained on appropriate harvesting and post-harvesting practices such as optimal time of harvest, storage temperature, quality indices, maturity indices, injuries, handling protocols, post-harvest injuries and decays, ripening process and use of ripening agents, use of right packaging, transportation impact etc. for other crops as well for better value realization and reducing damage to the produce.

Box 7: Use of Nets for harvesting fruits

#### **Use of Nets for harvesting fruits**

Majority of the mango growers do not use the mango harvester to harvest the fruits. The fruits are harvested by beating the branches with bamboo poles or climbing the tree and vigorously shaking the branches, making the fruits fall onto the ground. As a result, barring the fruits, which are on lower branches, the other fruits are either bruised or damaged during the harvesting process. Such practices result in direct/indirect wastage of almost 10%-15% of the fruits, when compared to the harvesting done by adopting scientific harvesting practices.

One reason cited for not using the mango harvester is that, the process is time consuming and requires more labor to do it. Considering this, nets can be used under the canopy of the trees, so that the fruits are collected in them and the physical injury to the fruits is prevented. This practice can be promoted as a better harvesting practice among the farmers.

## Credit and Insurance

- Access to finance and Creation of Seed Capital/ Venture Capital Fund. Availability of timely credit (both term loans and working capital) from banks and other financial institutions is a major challenge. The majority of banks and other financial institutions generally seek a minimum collateral of about 150% to 200% of loan value from the farmers/ farmer collectives/ enterprises/ start-ups. Moreover, difficulty in accessing working capital loan, many times forces the farmer to avail loans from informal sources, which typically involves high costs. For e.g., the potato farmers are primarily dependent on cold storage owners for informal credits, as access to formal credits is limited and warehouse receipt financing facility is mostly not available. These informal loans are provided at 18% to 24% per annum depending upon the mutual understanding and negotiation between the farmer and the cold storage owner.
- Moreover, most of the Government Subsidy Schemes are credit linked, such as Cold Chain Scheme, Scheme for Creation of Backward and Forward Linkages and Scheme for Creation/ Expansion of Food Processing & Preservation Capacities (Ministry of Food Processing Industries) term loan of a certain percentage of the project cost is a mandatory eligibility criterion. Many of the farmer collectives and other smaller agribusiness companies are unable to apply under these subsidy schemes for creation of processing, storage and value addition infrastructure due to their inability to raise bank loans. Considering this, it is recommended that the government may consider creating agri-business/ agri-processing fund which provided soft loans (both term and working capital) at 4-5% interest rates to farmer collectives and agri-business private companies.
- The agri-enterprises (especially the start-ups) which are operating and planning to operate have an acute need for seed / venture capital along with business/ enterprise incubation. Some of the existing funding and incubation programs have been quite successful in the state. For e.g., the INVENT programme has received encouraging response and several agri-startups have been funded and incubated under this programme. Also, recently India Agritech Incubation Network has been setup at IIT-Kanpur with a target to impact almost 50,000 farmers through 60 enterprises working on technological solutions for agriculture. There is need for such seed/ venture capital along with business/ enterprise incubation to provide a supportive environment to improve their business, entrepreneurial and marketing skills along with low cost funding.

### India Agritech Incubation Network

Recently, India Agritech Incubation Network (IAIN) has been setup at IIT-Kanpur with a target to impact almost 50,000 farmers through 60 enterprises working on technological solutions for agriculture. The Bill and Melinda Gates Foundation (BMGF) and Tata Trusts, in collaboration with Collectives for Integrated Livelihood Initiatives (CINI) and the Government of Uttar Pradesh, have jointly set up the IAIN. It aims to provide incubation support to innovators and agritech entrepreneurs, to come up with innovative technological solutions to positively impact the lives of smallholder farmers in the state of Uttar Pradesh.

Under this initiative, the Social Alpha Quest for Agritech Innovations has been announced in July 2019. In the first phase, around 12 innovations are proposed to be selected, which would receive incubation support for the next 1-2 years. The initiative would aim to bring about new technological innovations in the following areas:

- Improving productivity and yield intensification
- Better post-harvest loss management and value-addition
- Enhancing access to market and improving traceability

(Source: IIT Kanpur, Start-up Incubator and Innovation centre, <https://www.socialalpha.org/agritech-innovations/>, last accessed on 28<sup>th</sup> July 2020)

- Agricultural/ Crop Insurance has not taken off as envisaged. There have been multiple issues including high premium, limited coverage of crops, limited percolation geography – higher in South India vs North and East India, limited interest of insurance service providers, etc. Horticultural crops typically have been excluded from PMFBY.

### Low numbers, high premium

The number of insured farmers has decreased by nearly 3 per cent, pushing the average premium by close to 20 per cent



Note: \* Provisional data

Source: Ministry of Agriculture and Farmers' Welfare

Thus, there is a need to enhance the scope of insurance to cover all crops including horticultural, plantations and spice crops. For instance, in Uttar Pradesh, the cultivation area of Betel Leaf is roughly 1,000 hectares and the rain has destroyed 80% of the crop. However, Betel Leaf farming is considered as horticulture crop and not as agriculture and crop insurance does not cover it. Therefore, farmers in the state engaged in Betel Leaf farming have suffered heavy losses<sup>107</sup>.

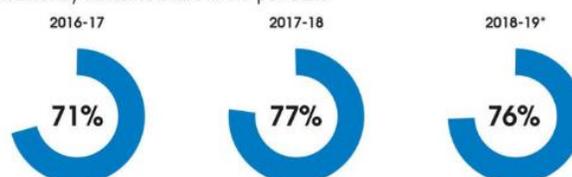
- Moreover, the risk has increased for private insurance companies because the number of farmers covered under the scheme has not increased over the years. In 2016-17, more than

<sup>107</sup> <https://www.hindustantimes.com/lucknow/farmers-seek-government-help-as-rain-hits-betel-leaf-cultivation-in-up/story-y9EEZbk2ndG94jP4n9CVOK.html>

58 million farmers were covered under the scheme, which dropped to around 56 million in 2018-19. This has pushed the scheme's premium as can be seen from the figure alongside.

The interest of private players is diminishing in the scheme due to high risks and this can weaken the overall efforts. This may also increase the risk burden of the government companies (already 5 government-run companies under the scheme cover over 50% of the disaster-prone areas) and the overall claim ratio of the government companies in the past three years have been substantially higher (86%) than the private players (77%). In case, the remaining players also increase the premium amount to compensate for the higher risk, it may make farmers unsure of the benefits from crop insurance scheme<sup>108</sup>. Therefore, the number of farmers under the scheme need to be increased to cover the entire country for long-term sustainability of the scheme.

The insurance claim ratio of Pradhan Mantri Fasal Bima Yojana has consistently remained above 70 per cent



- There is a need to revisit both the contours of the scheme and its implementation in its current form. It is proposed that the scope of crop insurance be widened to cover potential crop income/ livelihood rather than just crop inputs. It may also be considered to focus on providing insurance to collectives for more widespread coverage and reduced operational expenditure of service providers.

## Marketing

- There is need to encourage market development through initiatives such as promotion of digital e-market places, direct linkages with emerging agribusiness markets/ private players, export promotion, etc.
- Emerging agribusiness players and exporters need to be supported in developing market linkages or connecting with buyers in the international market and in turn benefiting the farmers. Therefore, such private sector agri-businesses which need critical support for enhancing marketing and promotion of their produce in both domestic and export markets, are suggested to be supported for availing professional services for these activities provided they procure certain prescribed percentage of their raw material directly from the farmer collectives.
- Industry led, crop specific market promotion and R&D associations may be promoted on the lines of American Soybean Association, US Dry Peas and Lentils Council, Horticulture Innovation Fund Australia, etc. supported in equal measures by the Government.

<sup>108</sup> <https://www.downtoearth.org.in/news/agriculture/punctured-cover-india-s-crop-insurance-scheme-loses-sheen-68379>

**Case Study: Hort Innovation (Australia)**

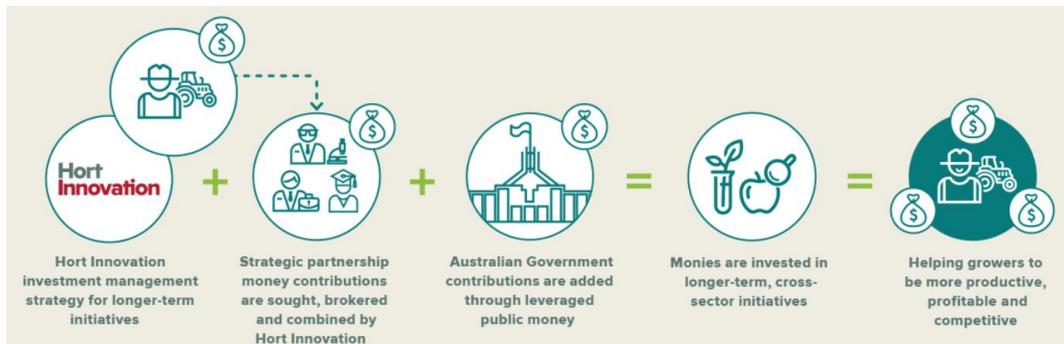
**Background:** Hort Innovation is grower-owned, not-for-profit research and development corporation for Australia's horticulture industry. Each year, investment of more than \$100 million in R&D, marketing and trade programs is made on behalf of industry to improve the productivity, farm gate profitability and global competitiveness of specific industries, and Australian horticulture as a whole.

**Funding:** Hort Innovation's investments are funded by grower levies and Australian Government contributions, as well other industry contributions and co-investment.

**Industry Insights:** For investments in R&D, marketing and trade, Hort Innovation consults with growers through industry-specific Strategic Investment Advisory Panels.

**Partnership:** Hort Frontiers strategic partnership initiative has been developed by Hort Innovation to better equip Australian horticulture farmers for the future ahead by facilitating collaborative cross-industry investments.

Hort Frontiers invests funds from a wide range of co-investors, as well as Australian Government contributions. Strategic co-investment partners can be any entities that want to invest in the future of horticulture – including commercial businesses, research agencies, government departments and education institutions.



**Learnings:** Similar initiatives for promotion of marketing and R&D led by industry players and farmer groups, supported by Government may be formed focusing on different sub-sectors in agriculture sector.

Source: Hort Innovation ([horticulture.com.au](http://horticulture.com.au))

- Effective marketing linkages for farmer collectives including branding need to be developed. As mentioned earlier, the major constraint faced by the farmers and their collectives is the lack of effective market linkages. As a result, the farmer collectives are not able to get better price realization for the produce. The farmer collectives can be provided handholding support to develop market linkages with agribusiness companies, modern retailers, processors and exporters.
- Different brands can be developed for the focus crops based on the geographical specialties, along with appropriate and attractive packaging. GI indicators based marketing can be promoted for higher value creation (e.g. Malihabadi Mangoes, Banarasi Langda, Govind Bhog Rice, Bydagi Chillies, etc.).

- There is an urgent need for training on e-marketplaces/ auctions and other digital marketing services. Incentives can be provided to buyer and sellers who would trade through e-market place such as e-NAM to encourage and popularize the usage of e-trading platform. Such awareness generation initiatives should be undertaken by the State Governments as well.

### **Research and Development**

- To promote innovations, it is proposed to create an R&D fund to develop innovative solutions/ technologies for post-harvest management and develop commercial models for such innovations. The Government needs to encourage innovation and collaboration in the sector with a fund available for R&D projects that will help the sector remain profitable and sustainable into the future. The fund should enable industry to partner with research organizations on projects that use new technologies and techniques for improving overall economic performance. The projects funded by the fund should include applied R&D that is innovative and likely to improve farm performance and that will improve market access/ business diversification.
- Leading research institutions/ organizations can be engaged for such R&D. Collaborations with foreign universities/ research organizations may also be encouraged. Development of innovations such as low-cost solar/ biomass powered small pre-coolers and cold storages at the farm level, packaging based on bio-polymers derived from renewable sources, low cost ethylene dispensers for uniform and healthy ripening of fruits, and advanced modified atmosphere packaging etc. can be encouraged.

### **Policy Level Interventions**

- It is important to note that despite the increase in agricultural production, the overall contribution of agriculture and allied sector in overall GVA has been consistently declining since 2012-13. This diminishing trend is a concern as agriculture still is the primary source of livelihood for more than 58% HHs in rural India and provides employment to 43.9% of country's total workforce. However, with reducing economic importance of agriculture, more people are shifting away from agriculture as the total share of employment in agriculture has declined from 51.1% in 2010 to 43.9% in 2018. One of the primary reasons towards this shift may be attributed to increasing cost of production and wide gap between farm-gate price and consumer prices, as only a small share of consumer price reaches farmers<sup>109</sup>. One of the other fallouts of reduced income from agriculture has been outmigration to urban and peri-urban areas which has led to unplanned urbanization and associated socio-economic issues. Considering this, there is an urgent need to make agriculture more viable through specific policy interventions.
- The budgeted estimates for umbrella scheme (including PMKSY-PDMC) has increased from about Rs. 14924 Crores in 2016-17 to about Rs. 17930 crores in 2018-19. However, in all the years, the budget estimates have been reduced by about 17% in revised estimates. In 2019-20, the BE has reduced by about 10.32% from that of 2018-19.

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<sup>109</sup> Doubling farmer's income volume-I and Volume-IV

- The reduction in BE for umbrella scheme between 2018-19 and 2019-20 is in contrast to the trend in allocation for central sector schemes/projects. The BE for key Central Sector Schemes/projects for DACFW<sup>110</sup> has increased by more than three times from Rs. 28200 in 2018-19 to Rs. 1.138 lakh crores in 2019-20. This increase is mainly driven by budget allocation of Rs 75,000 crores towards Income Support Scheme. In addition to the Income Support Scheme, the interest subsidy for short term credit to farmers (Rs 18,000 crores) and Crop Insurance Scheme (Rs 14,000 crores) are other major components of budgeted expenditure for DACFW.
- Given the diversity and range of challenges that the agriculture sector faces today in India viz. increasing production cost, depleting ground water resources, reducing availability of water, declining soil quality, scarcity of quality agriculture inputs<sup>111</sup>, low productivity, reducing crop diversity, climate change, increasing land degradation and most importantly low price realisation to farmers<sup>112</sup>. The interventions under the umbrella scheme of Green revolution and PMKSY can help in overcoming these challenges. Therefore, it is critical to give high importance to the umbrella schemes as well for achieving sustainable livelihood growth in rural areas.
- It has been observed that many times that the schemes are unable to perform as per the expectations due to lack of or delayed contribution of funds by the State Governments. This is mostly due to fiscal situation of the State Governments and their own development priorities. Considering this, it is recommended that some of the major schemes (or specific components of the schemes) which are critical for the growth of the sector may be funded as Central Sector Schemes.
- As mentioned earlier, horticulture contributes more than a third of the agricultural GDP, though it occupies less than a fifth of the cultivated area and is expected to increase further fuelled by high demand for fresh fruits and vegetables. Significant progress has been made in area expansion under horticulture resulting in higher production. Over the last decade, the area under horticulture grew by about 2.6% per annum and annual production increased by 4.8%<sup>113</sup>. Horticulture is also garnering greater importance as it contributes to nutritional security as well than only food security. A cost-benefit study by ICRIER, has indicated that it is more profitable to cultivate fruits and vegetables than cereals. It is important to generate optimal output and income through reallocation of land, keeping in mind the both food and nutritional security, domestic demand and export opportunities. Diversification to more profitable crops can improve the economic conditions of small and marginal farmers, especially in areas where the profitability of food grain cultivation has reduced. Thus, there is a need to give more focus to the growth of the horticulture sub-sector.

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<sup>110</sup> Department of Agriculture, Cooperation and Farmer's Welfare, India Budget 2019-20

<sup>111</sup> Seed, fertilizers and pesticides

<sup>112</sup> Multiple sources (i.e Economic surveys, NITI Aayog reports, vision documents and sectoral studies)

<sup>113</sup> Department of Agriculture, Cooperation and Farmers Welfare. 2019. Horticulture at a Glance 2018. Retrieved from <http://agricoop.gov.in/statistics/publication-reports>

- However, the focus on production and productivity increase in horticulture has to be supplemented by developing appropriate post-harvest infrastructure along the value chain. This is particularly important, as various studies have indicated post-harvest losses of fruits and vegetables in India are very high- ranging from 4.5% to almost about 44% for different fruits and vegetables. The losses are higher in states with poor connectivity and infrastructure. As mentioned earlier, there are severe gaps in post-harvest infrastructure and logistics in many parts of the country which contribute to the post-harvest losses.
- This also gets exacerbated by the fact that the current production is highly fragmented due to lower landholding which does not support individual farm level infrastructure. Therefore, it is recommended that a cluster based approach for integrated value chain development of horticulture should be adopted as it would provide certain economies of scale and lower marginal cost of operations. In this approach, the major horticulture production clusters should be identified and linked to consumer markets. In the identified clusters, end-to-end value chain development should be promoted that would include production/ productivity improvement through GAP/ organic cultivation, development of post-harvest infrastructure including storage, processing and transportation, assistance in certification and developing linkages with the large domestic and export markets.
- There is a need to develop an on-going real time surveillance mechanism linked to early warning systems for crop pests and diseases to take pre-emptive measures. A real-time MIS with open access should be developed which would support the pest and disease control interventions in line with GAP.
- Enhanced focus needs to be given to develop the farmer collectives into commercially viable business enterprises that would not only engage in production but also set up value addition facilities in terms of pack houses, innovative cold stores and processing facilities at the farm-gate. Thus, the farmer collective enterprises would need professional handholding support for all business aspects like operational, financial and technical services. In activity terms, it would translate into professional expertise for developing business and marketing plans, planning the investment – one time vis a vis phased inflow, market linkages, identification and selection of appropriate technology, partners, linkages, networks and service providers (legal, accounting, secretarial, sales & marketing, finance, human resources, tax planning etc.), leadership training, book keeping, etc. The main objective of these activities would be to develop entrepreneurship in the farmer collectives and helping them run successful enterprise. There would also be a focus on promoting new farmer collectives for the focus crops, based upon the presence/ absence of such collectives in major production clusters of the focus crops.

**Key Recommendations at the Sector Level for Achieving Transformational Improvements Across the Value Chain**

- As mentioned earlier, in India, adoption of GAP is at a nascent stage. There are several challenges in implementing Good Agricultural Practices in aspects such as seed and sowing,

seed priming, precision planting techniques, and using improved farm machinery. Studies have revealed lack of awareness of critical GAPs among farmers is very low. There is a need to develop a comprehensive crop-wise and agro-climatic zone-wise Package of Practices (PoPs) on GAP along with crop specific calendars outlining activities to be undertaken. The PoPs should to be widely disseminated using a mix of extension mechanisms and information technology (such as online portals, mobile apps, etc.) for ensuring increased awareness and adoption by the farmers. Promotion of Public-Private-Community Partnership (PPCP) approaches in agricultural extensions can lead to larger coverage of such activities. Master trainers from within the farming communities need to be identified and trained who would train the other farmers in GAP. This would lead to wider outreach and faster adoption.

- Promotion of better and hi-tech farm management practices such as precision farming which can accurately manage variations in the field to increase productivity and optimizing resource use. The field variations and requirements are monitored using information technology and tools such as GPS, sensors, robotics, drones, variable rate technology, GPS-based soil sampling, automated hardware, telematics, etc. These should be promoted on export oriented farms growing high value crops. Some private sector agri companies/ startups have already ventured into this space.
- There is a need to involve private sector participation through innovative mechanisms in development of post-harvest infrastructure including processing. One of the initiatives apart from ongoing schemes on this aspect could be creation of incubation cum product development centres where entrepreneurs can test new product/ value added products without incurring capital expenses on plant and machinery and pilot the products in the market before launching full-fledged commercial operations.
- There is a need to shift the focus from “traditional and subsistence agriculture” to “market led and export oriented production”. In spite having the second largest agricultural production in the world, India’s share of agricultural export is only 2.2% of the world’s agricultural exports as of 2017. There has been low acceptability of many Indian agricultural products in the international markets due to quality issues and lack of traceability. This can be addressed by promoting GAP and quality-based efficient production systems, traceability and certification, development of modern post-harvest infrastructure and logistics with export market as a target to increase India’s share in the global agricultural products trade.
- Climate resilient agriculture should be one of the thrust areas. Highly nutritious crops which are native to particular agro-climatic zone should be promoted. For example, millets which are drought resistant to large extent.
- India accounts for only about 4% of global water resources, but supports 18% of the World’s human population. India’s per capita water availability is constantly steadily declining due to population growth. According to estimates of Doubling Farmer’s Income report, India will be a water stressed country on the basis of per capita water availability in 2050 with only 686 cubic meter per year. Water required for irrigation purpose is estimated at around 75-85 per cent share in the total demand by the Standing Sub-Committee of MoWR. With over

80% of the total water in the country being used in agriculture, measures need to be taken for sustainable usage. Thus, there is a need for focussed efforts on water conservation in agriculture. Interventions such as micro-irrigation (PMKSY-PDMC), etc. needs to be supplemented with conservation mechanisms such as mulching, development and maintenance of water conservation structures, watershed management, etc. Higher allocations should be considered on water conservation efforts/ interventions.

- Technical support groups involving multi-disciplinary team needs to be created for project management, planning and implementation at the central and state level. Fixed term contracts/ tenures for scheme level officials for 3-4 years with yearly performance linked appraisal may be introduced for higher accountability.

## Part: B – Animal Husbandry Sector

### Chapter 1 : Sector Level Analysis: Animal Husbandry

#### 1.1 Background of the Sector

The Livestock Sector is a significant sub-sector under Agriculture and Allied Sector in terms of its economic contribution with a share of 27.4% of Gross Value Added (GVA) in agriculture and allied sector (2017-18). The economic activities under this domain covers production of milk, meat, eggs, wool, dung, etc.

Driven by the success of Operation Flood launched in 1970, the Livestock Sector has progressed by leaps and bounds as India has now become largest producer of milk, 6<sup>th</sup> largest producer of meat and 3<sup>rd</sup> largest producer of eggs in the world as of 2018<sup>114</sup>. Key strengths of the sector includes large and increasing population of milch cattle and poultry, presence of relatively disease free/drought resistant indigenous livestock species and strong dairy cooperatives chains across top milk producer states in India.

Animal Husbandry and Dairying is an integral part of the Indian rural economy. Not only does it provide large employment opportunities to landless, small and marginal farmers, it also contributes significantly to the food basket by providing nutritious food to millions<sup>115</sup>. While the percentage contribution of the sector to overall Gross Value Added (GVA) is relatively small (around 4%), it contributes significantly in terms of providing livelihood opportunities to the rural households, as more than 65 million households in India are engaged in animal farming activities<sup>116</sup> and more than 73% of rural farming households rear livestock<sup>117</sup>.

Major challenges for animal husbandry and dairying sectors include low productivity of animals, shortage of feed and fodder, pitiful living conditions of animals, inadequate healthcare, and slow dissemination of technology and skills to farmers for improving productivity. The government through its various schemes and programmes seek to enhance poultry productivity, milk and meat production, for attaining nutritional security, employment generation and economic prosperity for the country. The overarching vision of the Department for the sector correlates to enhancement in productivity of livestock in a sustainable and profitable manner. It also seeks to develop requisite infrastructure for breeding of animals, as well as storage and transportation of their produce. Preservation and protection of livestock through provision of healthcare is another thrust area for the Department. This may be achieved through improving genetic resources, ensuring livestock and poultry health, providing veterinary care, and better management of feed and fodder. Strengthening of central livestock farms (cattle, sheep and poultry) for development of superior germ plasm is also one of the critical objectives. Further, Private sector participation must be encouraged in to ensure better remuneration for farmers. Lastly, enabling easier access to finance is critical for the sector and

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<sup>114</sup> Source: UN FAO, <http://www.fao.org/faostat/en/#compare>

<sup>115</sup> NABARD, Sectoral paper on Animal Husbandry, January 2018

<sup>116</sup> Livestock Census 2019

<sup>117</sup> Livestock ownership in India NSS 70<sup>th</sup> round

thus is one of the key objectives for the sector. A representative illustrative of the sector’s vision is given below:

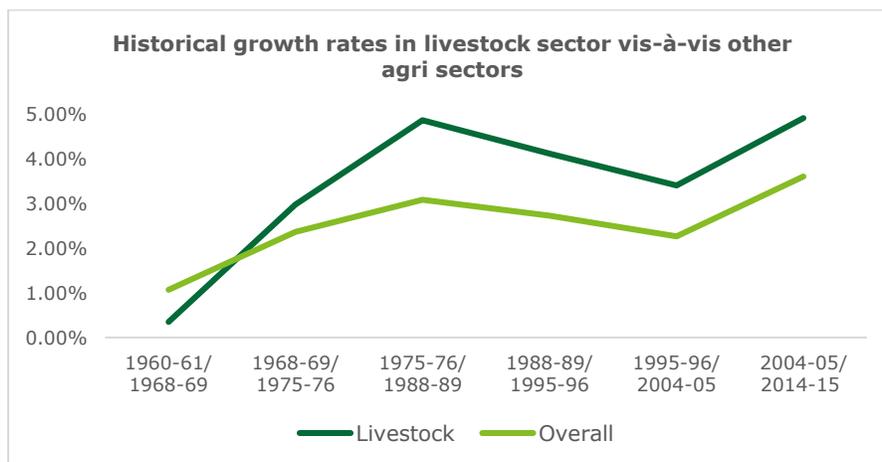
Figure 97: Animal Husbandry and Dairy Sector Vision



Source: Department of Animal Husbandry and Dairying; Deloitte analysis

As observed in the Doubling Farmer’s Income Report - Performance of Agriculture and Allied sector, Livestock Sector has never recorded a negative growth rate in the period from 1980 to 2015 which included several years of drought as well. This trend has been true for the subsequent years i.e. 2016 to 2018. The livestock sector demonstrated that it can be relied upon for risk mitigation and minimizing the losses for the farmers even in case of worst outcomes from others sub-sectors and is likely to emerge as engine of growth of agriculture sector.

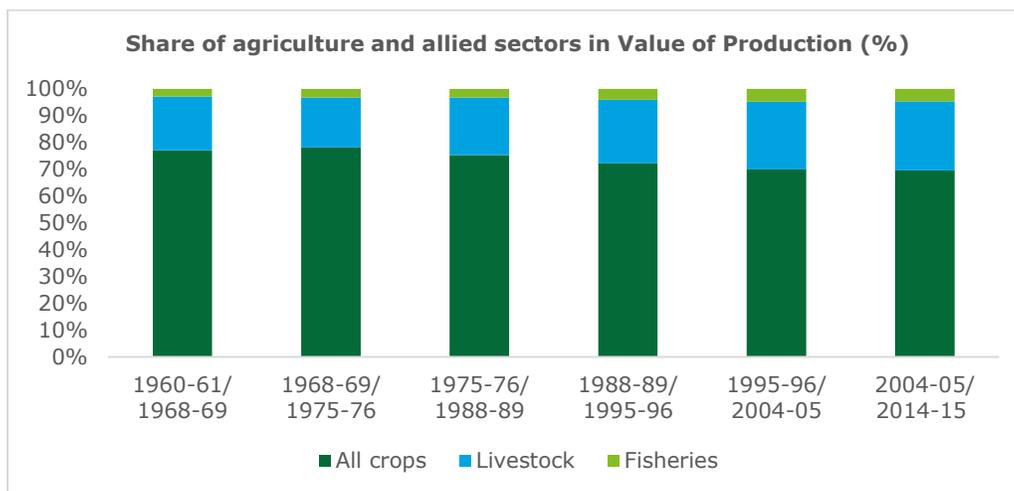
Figure 98: Historical growth rates in livestock sector vis-à-vis other agri sectors



Source: Doubling Farmer’s Income Report, Volume 1

As highlighted in figure above, the growth in livestock sector has been highest during 2004-05 to 2014-15. The sector has recorded higher growth rate than some of the major crop categories including paddy and wheat, nutri-cereals, pulses, oilseeds, and fruits & vegetables. The remunerative prices fetched by farmers led to higher production which has been inferred as the reason behind good performance.

Figure 99: Share of agriculture and allied sectors in Value of Production (%)



Source: Doubling Farmer's Income Report, Volume 1

With the objective of improving profitability from the agriculture and allied activities and ensure farmers' income security, diversification towards high value agricultural activities like livestock rearing activities is needed. Milk contributes to 24% in the value of output and meat contributes up to 8% in the value of output<sup>118</sup>. The contribution from the animal husbandry and dairy sector is higher than contribution from major cereal crops (rice, wheat and maize) which is 20% of the value of output. Income from this sector can be further improved by ensuring healthier and quality output through implementation of better animal husbandry practices, selection of breeds and focusing on safe and secure post-harvest management systems.

While there has been impressive growth, the sector also faces impending challenges such as increasing cost of fodder and feed; limited access to feed, fodder and water; inefficient livestock markets; low productivity of indigenous cattle; large unproductive cattle population; limited access to credit, among others.

The sector analysis covers important livestock products (milk, eggs, and meat), their production trends, national and global comparisons, contribution of the sector to Gross Value Added (GVA), exports, and employment creation. The section also covers sector's performance in terms of infrastructure across the value chain, price variations and exports. Based on the sector analysis, key growth drivers and major challenges have been discussed. A number of previous studies, evaluation reports, and annual reports were reviewed through the course of the study, including those from UN Food and Agriculture Organisation (UNFAO), NABARD, Lok Sabha Standing Committee, NITI Aayog,

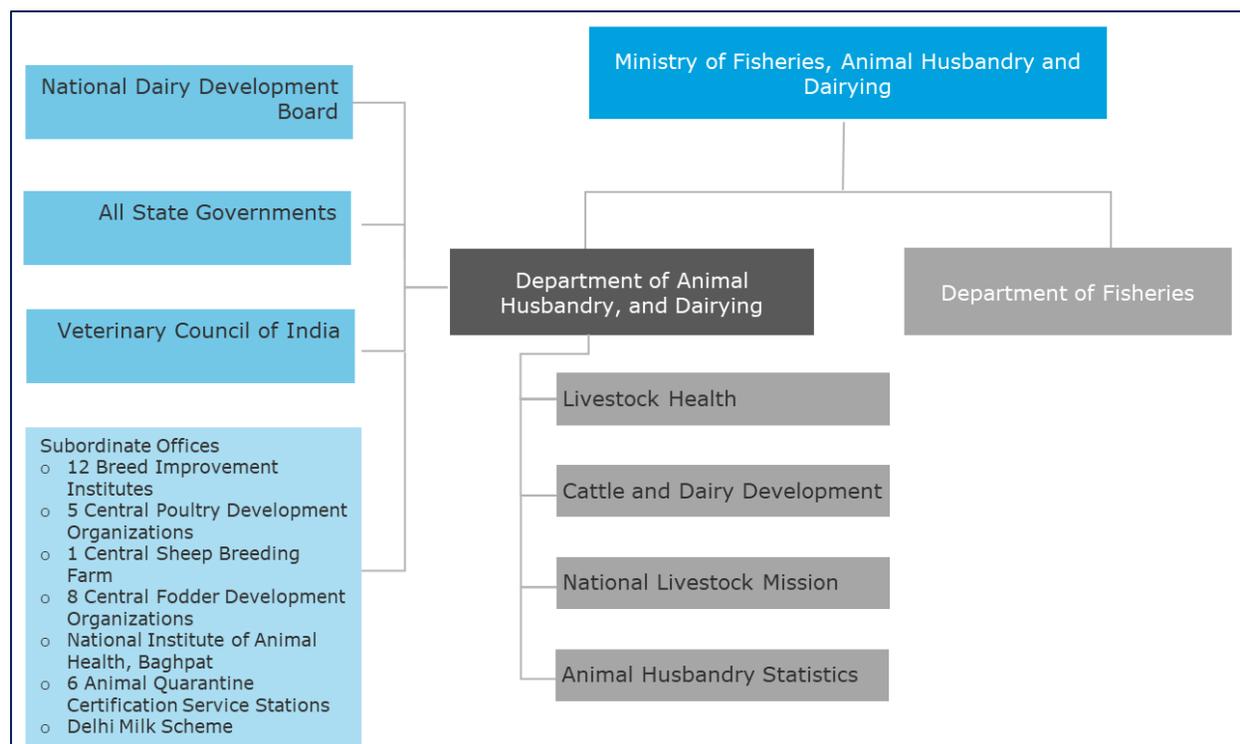
<sup>118</sup> Referred from the Area and Value Pyramid as discussed in Doubling Farmers' Income Report- Volume VIII

Economic Survey, Ministry-level reports, Department annual reports, other independent evaluation reports and analysis, among others.

## Public/ Private Structures and Stakeholders

In the Animal Husbandry and Dairy sector, multiple public and private stakeholders contribute in driving growth. The apex government institution in livestock sector is the Ministry of Fisheries, Animal Husbandry and Dairying. The government structure and its associated stakeholders has been depicted in the figure below:

Figure 100: Government Structure and Associated Stakeholders



Source: Analysed from various annual reports and websites of Ministry of Agriculture, Annual Report of Department of Animal Husbandry, Dairying and Fisheries. 2018-19

The various divisions handling the implementation of different schemes has been mentioned under the Department of Animal Husbandry and Dairy. The Department oversees the National Dairy Development Board, Veterinary Council of India and acts as an advisor to all State Governments. The Department also looks into the functioning of the listed Subordinate Offices.

Apart from the government institutions there are several stakeholders in the livestock sector. In dairy, the cooperative structure is well formed which is a three tier structure with Village Cooperative Society, District Union and State Federation. In addition, there are 14 Milk Producer Companies supported by National Dairy Plan, Tata Trusts and NRLM/ SRLM<sup>119</sup>.

<sup>119</sup> Annual Report of Department of Animal Husbandry, Dairying and Fisheries. 2018-19

Private stakeholders in dairy sector have grown at a fast pace over the last 20 years and have exceeded the combined capacity of the dairy cooperatives and the government dairies. Some of the leading private dairy companies are Nestle India Ltd., Anik Industries Pvt Ltd, Britannia Dairy Pvt Ltd, Parag Milk Foods, Bhole Baba Milk Food Industries, Lactalis India Ltd, etc.

## Key Drivers for Livestock Sector

The key drivers for growth in the Livestock Sector have been discussed below.

**Population Growth and Urbanization:** Increasing population with rapid urbanization has been driving the demand for meat, poultry and dairy products. As per the projected demand for meat and dairy products<sup>120</sup>, milk, eggs and meat are expected to surpass the demand for cereals.

Table 22: Projected Demand of Meat, Eggs and Dairy

Commodities	Current Production (million tons)	Projected Demand (million tons)		Growth in Demand between 2030 and 2050
		2030	2050	
Milk	160	170.4	401	135.3%
Meat	7	9.2	14	52.2%
Egg	4	5.8	10	72.4%

Source: Doubling Farmers' Income Report, Volume VIIIID-Production Enhancement through Productivity Gains

With increase in disposable income, a larger proportion of the income is spent on meat, poultry and dairy products as opposed to primary sector food grains. The demand for dairy products is high in India owing to a large vegetarian population.

**Technical Innovation in Meat, Poultry and Dairy Product Processing:** Establishment of state-of-the-art facilities like mechanized abattoirs-cum-meat processing plants complying with standard sanitary and phyto-sanitary (SPS) measures have improved the quality of meat and poultry products in the market. Similarly, the growth of the dairy industry is also dependent on the processing innovations that have contributed to the value chain of milk and milk products.

**Livestock Science and Technology:** Livestock breeding techniques including breed substitution, cross-breeding and within-breed selection has been an important factor influencing supply of meat and dairy products in the market. The quality of feed for animals and poultry also contributes to the quality of meat or dairy produced. Catering to the adequate nutritional needs of the farm animals and poultry results in higher productivity.

**Fast Changing Food Habits and Value Added Products:** The shift towards consumption of value-added products and frozen food has increased the demand for processed meat and dairy products such as cheese, yoghurt, UHT (ultra-heat treatment) milk, flavored milk, sausages, kebabs, patties, etc. As per the Indian meat market analysis<sup>121</sup>, chilled raw packaged meat (processed) was the fastest growing category (by volume) during 2012 – 2017, registering a CAGR of 5.99% followed by frozen meat which grew at 5.42%.

The production projections in the animal husbandry and dairy sector for 2022-23 are estimated to outpace the requirement given the current output growth rates. As per the table given below, the

<sup>120</sup> Doubling Farmers' Income report

<sup>121</sup> GlobalData, 2019, Meat Market in India: Market Snapshot to 2022,

projected production of milk would be 204 million tonnes whereas according to the table on “Projected Demand of Meat, Eggs and Dairy” provided above the demand would reach 170 million tonnes that too by 2030. Similarly in meat, the production is predicted to reach 14.6 million tonnes by 2022-23 whereas the demand for meat would reach 9.2 million tonnes by 2030. This would mean production at the current rate would still create a surplus of milk and meat products in the country.

Table 23: Projected Production Levels of Livestock Sector 2022-23

Commodity	Projected Production, 2022-23 (in million tons)	
	Business as Usual Based on output growth between 2000-15 (% growth)	(Description)
Milk	204.0	Based on output growth of 5.36%
Meat	14.6	Based on output growth of 11.02%

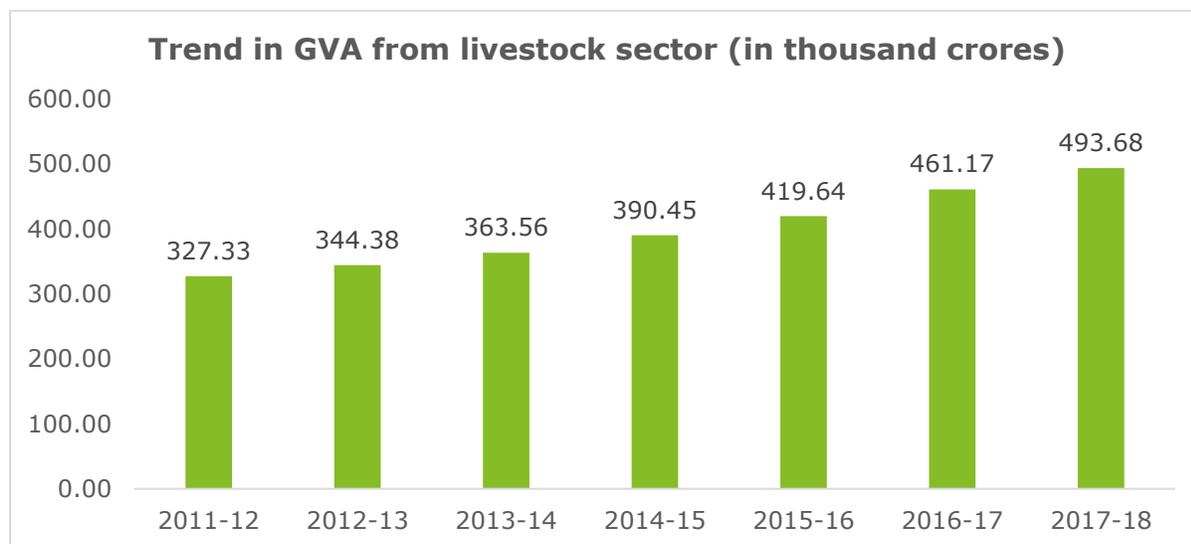
Source: Doubling Farmers' Income Report, Volume VIID-Production Enhancement through Productivity Gains

## 1.2 Performance of the Sector

### Gross Value Added (GVA)<sup>122</sup> from Animal Husbandry and Dairy products

The GVA from the sector in 2017-18 was Rs. 4.93 lakh crores, which contributed to about 4.1% of the total GVA of the Indian economy. The relative share of the sector as percentage of agriculture and allied sector has increased from 21.8 % in 2011-12 to 27.4% in 2017-18. The trend in GVA from livestock sector<sup>123</sup> since 2011-12 is depicted below.

Figure 101: Trends in GVA from livestock (Rs. thousand crores)



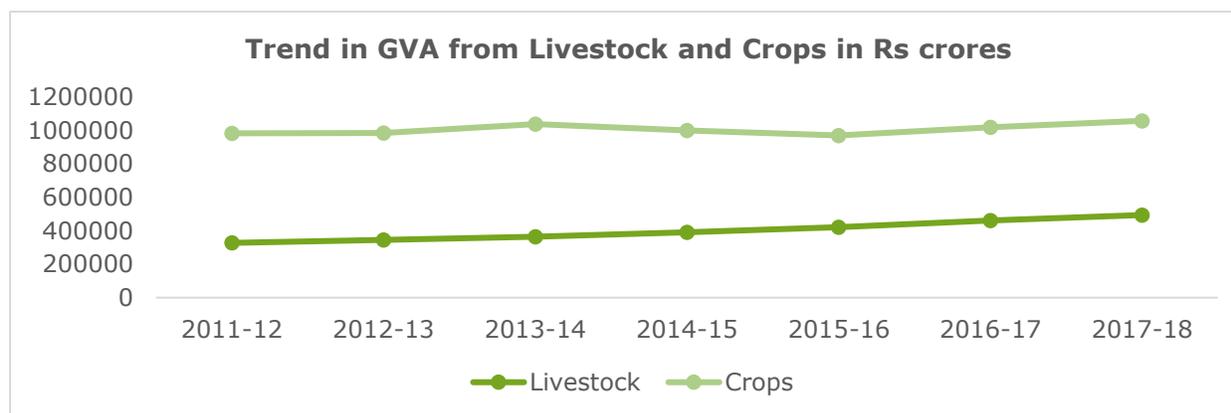
Source: National Account Statistics, 2019

The trend in GVA from crops and livestock sector is provided in figure below. The data indicates that while GVA from livestock sector has shown a consistent positive growth, the trend for crops sector has been inconsistent. Since 2011-12, rate of growth in livestock sector has been much higher at 6.5% than crops sector which grew at 1.05%. The share of GVA of crops in Indian economy also declined from 12.1% in 2011-12 to 8.7% in 2017-18, while livestock sector has kept pace with overall economic growth and consistently remained around 4%. This clearly indicates the increasing contribution of livestock sector in economy.

<sup>122</sup> At 2011 prices

<sup>123</sup> As per National Accounts Statistics classification, Livestock sector includes Animal Husbandry, Dairying, poultry, meat and other animal products

Figure 102: Trends in GVA from livestock and crop sectors (Rs. thousand crores)



Source: National Account Statistics, 2019

Major products within livestock sector can be classified as milk group, meat group, eggs, wool and hair etc. In 2017-18, about 96.88% of total value of output from livestock sector came from milk group of products (66.22%), meat and meat products (22.03%), eggs (3.23%) and dung (5.36%). The contribution of wool and hair to the overall output from livestock sector was negligible at 0.07%<sup>124</sup>.

The product wise trends in GVA from livestock sector are given in the table below. The GVA from livestock sector increased by about 50.8% between 2011-12 and 2017-18. During this period, the contribution of milk group of products has been highest. Contribution from meat group of products also grew consistently as it increased by about Rs. 53.13 thousand crores (having a growth of about 55% during the period). The only category to show a reduction of GVA during the period was wool and hair which reduced by about 10% with a production value of Rs. 447 crores in 2017-18.

Table 24: GVA from livestock at 2011-12 prices from 2011-12 to 2017-18 (in Rs crores)

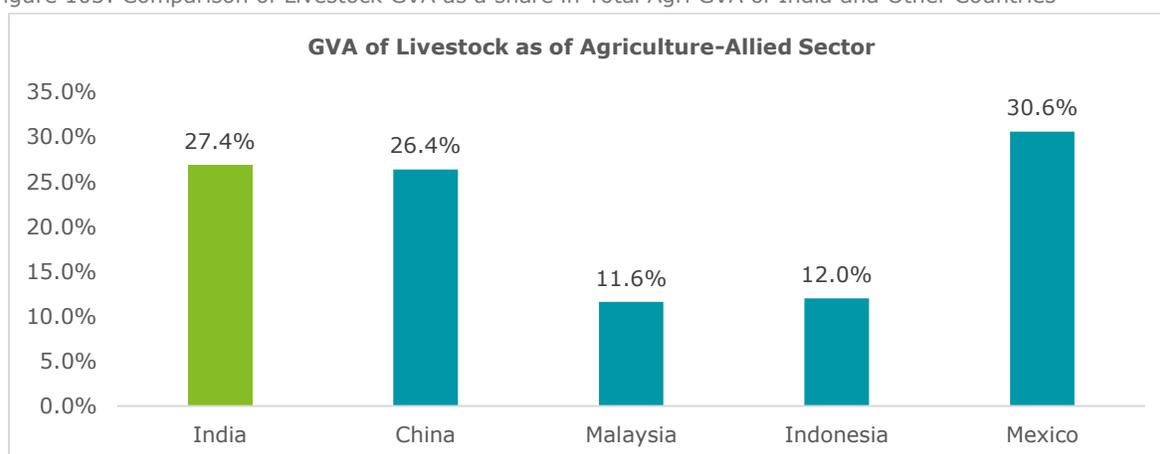
Item	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Milk group	327767	339240	352247	374267	396662	421495	448970
Meat group	96219	102623	110744	117264	125631	143744	149352
Eggs	16633	17364	18308	19080	19829	20346	21876
Wool and hair	496	508	522	518	464	477	447
Cow dung	32599	33468	33311	34177	34870	35566	36359
Silk worms cocoons and honey	4326	4507	4718	4768	4830	4978	5019
Increment in stock	9710	10364	11102	11952	12958	14205	15938
<b>Value of output from livestock</b>	<b>487751</b>	<b>508074</b>	<b>530953</b>	<b>562026</b>	<b>595242</b>	<b>640811</b>	<b>677960</b>
<b>Cost of inputs and services</b>	<b>285239</b>	<b>160418</b>	<b>163699</b>	<b>167394</b>	<b>171577</b>	<b>175605</b>	<b>179640</b>
<b>Gross Value Added</b>	<b>327334</b>	<b>344375</b>	<b>363558</b>	<b>390449</b>	<b>419637</b>	<b>461171</b>	<b>493676</b>

Source: National Account Statistics, 2019

<sup>124</sup> Gross value added by Economic activity, National Accounts Statistics, 2019

The contribution of the livestock sector in economy as represented through the Gross Value Added from Livestock sector to that of Agriculture and Allied sector has been compared across different geographies to benchmark India's status. The graph below compares the GVA of Livestock as a share of GVA in Agri-Allied Sector.

Figure 103: Comparison of Livestock GVA as a share in Total Agri GVA of India and Other Countries



Source: EMIS Insights Industry Reports- China, Malaysia, Indonesia, and Mexico<sup>125</sup>

India's livestock sector contribution to the total agriculture economy is similar to that of China and Mexico, while other South East Asian countries like Malaysia and Indonesia has a smaller contribution to its agriculture economy.<sup>126</sup>

## Livestock ownership and dependence on livelihood

According to 20<sup>th</sup> Livestock Census of India, the total livestock population<sup>127</sup> was 536.76 million in 2019 which showed an increase of 4.82%. The total bovine population<sup>128</sup> of the country was 303.76 million which shows an increase of 1.3% over the previous census. Total cattle population has increased by 1.3% with around 29.3% increase in exotic breeds. The overall population of female indigenous/non-descript cattle increased by 10% while population of male indigenous cattle reduced by 29%. Similar trend was observed for buffalo population wherein the male buffalo population went down by 42.3% while female population increased by 8.61%. The summary of the livestock census is shown in the table below:

Table 25: Summary of Livestock Census

Livestock	No. (in Millions) in 20 <sup>th</sup> Census	% Change over 19 <sup>th</sup> Census	Top three States
<b>Poultry</b>	851.81	16.8%	<i>Tamil Nadu, Andhra Pradesh, Telangana</i>
<b>Backyard Poultry</b>	317.07	45.8%	
<b>Commercial Poultry</b>	534.74	4.5%	

<sup>125</sup> Malaysia and Indonesia GVA ratios are of year 2016-17, while India, China and Mexico is of 2017-18

<sup>126</sup> EMIS Insights Industry Reports on Agriculture Sector for China, Malaysia, Indonesia, and Mexico

<sup>127</sup> Includes Cattle, Buffalo, Sheep, Goat, Pig, Horse and ponies, Yak, Donkey, Camel, Mule and Mithun

<sup>128</sup> Includes Cattle, Buffalo, Yak and Mithun

Livestock	No. (in Millions) in 20 <sup>th</sup> Census	% Change over 19 <sup>th</sup> Census	Top three States
<b>Cattle</b>	193.46	1.3%	<i>West Bengal, Uttar Pradesh, Madhya Pradesh</i>
<b>Exotic/Crossbred</b>	51.36	29.3%	
<b>Indigenous/Non-descript</b>	142.11	-6.0%	
<i>Male</i>	43.94	-29.1%	
<i>Female</i>	98.17	10%	
<b>Buffalo</b>	109.85	1.1%	<i>Uttar Pradesh, Rajasthan, Gujarat</i>
<i>Male</i>	9.28	-42.35%	
<i>Female</i>	100.57	8.61%	
<b>Sheep</b>	74.26	14.1%	<i>Telangana, Andhra Pradesh, Karnataka</i>
<b>Goat</b>	148.89	10.1%	<i>Rajasthan, West Bengal, Uttar Pradesh</i>
<b>Pigs</b>	9.06	-12.03%	<i>Assam, Jharkhand, Meghalaya</i>
<b>Other Livestock</b>	1.24	-	
<b>Total Livestock</b>	536.76	4.8%	

Source: Department of Animal Husbandry & Dairy, 20<sup>th</sup> Livestock Census, 2019

Poultry population also increased substantially by 16.8% to about 851.81 million in this period with significant increase in backyard poultry by 45.8%. In other types of livestock, the population of goats and sheep increased by 10.1% and 14.1% respectively and population of pigs decreased by 12.03%.

The top five states in terms of livestock population in India are Uttar Pradesh, Rajasthan, Madhya Pradesh, West Bengal, and Bihar. These states together account for about 44.6% of overall livestock population. The highest livestock population (about 68 million) is reported in Uttar Pradesh. Uttar Pradesh is also home to the largest bovine population (about 52.04 million) in the country which is about 17.2% of total bovine population and 30% of buffalo population of India.

While northern states lead in livestock and bovine population, poultry is mostly concentrated in southern states of Andhra Pradesh, Tamil Nadu and Karnataka. The top five poultry producing states (Tamil Nadu, Andhra Pradesh, Telangana, West Bengal and Maharashtra) of India account for more than 54% of total poultry population in the country.

At the household level, livestock resources are considerably distributed across India as marginal farmers have more than half of the cattle population and own more than 60 percent of small ruminants' i.e. goats, pigs.<sup>129</sup> More than 57.8 million Households (HHs) in India own cattle, more than 34 million HHs own buffaloes, about 27 million HHs own goats, 2.6 million HHs own sheep and over 23.7 million HHs rear poultry<sup>130</sup>.

<sup>129</sup> NABARD, Sectoral paper on Animal Husbandry, January 2018

<sup>130</sup> Livestock census, 2019; Data shared by department

Table 26: Top five states and number of HHs / enterprises (in lakhs) reporting livestock ownership

Cattle		Buffaloes		Goats		Backyard poultry		Poultry farm & Hatcheries	
State	No of HH	State	No of HH	State	No of HH	State	No of HH	State	No of HH
UP	81.33	UP	119.56	RAJ	47.36	WB	57.12	KL	1.42
WB	65.02	RAJ	48.46	UP	45.25	AP*	37.79	AN	1.33
MP	59.38	Bihar	35.54	Bihar	41.28	TN	31.94	PJ	0.75
Bihar	55.68	GUJ	33.48	WB	39.43	AM	21.65	MZ	0.67
RAJ	50.11	AP*	28.72	TN	22.18	MAH	20.19	AM	0.66

\* Data of AP includes both AP and Telangana; UP-Uttar Pradesh, WB-West Bengal, MP-Madhya Pradesh, RAJ-Rajasthan, TN-Tamil Nadu, KL-Kerala, MZ: Mizoram, WB-West Bengal, AM-Assam, AP-Andhra Pradesh, GUJ-Gujarat, PJ-Punjab, MAH-Maharashtra, AN-Arunachal Pradesh

Source: Department of Animal Husbandry, Dairy & Fisheries, 19<sup>th</sup> Livestock Census

### Dependence of Farming HHs on Livestock

The dependence of small and marginal farmers on livestock, as reported in Economic Survey of 2016-17, is very high. Among the households that possess less than 0.4 hectares of land, almost 50 percent of average household expenditure on productive assets is incurred on livestock and poultry. Economic Survey 2017-18 has highlighted the increasing share of livestock in total farm income. It has reported that the share of livestock in total farm income has increased from 4% in 2002-03 to 13 % in 2012-13.

Livestock is one of the sectors where women play an important role and are engaged actively for livelihood. Nearly 43.8 lakhs women producers are involved in dairy societies and number of all dairy women societies is also growing at an annual growth rate of about 10%<sup>131</sup>. Considering the increasing share of livestock in farm income of small and marginal farmers and increasing participation of women in livestock sector, the need of re-orientation of government policies towards increased focus on allied activities such as dairying and livestock development have been highlighted in Economic survey 2017-18<sup>132</sup>.

<sup>131</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2016-17. Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

<sup>132</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2018-19. Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

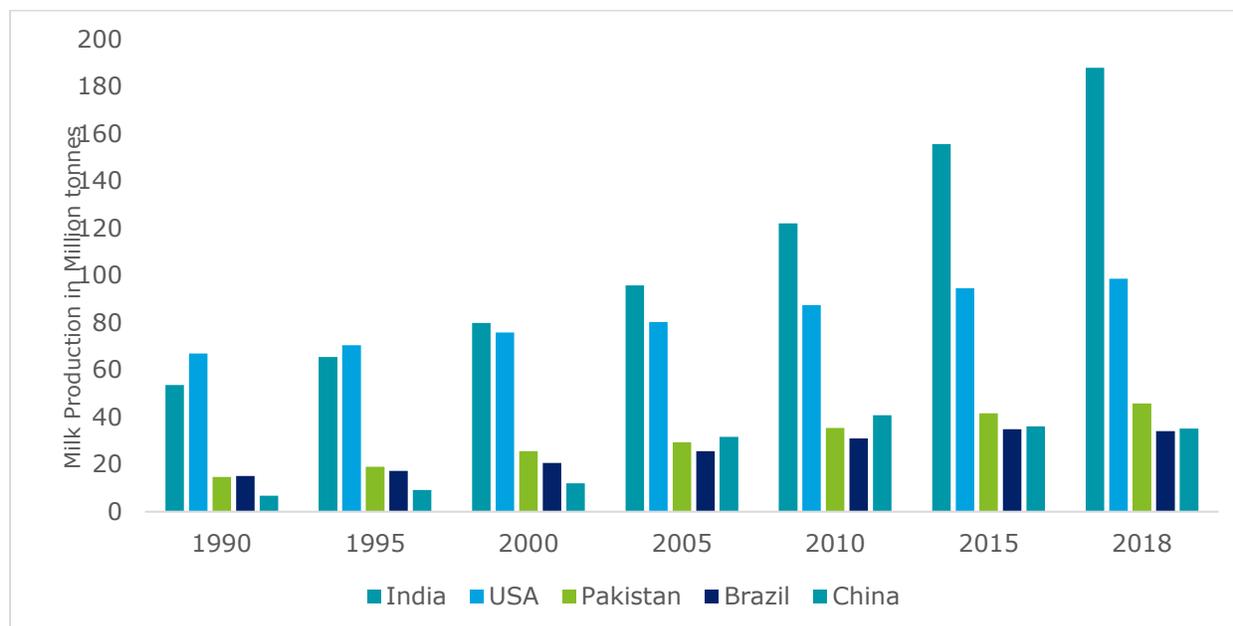
## Production trends of important livestock products

### .1.1.1 Milk

#### Status of milk production in India

India is the largest producer of milk globally contributing nearly 21.6% percent of global production in 2017-18.<sup>133</sup> The production trends of top five milk producing countries (India, USA, Pakistan, China and Brazil) are depicted in the diagram below.

Figure 104: Comparison of Milk production across globe



Source: UN FAO

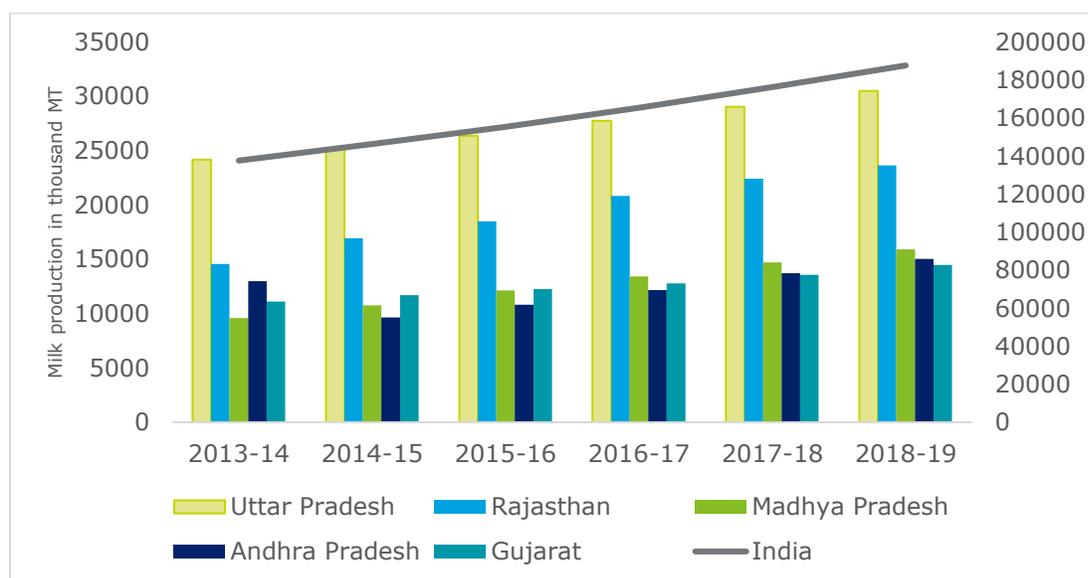
All five countries reported increase in the level of production of milk since 1990. The growth of milk production in India surpassed all others as the overall milk production has increased by more than 250% in past 27 years. As a result of this unprecedented growth, India, which used to lag behind USA in 1990's, has been the undisputed global leader since 2000.<sup>134</sup>

In India, Uttar Pradesh (30 million MT) is the largest producer of milk as of 2018-19 with around 16% of the production share in the country. The other major milk producing states in India are Rajasthan (23.6 million MT), Madhya Pradesh (15.9 million MT), Andhra Pradesh (15 million MT) and Gujarat (14.4 million MT) as of 2018-19.

<sup>133</sup> Annual production of 176.3 million MT in 2017-18 and estimated production of 187 million MT in 2018-19 <http://dahd.nic.in/about-us/divisions/statistics> (Last accessed on 19/09/2019)

<sup>134</sup> Statistics of National Dairy Development Board. Retrieved from <https://www.nddb.coop/information/stats>

Figure 105: Trends in Milk production among top producer states



Source: Analysis of data from Basic Animal Husbandry and Fisheries Statistics 2019

The milk production trends of top five states vis-à-vis India are depicted above. As can be seen from the graph, the overall milk production in India increased significantly between FY 2013 and FY 2018 by about 36%. This growth can be majorly attributed to the states of Madhya Pradesh and Rajasthan which recorded an increase of more than 50% during this period.<sup>135</sup>

The increase in milk production in India is mainly due to the increase in population of milch animals<sup>136</sup> as the milk productivity remains a concern with an average yield of 4 litres per day per milch cattle, in comparison to global average of about 7 litres per day<sup>137</sup>. In India, higher productivity is observed in the states of Punjab, Gujarat, Haryana and Andhra Pradesh and Kerala whereas the states with low yield are Assam, Nagaland, Odisha and Himachal Pradesh<sup>138</sup>.

<sup>135</sup> Analysis of data from Basic Animal Husbandry and Fisheries Statistics, 2018

<sup>136</sup> Dairy market review, 2018, FAO, <http://www.fao.org/3/ca3879en/ca3879en.pdf> (Last accessed on 19/09/2019)

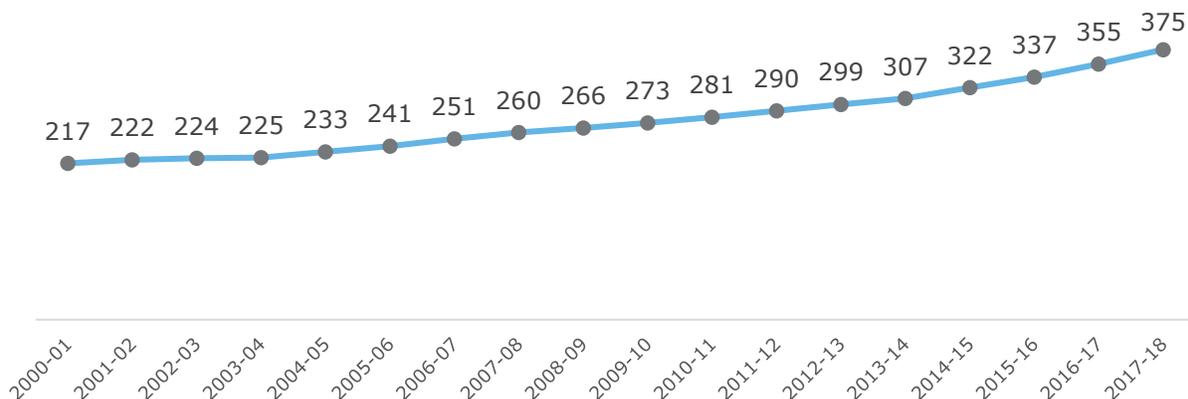
<sup>137</sup> Boston Consulting Group. 2012. Indian Agri-business -Cultivating Future Opportunities. Retrieved from <http://media-publications.bcg.com/Indian-Agribusiness.pdf>

<sup>138</sup> Department of Animal husbandry, dairy and fisheries. 2018. Basic Animal Husbandry and Fisheries statistics, 2018. Retrieved from <http://dahd.nic.in/>

## Per Capita Availability of Milk

Presently, the per capita availability of milk in India is about 375 gm/day which is higher than the world average of 309 gm/day<sup>139</sup>.

Figure 106: Trend in per capita availability of milk (gms/day)



Source: The World Dairy Situation, Bulletin of International Dairy Federation, 2018

The trend in per capita availability of milk in India since 2000-01 is depicted in the graph above. It can be seen that per capita availability has increased by about 72% since 2000. This gains significance as milk is a major protein source for a largely vegetarian population. However, there is a wide interstate variability in per capita availability. For instance, the states of Punjab (1120 gm/day), Haryana (1005 gm/day) and Rajasthan (834 gm/day) have reported high per capita availability of milk whereas Assam (71 gm/day), Orissa (132 gm/day), West Bengal (153 gm/day), Kerala (192 gm/day) and Bihar (239 gm/day) have reported lower per capita availability<sup>140</sup>.

## Yield rate

The average yield of milk per day per milch cattle is low in India. The species wise overall milk contribution and average yield of milk per day per animal for FY 2017-18 is depicted in the table below.<sup>141</sup>

Table 27: Yield per day per milch cattle in India

Species	Yield rate (kg/day)	% share of milk production
Exotic cows	11.48	1
Crossbred cows	7.61	26
Indigenous cows	3.73	10
Non-descript cows	2.41	10
indigenous buffalo	6.19	35
Non-descript buffalo	4.21	14
Goat	0.47	4

Source: Annual report of DADF, 2018-19

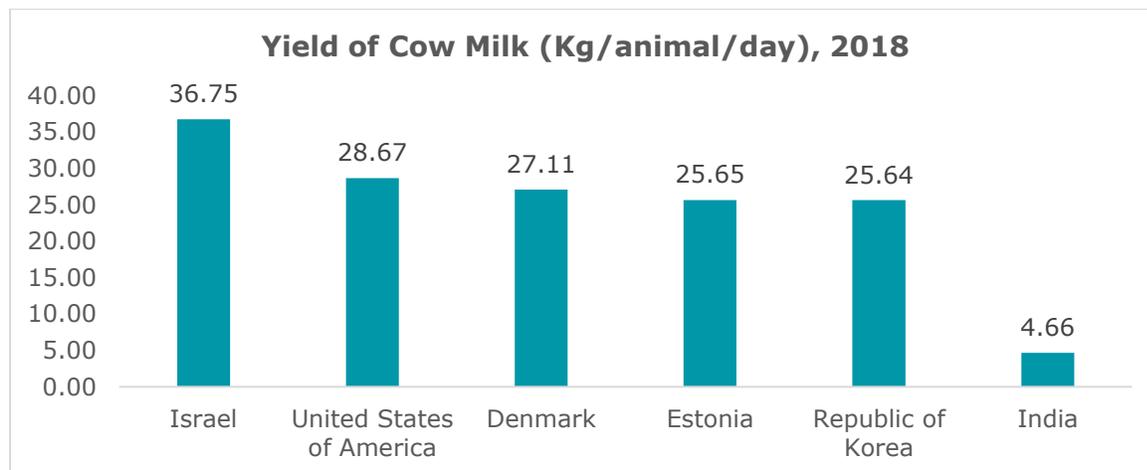
<sup>139</sup> The world dairy situation 2018, Bulletin of international dairy federation

<sup>140</sup> Department of Animal husbandry, dairy and fisheries. 2019. Basic Animal Husbandry and Fisheries statistics, 2018. Retrieved from <http://dahd.nic.in/>

<sup>141</sup>Department of Animal Husbandry, Dairying and Fisheries. 2019. Annual report 2018-19,

As can be seen the average yield rate of milk per day for animals across species in India is very low in comparison to countries such as Israel (36.75Kg/day), USA (28.67 Kg/day), Denmark (27.11Kg/day)<sup>142</sup>. The yield rate of milk from cows has been compared with the top yield rates across the globe.

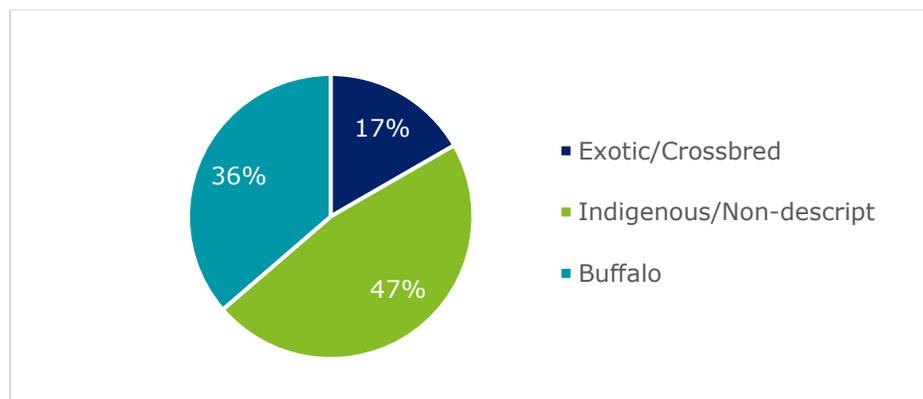
Figure 107: Yield of cow across countries



Source: FAO, 2018

The indigenous and non-descript cows have very low yield of about 3.73 and 2.41 kg/day respectively which contribute to only about 20% of overall production. The exotic and crossbred cows having better yield of about 11.48 kg/day and 7.61 kg/day respectively contribute nearly about 27% of overall milk production. Buffaloes contribute about 49% of overall milk production. Though the cross bred and exotic species contribute significantly to the overall milk production, their population, as reported in 20<sup>th</sup> livestock census, is only about 16.7% of all milch cattle. In view of this, Government of India has launched Rashtriya Gokul Mission in recent years for improving the overall productivity of indigenous milch cattle in India.

Figure 108: Population of milch cattle (millions)



Source: Department of Animal Husbandry, Dairy & Fisheries, 20<sup>th</sup> Livestock Census, 2019

<sup>142</sup> FAO Statistics

## Quality Standards of Milk and Milk Products

The quality standards of milk and milk products in India are mainly driven by provisions of Food Safety and Standards Act 2006. FSSAI revised its provisions in 2017 and 2018 to widen the scope of products under the purview of the Act. The standards cover more than 18 items (e.g milk, cheese, shrikhand, ghee, ice cream, flavoured milk, milk powder etc.)<sup>143</sup>. All milk food business operators are required to comply with these regulations for processing and trade of milk and milk products. Some of the important definitions specified under the Act are:

Table 28: Definitions under FSSAI Act 2006

S. No	Term	Definition
1	Boiling, boiled and similar terms	when used in association with milk, shall be taken to refer to the process of heating milk continuously to bring it to boil at atmospheric pressure
2	Composite milk product	means a product of which the milk, milk products or milk constituents shall be an essential part in terms of quantity in the final product, as consumed, Provided that the constituents not derived from milk shall not take the place in part or in whole of any milk constituent e.g. ice cream, shrikhand etc.
3	Dairy terms	means names, designations, symbols, pictorial or other devices which refer to or are suggestive, directly or indirectly, of milk or milk products
4	Heat treatment	means pasteurization, ultra-pasteurization, sterilisation, ultra-high temperature treatment or boiling
5	Milk	means the normal mammary secretion derived from complete milking of healthy milch animal, without either addition thereto or extraction therefrom, unless otherwise provided in these regulations and it shall be free from colostrum
6	Milk Product	means a product obtained by processing of milk, which may contain food additives and other ingredients functionally necessary for the milk product as permitted in these regulations. This includes 18 items e.g cream, yoghurt, cheese, milk derivatives, khoa, etc
7	Recombined milk or milk product	means a product resulting from the combination of milk fat and milk solids- non-fat in their preserved forms with or without the addition of potable water to achieve similar end product characteristics and appropriate milk product composition as per the Standard for that product and in the case of recombined milk, the source of milk-solids-non-fat shall be dried or concentrated milks only
8	Reconstituted milk or milk product	means a product resulting from the addition of potable water to the dried or concentrated form of milk or milk products in the amount necessary to re-establish the appropriate water-to solids ratio to achieve similar end product characteristics and appropriate milk product composition as per the standards for that product
9	Sterilisation, sterilised and similar terms	means application of heat at high temperatures for a time sufficient to render milk or milk products commercially sterile, thus resulting in products that are safe and microbiologically stable at room temperature
10	Species identified milk	means milk as defined under the General Standard for Milk and Milk Products. The fat and SNF content of species identified milk specified under this regulation (namely buffalo milk, cow milk, goat milk, sheep milk and camel milk) shall conform to the respective composition given in sub-item (b) of item 2 of the 2017 notification and product may be subjected

<sup>143</sup> Detailed list is specified in Food Safety and Standards (Prohibition and Restrictions on sales) First Amendment Regulations, 2017 notification and its subsequent amendments.

\* Of the 2017 notification

S. No	Term	Definition
		to pasteurization, boiling, sterilisation or Ultra High Temperature sterilisation/treatment.

Source: FSSAI Act, 2006

The regulations contain specifications on labelling and naming of products, allow use of specific enzymes, addition of essential minerals and use of prebiotics and probiotics in milk and milk products<sup>144</sup>. Essential composition and quality factors for different classes of milk viz. species identified milk, standardised milk and toned milk, etc. are provided below.

Table 29: Essential composition and quality factors for different classes of milk

S. No	Class of Milk	Locality or state	Minimum milk fat (%m/m)	Minimum Milk Solids Non-fat (SNF) (%m/m)
1	Buffalo Milk	Assam, Bihar, Chandigarh, Delhi, Gujrat, Haryana Jharkhand, Maharashtra, Meghalaya, Punjab Sikkim, Uttar Pradesh Uttarakhand, West Bengal	6	9
2	Buffalo Milk	Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Kerala Dadra and Nagar Haveli, Goa Daman and Diu, Himachal Pradesh, Jammu and Kashmir, Karnataka, Lakshadweep, Madhya Pradesh, Manipur, Mizoram, Nagaland, Odisha, Puducherry, Rajasthan, Tamil Nadu, Telangana, Tripura	5	9
3	Cow Milk	All India	3.2	8.3
4	Goat/Sheep Milk	Chandigarh, Haryana, Kerala Madhya Pradesh, Maharashtra Punjab, Uttar Pradesh, Uttarakhand	3.5	9
5	Goat/Sheep Milk	Andaman and Nicobar, Andhra Pradesh, Arunachal Pradesh, Assam Bihar, Chhattisgarh, Dadra and Nagar Haveli, Delhi, Goa, Daman and Diu, Gujarat, Himachal Pradesh Jammu and Kashmir, Jharkhand, Karnataka, Lakshadweep, Manipur Meghalaya, Mizoram	3	9
6	Goat/Sheep Milk	Nagaland, Odisha, Puducherry, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, West Bengal	3	9
7	Camel Milk	All India	2	6
8	Mixed Milk	All India	4.5	8.5
9	Standardized Milk	All India	4.5	8.5
10	Toned Milk	All India	3	8.5

<sup>144</sup> Detailed specifications are provided in the Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Food and Novel food) Regulations, 2016

S. No	Class of Milk	Locality or state	Minimum milk fat (%m/m)	Minimum Milk Solids Non-fat (SNF) (%m/m)
11	Double Toned Milk	All India	1.5	9
12	Skimmed milk	All India	<0.5	8.7
13	Full cream milk	All India	6	9

Source: FSSAI Act, 2006

The total urea content in the milk should be less than 700 PPM. The notification also provides specifications on additives, hygiene, labelling, contaminants toxins and residue. The notification has separate quality specifications for flavoured milk, concentrated milk, sweetened condensed milk, khoa, cream and other milk products.

### Quality Mark<sup>145</sup>

NDDB has developed a set of protocol and practices for meeting food safety and management requirement of milk and milk product manufacturing. The logo/ symbol of Quality Mark on milk and milk product packages conveys that the unit has adopted and implemented specified processes as per food safety and quality management system and is in accordance with set quality parameters. The quality mark logo was registered under trademarks act in 1999. The essential requirements of quality mark includes valid license from FSSAI, accreditation from Quality and Food Safety Management System (such as ISO 22000/FSSC 22000 or ISO 9001 with HACCP certifications-IS 15000) from certifying bodies short listed by the National Accreditation Board for Certification Body (NABCB) / International Accreditation Forum (IAF), valid clearance from state pollution control board and compliance in necessary conditions for water use.

Award of quality mark is a two-step process which includes preliminary and final assessment. The unit needs to score at least 70% in preliminary assessment to be eligible for final assessment. The parameters of evaluation under final assessment are categorized into Critical, Major and Minor parameters. The unit needs to ensure 100% in compliance of critical parameters<sup>146</sup>. As on 31st March 2019, NDDB received 102 applications for quality mark, of these 32 units were found eligible for Quality mark and 67 units were informed about areas of improvement<sup>147</sup>. In addition to Quality mark, FSSAI has also issued guidelines for compliance with good management practices in 2018<sup>148</sup>.

<sup>145</sup> National Dairy Development Board's (NDDB). 2019. Guidelines for award of Quality mark for Milk and Milk Products. Retrieved from [https://www.nddb.coop/sites/default/files/QM\\_Guideline\\_Version\\_7\\_0.pdf](https://www.nddb.coop/sites/default/files/QM_Guideline_Version_7_0.pdf)

<sup>146</sup> e.g Whether the establishment have records to support the backward traceability, Are effective steps taken by the unit to prevent use of prohibited antibiotics/pharmacological substances and Chemicals)

<sup>147</sup> Annual Report (2018-19), Department of Animal Husbandry and Dairying

<sup>148</sup> Guidance document food safety management systems, food industry guide to implement GMP/GHP requirements, FSSAI 2018

## International Standards

The General Agreement on Tariffs and Trade (GATT) allows governments to act on trade in order to protect human life and health. While the WTO member countries are encouraged to use international standards such as FAO/ WHO Codex Alimentarius Commission for food, the agreement on Sanitary and Phytosanitary (SPS) Measures allows the countries to set their own standards<sup>149</sup>.

There are many countries where Indian dairy products are restricted due to standards and trade barriers by those countries e.g. Due to extremely strict sanitary and phytosanitary standards in European countries, they do not approve any of the Indian milk products<sup>150</sup>.

Some of the measures identified to overcome these trade barriers particularly for enabling access to European markets are provided below<sup>151</sup>.

**1. Implement product traceability-** A key barrier to export is the lack of traceability. Implementation of product traceability can help in overcoming SPS barrier.

**2. Strengthen testing procedures and follow global best practices-** General Principles of Food Hygiene (GPH) based on the Hazard Analysis and Critical Control Points (HACCP) system for milk production and processing should be followed throughout the milk supply chain.<sup>152</sup>

**3. Clear distinction between cow and buffalo milk-** European countries and USA have preference for cow milk while a significant proportion of milk in India is from buffalo, labelling/ branding of product will help in providing clear distinction whether the milk is from cow, buffalo or is mixed.

**4. Quality compliance-** Quality compliance is a major issue.

## Recent initiatives towards achieving International Standards

- National Dairy Plan-I and Rashtriya Gokul Mission with introduction of unique 12 digit Animal ID and animal health cards are trying to strengthen its effort in ensuring product traceability, the quality mark standards and good animal management practices, etc.
- The Foot and Mouth Disease (FMD) control programs under Livestock Health and Disease Control have been successful in controlling instances of FMD in many areas, a separate budget head for controlling FMD under National Animal Disease Control Programme (NADCP) has been provided in Budget 2019.

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<sup>149</sup> Joshi R.M., Research and International Collaborations, Indian Institute of Foreign Trade. India's Dairy Exports: Opportunities, Challenges and Strategies. Retrieved from <https://www.dairyknowledge.in/sites/default/files/ch6.pdf>, (last accessed on 09<sup>th</sup> October 2019)

<sup>150</sup> ICRIER. March 2019. SPS Barriers to India's Agriculture Export Learning from the EU Experiences in SPS and Food Safety Standards, Retrieved from [http://icrier.org/pdf/SPS\\_Barriers\\_to\\_India\\_Agriculture\\_Export.pdf](http://icrier.org/pdf/SPS_Barriers_to_India_Agriculture_Export.pdf)

<sup>151</sup> ICRIER, 2019

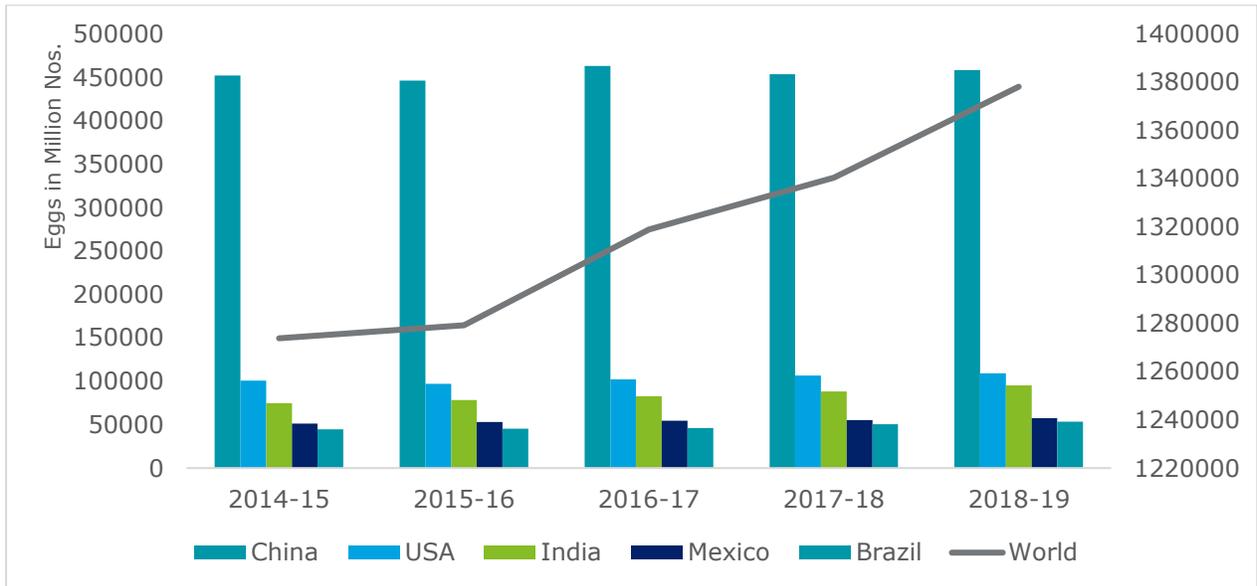
<sup>152</sup> ICRIER . 2019. SPS Barrier to India' Agriculture Export. Retrieved from [https://www.icrier.org/pdf/SPS\\_Barriers\\_to\\_India\\_Agriculture\\_Export.pdf](https://www.icrier.org/pdf/SPS_Barriers_to_India_Agriculture_Export.pdf)

### .1.1.2 Poultry and Eggs

#### Status of Production

Poultry including eggs production has made significant progress in India in the last four decades. India, which ranked 14<sup>th</sup> globally in terms of egg production in 1971, is now the 3<sup>rd</sup> largest egg producer after China and USA. China is the global leader in egg production accounting for nearly 42% of global egg production whereas India accounts for only 5.57%. In 2017, the top five egg producing countries were China, USA, India, Mexico and Brazil accounting for 60.9% of the global egg production<sup>153</sup>.

Figure 109: Egg production in major countries



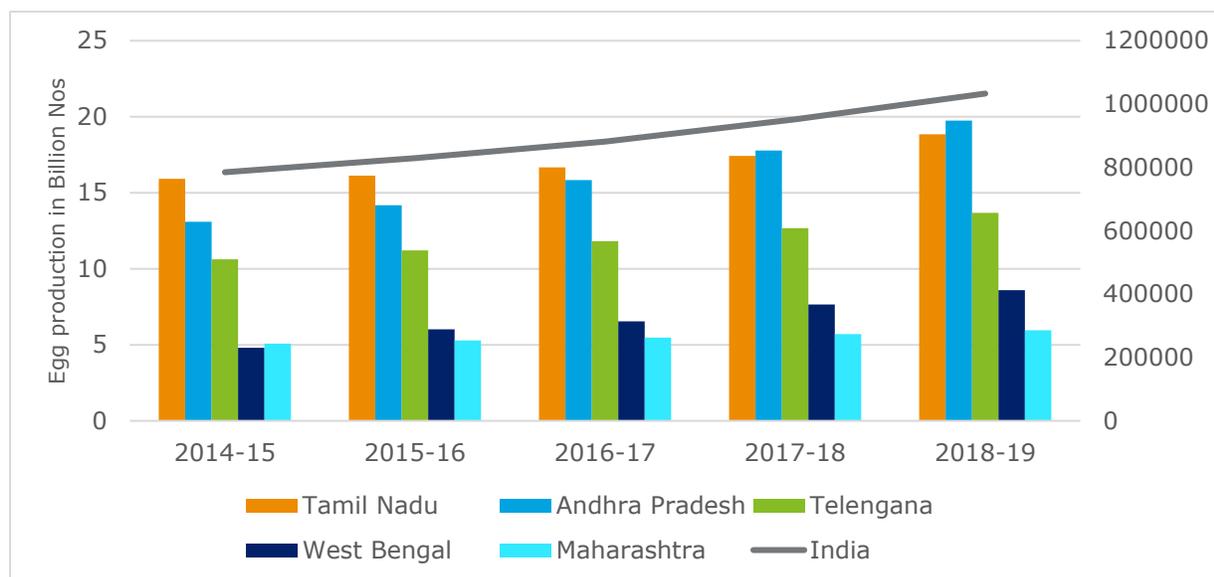
Source: UN FAO

The production trend of these five countries over 2014 to 2018 is depicted in the above graph. The global egg production increased by about 8% over these five years whereas egg production<sup>154</sup> in India grew by around 27% over the same period.

<sup>153</sup> FAO stat (last accessed on 19/09/2019)

<sup>154</sup> Unit for global egg production is in thousand MT, while for production in India it is Billion No

Figure 110: Major egg producing states in India (No's billion)



Source: Basic Animal Husbandry and Fisheries Statistics 2019

Egg production in India has jumped from 50.66 billion eggs in 2006-07 to 103.3 billion in 2018-19. Within India, Andhra Pradesh, Tamil Nadu, Telangana<sup>155</sup>, West Bengal and Maharashtra were the leading egg producer states in 2018-19 and accounted for nearly 65% of total egg production in the country. Tamil Nadu accounted for 19% of total production in 2018-19, followed by AP accounting for about 18% of the total production. West Bengal registered the highest growth of 61% in egg production among top producer states in India during 2013-17<sup>156</sup>.

### Per capita availability of egg in India

Egg is a nutritious functional food, rich in protein, vitamins, folate, iron, selenium and zinc. Due to presence of nutrients such as lutein, egg provides health benefits beyond its nutrient content<sup>157</sup>.

Egg and poultry consumption is growing in India at fast pace. Along with the increasing demand, the production levels are also going up; the production of eggs has multiplied by 50 times since 1951 and the per capita availability of eggs in India has grown by nearly 15 times<sup>158</sup> in the same period.

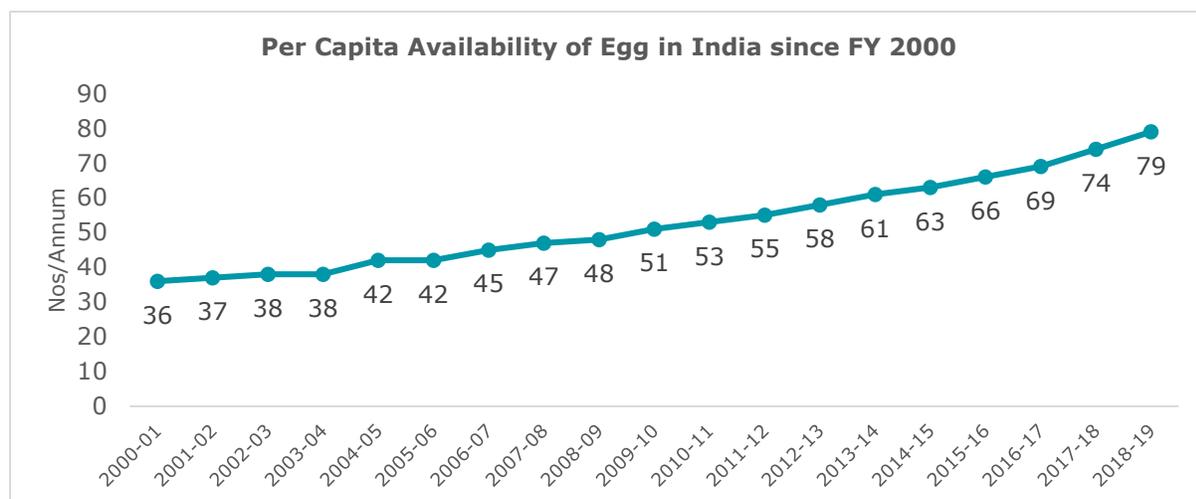
<sup>155</sup> In 2013 data, Telangana is absent as the state was not formed. The data for AP includes Telangana in 2013

<sup>156</sup> Analysis of data from Basic Animal Husbandry and Fisheries Statistics, 2018

<sup>157</sup> National action plan for egg and poultry 2022, Department of Animal Husbandry, Dairying & Fisheries

<sup>158</sup> Basic Animal Husbandry and Fisheries statistics, 2018, Department of Animal Husbandry & Fisheries

Figure 111: Per capita availability of egg in India since FY 2000



Source: Analysis of data from Basic Animal Husbandry and Fisheries Statistics, 2019

Measured in eggs per annum, per capita availability of eggs in India since 2000 is depicted in the graph above. There has been a consistent growth during this period as the per capita availability doubled from 36 eggs per annum in 2000 to 79 eggs per annum in 2018-19<sup>159</sup>.

### .1.1.3 Meat

#### Status of Production

Meat production has grown in India over the years and it contributes significantly to India's exports. India is the 6<sup>th</sup> largest producer of meat<sup>160</sup> in the world although it contributes to less than 3% of global meat production. China is the largest producer and contributes about 30% of global meat production. China, USA, Brazil, Russia and Germany are top five meat producing countries accounting for more than 60% of global meat production.

Meat production in India has grown nearly 4 times since 2000. In FY 2018, the estimated meat production in India was 8.11 million MT. Meat group of products accounted for nearly 22.03% of value of output from livestock sector as of 2017-18 (at constant prices).

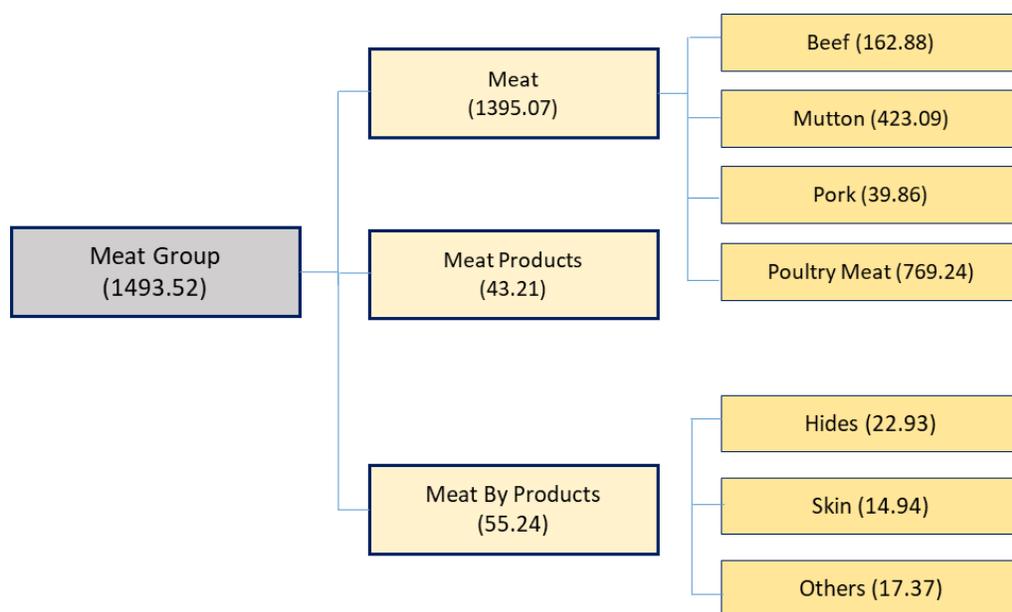
The National Accounts Classifications and value of output (in Rs. Billion) for each category of meat sub group of products in India estimated in 2016-17 is provided below<sup>161</sup>.

<sup>159</sup> Department of Animal husbandry, dairy and fisheries. 2019. Basic Animal Husbandry and Fisheries statistics, 2018. Retrieved from <http://dahd.nic.in/>

<sup>160</sup> FAO stat (last accessed on 19/09/2019)

<sup>161</sup> Ministry of Statistics and Programme Implementation, Govt. of India. 2018. Statewise And Item-Wise Estimates Of Value Of Output From Agriculture And Allied Sectors 2011-12 to 2015-16

Figure 112: National accounts classifications and values of output (in Rs. Billion) as of 2017-18

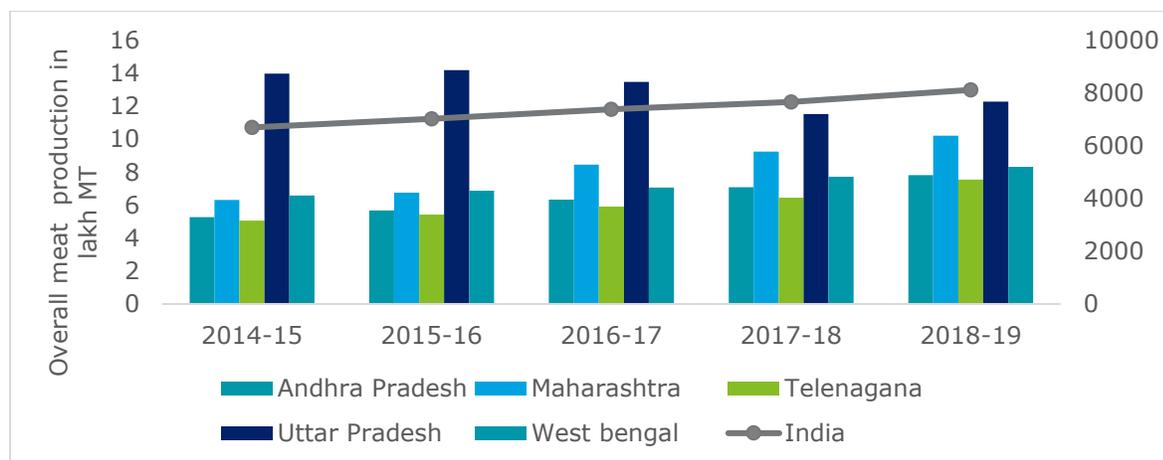


Source: National Account Statistics 2019, MOSPI

Among the Indian states, Uttar Pradesh (UP), Maharashtra, West Bengal, Andhra Pradesh and Telangana<sup>162</sup>, were the top meat producers in India in 2018-19. These five states accounted for nearly 56.8% of total meat production in the country. UP accounted for about 15%, followed by Maharashtra which accounted for about 12% of total production.

Overall meat production in India increased steadily by about 21% between 2014 and 2018. During this period, Maharashtra registered highest growth in production (about 62%) among top producer states. In case of UP, a decline of about 12% in production was observed during 2014-2018<sup>163</sup>.

Figure 113: Major meat producing states in India (lakh MT)



Source: Analysis of data from Basic Animal Husbandry and Fisheries Statistics, 2019

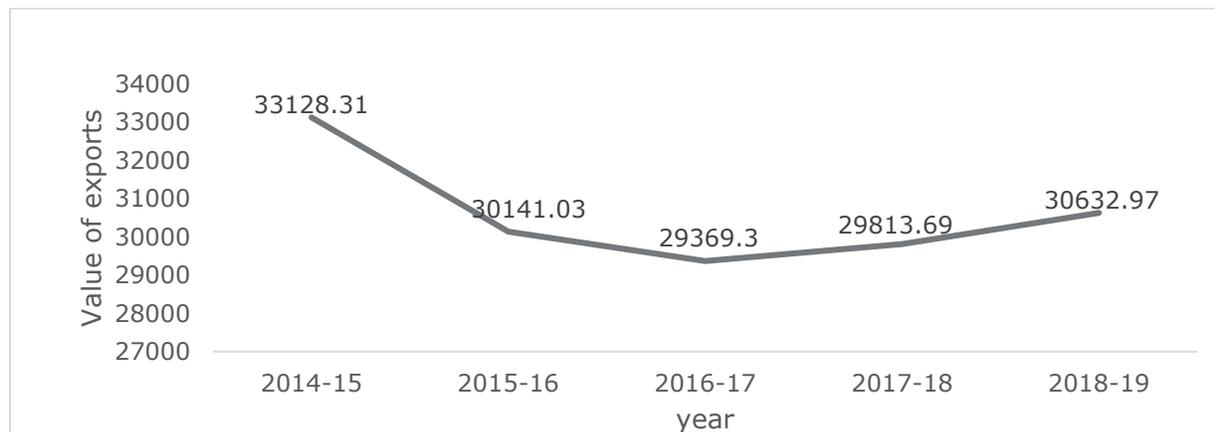
<sup>162</sup> In 2013 data, Telangana is absent as the state was not formed. The data for AP includes Telangana in 2013.

<sup>163</sup> Analysis of data from Basic Animal Husbandry and Fisheries Statistics, 2019

## Exports<sup>164</sup>

Indian meat is generally of good quality having much lesser average fat content (4%) than that of developed countries (15-20%)<sup>165</sup>. Moreover, progress in Indian animal health system has ensured that Indian meat is largely free from foot and mouth disease, mad cow disease, rinderpest, contagious bovine pleuropneumonia, etc. Since 2014, India has exported livestock and associated produce worth Rs. 1.53 lakh crores. However, the value of exports from livestock products has declined from about Rs. 33,128 lakhs in 2014-15 to about Rs. 30,632 lakhs in 2018-19<sup>166</sup>.

Figure 114: Income from exports (Rs. crores)



Source: Analysis of data from APEDA, Agriexchange, export of animal product

APEDA has classified the livestock and dairy products into 10 product classes. These products constitute processed and value added products from livestock. The value of exports and quantity exported with respective top export destinations from 2014 to 2019 for each product class are given in the table below<sup>167</sup>.

Table 30: Export details for livestock

S. No	Product class	Quantity exported (MT)	Value of export (in Rs crores)	Average value per MT (in thousand Rs)	Top export destination
1	Buffalo Meat	6701621.36	133340.9	198.97	Vietnam, Malaysia, Indonesia
2	Dairy Products	300799	6485.84	215.62	Bangladesh, Turkey, UAE and Egypt
3	Sheep/ Goat Meat	106803.52	4151.58	388.71	UAE, Saudi Arab, Qatar
4	Natural Honey	225692.26	3184.53	141.1	USA, UAE, Saudi Arab and Morocco

<sup>164</sup> APEDA, Agriexchange sectoral statistics, <https://agriexchange.apeda.gov.in> ( Last accessed on 19/09/2019)

<sup>165</sup> Rajesh Kumar, International Journal of Current Microbiology and Applied Sciences. 2018. Indian Meat Industry, Red Meat Manual; Present status of Indian Meat Industry

<sup>166</sup> Analysis of data from APEDA, Agriexchange, export of animal product, <https://agriexchange.apeda.gov.in>

<sup>167</sup> Analysis of data from APEDA, Agriexchange <https://agriexchange.apeda.gov.in> ( Last accessed on 19/09/2019)

S. No	Product class	Quantity exported (MT)	Value of export (in Rs crores)	Average value per MT (in thousand Rs)	Top export destination
5	Poultry Products	2663679.27	3189.82	11.98	Oman, Maldives, Vietnam and Japan
6	Animal Casings	27947.24	858.29	307.11	Vietnam, Myanmar and South Africa
7	Albumin (Eggs & Milk)	10041.28	585.62	583.21	Japan, Vietnam, Indonesia and Thailand
8	Processed Meat	1501.72	48.37	322.1	UAE, Myanmar and Qatar
9	Other Meat	2170.78	33.04	152.2	Bhutan
10	Casein	28505.15	1207.34	423.55	USA, Thailand, Vietnam and Malaysia

Source: APEDA

As can be seen above, buffalo meat constitutes about 66.56% of total quantity exported and 87.1% of total value of exports from India. In terms of value per MT, exported buffalo meat was valued at Rs 1.98 lakhs/MT whereas dairy products were valued higher at Rs. 2.15 lakh/MT. Among the product classes, value from export of Albumin protein is highest at Rs. 5.83 lakhs/MT, while poultry products are lowest at Rs. 0.11 lakh/MT.

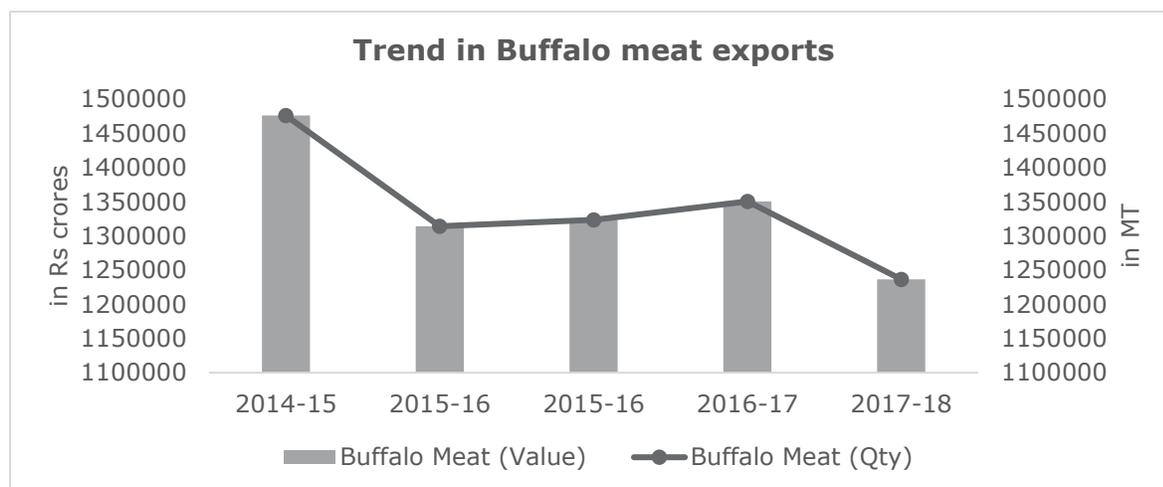
Except for USA, most of the export destinations for India are in Asia and Middle East. South East Asian countries such as Vietnam, Malaysia and Indonesia are the largest importer of Buffalo meat from India. In 2018-19, about 63.45% of the total Buffalo meat were exported to Vietnam, Malaysia and Indonesia.

Vietnam is one of the largest importers of Indian livestock products, as it imported nearly 46% of Buffalo meat and about 88.5% of animal casing from India in 2018-19 in terms of quantity. Vietnam was also the 2<sup>nd</sup> largest importer of Albumin, 4<sup>th</sup> largest importer of poultry and 3<sup>rd</sup> largest importer of caseins. Other important export destinations of livestock and dairy products are UAE, USA, Saudi Arab, Qatar, Thailand, Japan, Oman, Bangladesh and Egypt.

### **Trends in Buffalo Meat Exports**

Buffalo meat exports have declined by about 16% since FY 2014. In addition, sheep/goat meat and casein exports have also registered a reduction of about 19% and 31% respectively. On the other hand, exports of dairy products registered an increase of about 71%. As mentioned earlier, the overall value of exports from livestock products has declined since 2014-15. This can be attributed to the decline of Buffalo meat exports, which contributes more than 80% of the overall value of exports.

Figure 115: Trends in buffalo meat export



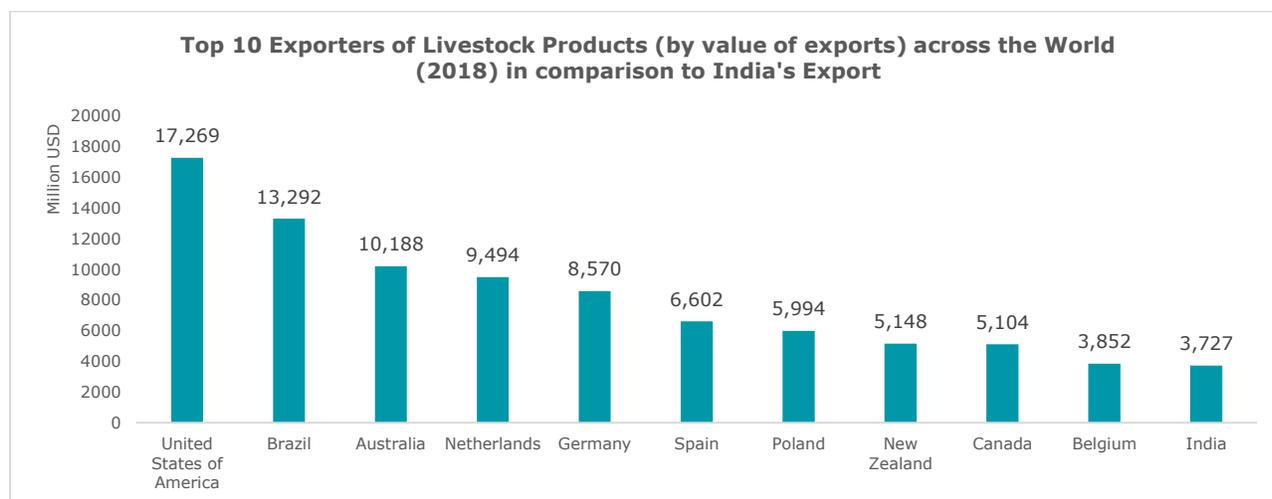
Source: APEDA

This decline in buffalo meat exports can be attributed to reduction in production of meat in UP which is home to the largest buffalo population in India.

### Global Scenario

Livestock products are one of the leading agri-export commodities of India. It has a share of 3.9% of the total global export of meat and edible meat offal. However, at the global level, the share of total export of livestock products (meat and edible meat offal<sup>168</sup>) has been reduced by 14% in 2018 over the last year and is currently pegged at ~USD 3727 million<sup>169</sup>. In the global trade of meat and edible meat offal, India ranks 11<sup>th</sup>. The top 10 exporters of livestock products along with their respective share in the world livestock exports as of 2018 is shown in the following figure.

Figure 116: Top Exporters (Countries) of Livestock Products



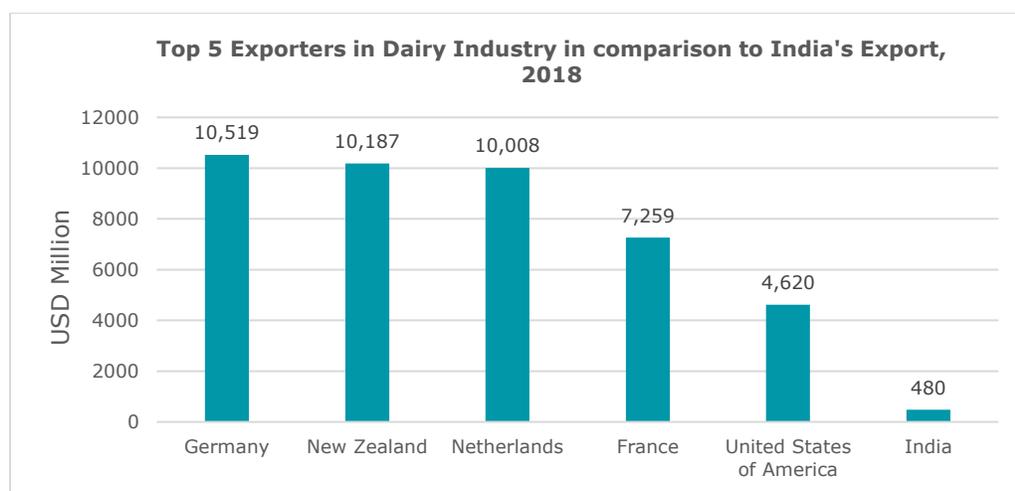
<sup>168</sup> Classification of 02 Meat and edible meat offal of UN Comtrade is referred for the group (<https://unstats.un.org/unsd/tradekb/Knowledgebase/50043/HS-2002-Classification-by-Section>)

<sup>169</sup> International Trade Statistics referred from <http://www.intracen.org>

Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

The dairy products traded from India includes fresh butter, buttermilk, butteroil, fresh cheese, milk for babies, milk & cream in powder, skimmed milk powder, whole milk and ghee. The major export destinations for dairy products are Turkey, United Arab Emirates, Egypt, Bangladesh and Bhutan<sup>170</sup>. However, at the global level, the export value of dairy products<sup>171</sup> from India is pegged at ~480 million USD, which constitutes 0.53% of the world's export value. In global trade, India ranks 32<sup>nd</sup> given its current export value in dairy products. The top 5 exporters of dairy products as of 2018 in comparison to India's export is shown in the following figure.

Table 31: Top 5 Exporters in Dairy Industry as of 2018



Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

## Infrastructure

Indian dairy sector is facing challenge in disposal of surplus milk production. Due to weak international market and sustained growth in domestic milk production in 2018-19, the export-oriented processing plants in India reduced purchasing milk from farmers. As a result, the surplus milk got diverted to dairy cooperatives resulting in a 6.8% increase in average milk procurement. While the sale of liquid milk increased only 1.4%, the net surplus was converted mainly into SMP and butter as these had longer shelf life. In the process, the cooperative dairies commenced the following year with unsold stocks of skimmed milk products, butter and ghee. The increased procurement in summer and unsold inventory is putting severe pressure on cooperatives. However, the revival in export of skimmed milk products this year has provided some relief, but the subdued market prices of SMP in domestic market are adversely affecting the margins of dairy cooperatives<sup>172</sup>.

<sup>170</sup> [http://apeda.gov.in/apedawebsite/SubHead\\_Products/Dairy\\_Products.htm](http://apeda.gov.in/apedawebsite/SubHead_Products/Dairy_Products.htm)

<sup>171</sup> Classification of 04 Dairy produce; birds' eggs; natural honey; edible products of animal origin of UN Comtrade is referred for the group (<https://unstats.un.org/unsd/tradekb/Knowledgebase/50043/HS-2002-Classification-by-Section>)

<sup>172</sup> NDDB, Annual report 2018-19

## Dairy cooperative cold chain infrastructure<sup>173</sup>

The cold chain infrastructure comprising of bulk milk coolers, chilling centres and dairy plants in the cooperative sector is summarized below.

Table 32: Dairy cooperative cold chain infrastructure

Zone	BMC(TL)	Chilling centre (TLPD)	Dairy plant (TLPD)
North	6,695	3,377	16,698
East	2,926	481	5,469
West	20,098	8,768	35,211
South	7,943	5,419	15,541
India	37,662	18,045	72,919

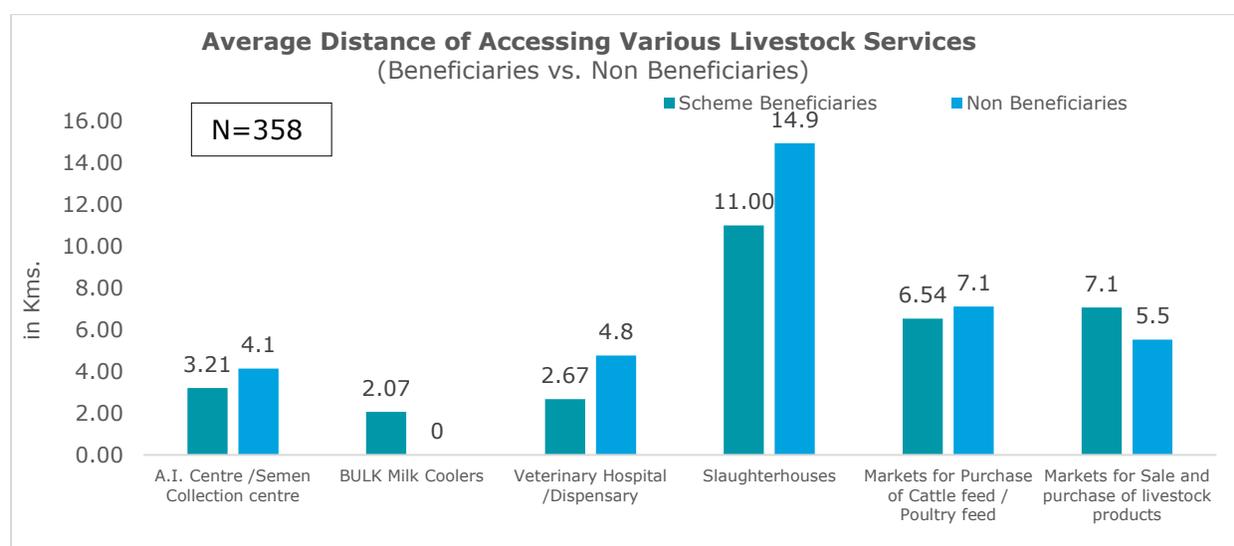
Units TL: Thousand Litres, TLPD: Thousand Litres Per Day; Source: Annual report 2017-18, NDDB

India has bulk milk coolers with a total capacity of 37.66 million litres, dairy plants with a capacity of 72,919 TLPD and chilling centres with capacity of 18,045 TLPD.

As can be seen, the west zone has better infrastructure with Gujarat having the best dairy infrastructure available among all the states. Gujarat leads all states with Bulk Milk coolers having a capacity of 17.53 million litres, chilling centres with capacity of 6,435 TLPD and dairy plants with capacity of 24,175 TLPD.

As observed from the household (HH) survey, livestock farmers have been accessing various infrastructures, many of which are created by the dairy cooperative federations. Schemes such as National Dairy Plan I, Rashtriya Gokul Mission have led to development of artificial insemination or semen collection centers, setting up of bulk milk coolers and establishment of veterinary hospitals and dispensaries.

Figure 117: Average Distance of Accessing Various Livestock Services



Source: HH Survey, Deloitte Analysis

<sup>173</sup> National Dairy Development Board, 2019. Annual Report 2017-18

The analysis shows that beneficiaries under White Revolution scheme have better access to the commonly used service points. As it can be seen from the graph, the average distance covered by livestock farmers under White Revolution to reach out to various livestock services is lesser than average distance covered by eligible non beneficiaries. Among the animal husbandry services, it can be observed that markets of sale and purchase of livestock is 6.5 km on an average and scheme beneficiaries also have not been able to have better access than eligible non-beneficiaries. This analysis shows that distance may be a factor in availing the benefits of the scheme.

### Other infrastructure:

Details of various other important livestock infrastructure is provided in the table below: <sup>174</sup>

Table 33: Livestock infrastructure

Livestock and Dairy Infrastructure	Salient Features and potential in the Infrastructures	Facility	Number	Top states
Breeding Infrastructure	<ul style="list-style-type: none"> <li>• Development indigenous breeds &amp; undertaking cross breeding programme</li> <li>• Improved quality of milch animals or other livestock for producing milk, meat and wool in a profitable manner.</li> </ul>	Semen production centre	54	Haryana, Tamil Nadu
		Frozen semen bank	235	Maharashtra, Tamil Nadu
		Cattle breeding farm	169	Tamil Nadu, Kerala
		Buffalo breeding farm	34	Tamil Nadu
		Sheep breeding farm	87	Jammu & Kashmir, Tamil Nadu
		Goat breeding farm	161	Jharkhand, Tamil Nadu
		Pig breeding farm	366	Jharkhand, Assam
		Poultry breeding	6274	Jammu & Kashmir, Punjab
AI Support	<ul style="list-style-type: none"> <li>• Reduction in cost of rearing bulls by farmers</li> <li>• Effective in reducing both genital and non-genital diseases in the farm stock</li> <li>• There is a 25% gap in AI infrastructure in the country with an estimated need of 32,902 AI centers in India</li> <li>• With 7.56 crores AI performed in 2017-18, there has been AI coverage of 29.7% on breedable bovines in India<sup>175</sup></li> </ul>	AI centres	113,264 <sup>176</sup>	UP, Gujarat, Tamil Nadu
Veterinary Institutes	<ul style="list-style-type: none"> <li>• Catering to the healthcare of animals and birds including</li> </ul>	Veterinary institutions	65815	Rajasthan, Uttar Pradesh, Odisha

<sup>174</sup> Department of Animal husbandry, dairy and fisheries. 2018. Basic Animal Husbandry and Fisheries statistics, 2019. Retrieved from <http://dahd.nic.in/>

<sup>175</sup> Annual Report 2018-19, DAHD

<sup>176</sup> Annual Report 2018-19, DAHD

Livestock and Dairy Infrastructure	Salient Features and potential in the Infrastructures	Facility	Number	Top states
	<p>cattle, buffaloes, sheep, goat, pigs and poultry</p> <ul style="list-style-type: none"> <li>• Different types of institutions which covers Veterinary Hospitals/polyclinics, dispensaries and aid centers</li> <li>• As per the National Commission on Agriculture (NCA) recommendations, up to 5000 Livestock Units (LU) can be treated in a graduate veterinary institute to maintain quality of care. Currently, each veterinary institutes serve up to 5071 LU</li> <li>• Gujarat, Jharkhand and Madhya Pradesh have more than 50% deficit in veterinary institutes</li> </ul>			
Feed and Fodder Production Farms	<ul style="list-style-type: none"> <li>• Provides for the livestock rearing inputs in terms of feed and fodder</li> <li>• There is a deficit for all three types of livestock feed<sup>177</sup>: <ul style="list-style-type: none"> <li>- concentrates: 39%</li> <li>- dry fodders: 36%</li> <li>- green fodders – 57%</li> </ul> </li> </ul> <p>The states which are deficit in dry fodder are Jharkhand, J&amp;K, Uttrakhand, Tamil Nadu, West Bengal</p> <p>The states with high deficit in green fodder are West Bengal, Bihar, Jharkhand, Assam and Orissa.</p> <p>With respect to concentrates, Kerala, Tamil Nadu, A.P and Jharkhand are high in deficit</p>	Fodder seed production farms	301	Jammu & Kashmir, Gujarat, Tamil Nadu,
Milk Procurement and Processing Infrastructure	<ul style="list-style-type: none"> <li>• The marketable surplus of milk is 52% of the total milk production in India. The share of milk marketing on different platforms is given below: <ul style="list-style-type: none"> <li>- organized milk marketing by Cooperatives -16% of</li> </ul> </li> </ul>	Milk procurement factories	307	Karnataka, Haryana, Gujrat, MP

<sup>177</sup> NABARD. 2018. Sectoral Paper on Animal Husbandry. <https://www.nabard.org/auth/writereaddata/tender/1103195107AH%20Final.pdf>

<b>Livestock and Dairy Infrastructure</b>	<b>Salient Features and potential in the Infrastructures</b>	<b>Facility</b>	<b>Number</b>	<b>Top states</b>
	<ul style="list-style-type: none"> <li>marketable milk surplus</li> <li>- organized milk marketing by private sector -21% of marketable milk surplus</li> <li>- unorganised milk marketing - 60% of marketable milk surplus</li> <li>• There is scope to improve processing of marketable milk surplus to 90% in the organized sector as prevalent in developed countries</li> </ul>	Liquid milk plants	1,543	Tamil Nadu Odisha
Meat Processing Infrastructure	<ul style="list-style-type: none"> <li>• Establishing modern meat processing units is critical for clean/ hygienic meat processing</li> <li>• In India the level of processing of meat is as low as 1%<sup>178</sup>. With improvement in processing infrastructure there can be a significant improvement in reduced post-harvest losses and production of export quality meat products</li> <li>• Exports can go up with increase in production of processed meat</li> </ul>	Registered slaughter houses	1,783	Maharashtra, Madhya Pradesh, Uttar Pradesh
		Abattoirs cum meat processing plants registered with APEDA	78	Uttar Pradesh, Telangana and Maharashtra
		Meat processing plants registered with APEDA	29	Uttar Pradesh, Telangana and Maharashtra
Livestock Markets	<ul style="list-style-type: none"> <li>• Sale of live animals in state owned or private markets as well as through livestock fairs</li> <li>• Livestock markets have been brought under Agriculture Produce Market Committee (APMC) Act in few states</li> <li>• There is lack of organised livestock markets in the country</li> </ul>	Cattle and livestock fair in Sonapur, Bihar is the largest in the world.		

Some of the other infrastructure in livestock sector is given below:

Figure 118: Summary of other important livestock infrastructure

<b>Facility</b>	<b>No.</b>	<b>Top states</b>
No of Gaushalas	5955	Rajasthan, Gujarat, Madhya Pradesh
Liquid Nitrogen plants	93	Karnataka, Jammu & Kashmir

<sup>178</sup> National Dairy Development Board, 2019. Annual Report 2017-18

Facility	No.	Top states
Registered Veterinary colleges <sup>179</sup>	45	Karnataka, Gujarat, Uttar Pradesh, Maharashtra

Source: Basic Animal Husbandry and Fisheries Statistics, 2019

## Post-Harvest Losses in Livestock

Livestock produce such as raw and processed meat, milk and eggs are highly perishable and require proper handling, storage and distribution. An assessment of the post-harvest losses in the livestock sector was conducted by ICAR-CIPHET in 2015. The economic loss due the post-harvest loss in livestock sector has been assessed to have a monetary value of Rs 10,906 Crores during 2012-13 which consists of 12% of the total agriculture and allied sector loss.

Table34: Post-harvest losses in Animal Husbandry and Dairy in 2012-13 (at national level)

Livestock Produce	% Post-Harvest Loss (PHL) at the following stages:				Monetary Value of the Losses (in Rs Crores)
	During Transportation	Farm operations (and first mile)	During Storage	Overall Total Loss	
Milk	0.02	0.71	0.21	0.92	4,409
Meat	0.00	1.99	0.72	2.71	1,235
Egg	0.36	4.88	2.31	7.19	1,320
Poultry Meat	0.66	2.74	4.00	6.74	3,942
<b>Overall PHL</b>	<b>0.92 – 7.19</b>				<b>10,906</b>

Source: ICAR-CIPHET, 2015, Harvest and Post-Harvest Losses in India, Retrieved from <https://www.ciphnet.in/study-on-post-harves-losses.php>

In case of meat including poultry meat, the losses were attributed to inefficiencies in processing and repeated interruption of electricity supply during freezing. Egg shell damage and egg breakage during laying, gathering, grading, packaging and transportation as well as rotten eggs have been the causes of losses in eggs<sup>180</sup>. Post-harvest losses for eggs were observed to be low in case of mechanized and organized egg production as compared to backyard poultry farming and unorganized farms with high temperatures. Storage loss, loss during sorting using traditional techniques, was also a significantly high. Non usage of cold storage for eggs led to higher overall losses. Post-harvest losses in meat was attributed to wholesale storage level loss and due to insufficient refrigeration. In case of other meat, the loss was caused by inefficiencies in grading, insufficient storage in deep freezers.

Losses in dairy have been found to be on account of spoilages, wastages, spillages, drainages of milk from plant, packaging and storage losses. The farm operations and extent of coverage considered for the study in livestock produce included the following:

Table 35: Sources of Post-harvest Losses in Livestock Commodities

Operation Channel	Extent of operation	Livestock Produce
Harvesting	During milking of animal	Milk
	Slaughtering of animal/poultry	Meat, Poultry Meat

<sup>179</sup> NABARD, Sectoral paper on Animal Husbandry, January 2018

<sup>180</sup> ICAR-CIPHET, 2015, Harvest and Post-Harvest Losses in India, Retrieved from <https://www.ciphnet.in/study-on-post-harves-losses.php>

Operation Channel	Extent of operation	Livestock Produce
Collection	Filling at collection centers	Milk
	Collection of eggs, transportation up to packing yards	Eggs
Grading	Sorting of material not fit for human consumption	Eggs, Poultry Meat, Meat
Packaging	Packaging in filler flats, stacking filler flats	Eggs
Transportation	Loading, unloading and transportation from grading place/farmer to market yard	Milk, Eggs
Storage at farm/household level	During storage, cleaning, grading before monetization/consumption of produce	Eggs, Milk
Storage at wholesale level	Unloading and loading during storage and grading for sale	Eggs, Meat, Poultry Meat
Storage at retailer level	Unloading and loading and storage of raw material	Eggs, Meat, Poultry Meat, Milk
Storage at processing units	Unloading and loading and storage of raw material	Eggs, Milk, Poultry Meat

Source: ICAR\_CIPHET. 2015. Report on Assessment of Quantitative Harvest and Post-Harvest Losses on Major Crops and Commodities in India

The recommendations to reduce post-harvest losses focused on the following aspects:

- Strengthening the storage channels,
- Handling livestock in cold chain immediately after harvest
- Address butcher shops and retailers on technological interventions
- Hazard Analysis and Critical Control Points to maintain hygiene standards

## Price of Livestock Produce

The inputs and services involved in livestock management are classified into following four categories under National Account Statistics:

- Feed of livestock
- Current repairs, maintenance of fixed assets & other operational costs
- Market charges
- Financial intermediation services

During 2012-2016, the value of inputs and services (at 2011 prices) for livestock management was approximately 30% of total value of output<sup>181</sup>. This is essentially the cost of inputs and services that are involved in management of livestock. It is deducted from total value of output to calculate GVA of the sector. The average cost incurred per year on inputs and services from 2012 to 2016 was

<sup>181</sup> Output and Value added from Livestock sector, National Accounts Statistics, 2018

estimated at about Rs. 1.71 lakh crores. About 97% of the overall cost of inputs and services was incurred on livestock feed while market charges, financial services and maintenance cost constitute only 3% of total cost<sup>182</sup>.

### Trends in prices of livestock produce

The Wholesale Price Index (WPI) captures the prices of goods before it reaches to retailers. The WPI is an important indicator of inflation in economy. The WPI basket in India has 697 items and the food articles among these items have a weightage of 15.25. Milk has the highest weightage among food articles, as higher weights are assigned to item on the basis of its net traded value in the base year 2011-12<sup>183</sup>. Higher weights assigned to an item represent its relative importance.

The weightage of all food categories across the basket are provided under<sup>184</sup>.

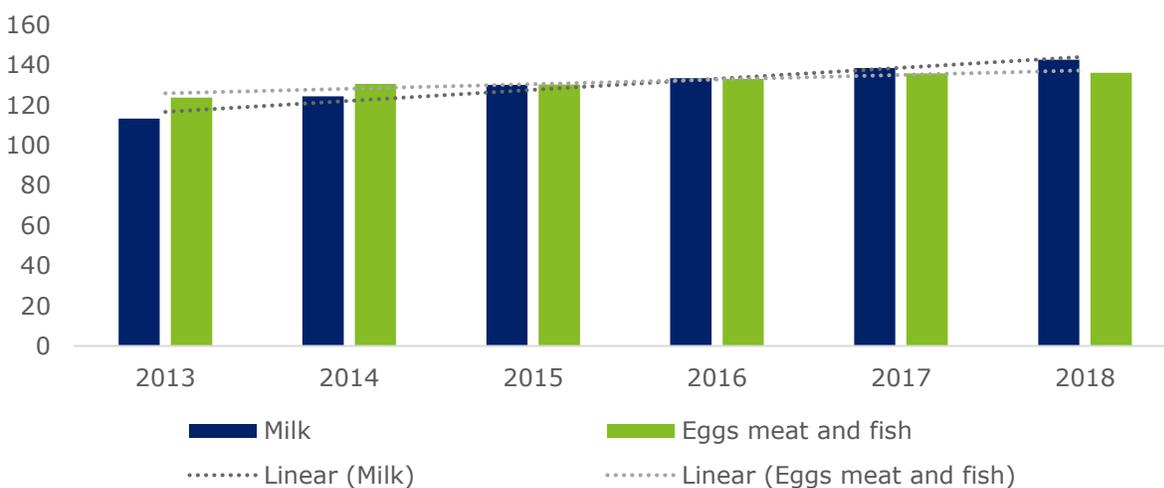
Table36: Weightage of all food categories across livestock basket

	Cereals	Pulses	Fruits	Vegetables	Egg, meat and fish	Milk
Weight	2.82378	0.63860	1.60060	1.87448	2.40156	4.43999

Source: Website of office of economic advisor

Both livestock product categories has higher weightage than all other food articles. The trend in WPI of milk, egg, meat and fish is provided below<sup>185</sup>.

Figure 119: Trends in WPI inflation of livestock products



Source: www.eaiindustry.nic.in

Figure 7: Increase in Average Price of Milk among Dairy Farmers

<sup>182</sup> Output and Value added from Livestock sector, National Accounts Statistics, 2018

<sup>183</sup> [https://eaiindustry.nic.in/uploaded\\_files/FAQs\\_on\\_WPI.pdf](https://eaiindustry.nic.in/uploaded_files/FAQs_on_WPI.pdf) (Accessed on 19/09/2019)

<sup>184</sup> Website of office of economic advisor, [https://eaiindustry.nic.in/uploaded\\_files/FAQs\\_on\\_WPI.pdf](https://eaiindustry.nic.in/uploaded_files/FAQs_on_WPI.pdf)

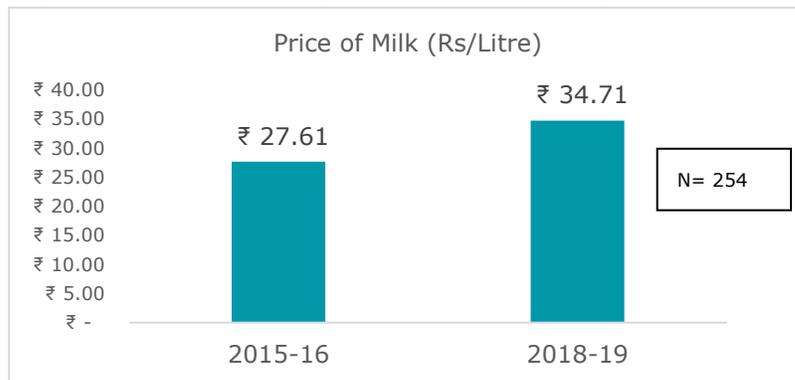
<sup>185</sup> Website of office of economic advisor [https://eaiindustry.nic.in/download\\_data\\_1112.asp](https://eaiindustry.nic.in/download_data_1112.asp)

As can be seen in the table, the inflation in milk products is growing at much higher pace than other livestock products. Between 2014 and 2018, the prices of milk rose by about 26%, while prices of egg, meat and fish increased by only 10%.

As observed in the HH survey, between 2015-16 and 2018-19 the price of milk being sold by the dairy farmers has increased by 25%.

Increase in the average price of milk among livestock farmers during the said period has been depicted in the graph alongside.

Figure 120: Increase in Average Price of Milk among Dairy Farmers

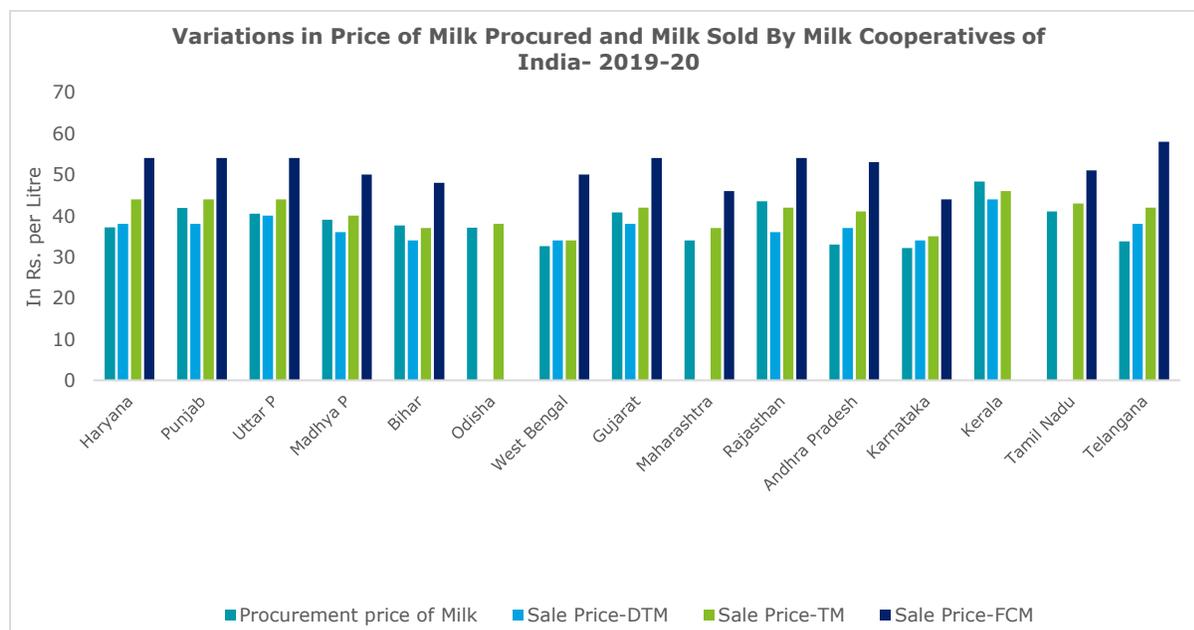


Source: HH Survey, Deloitte Analysis

### Variations in Milk and Milk products across different states

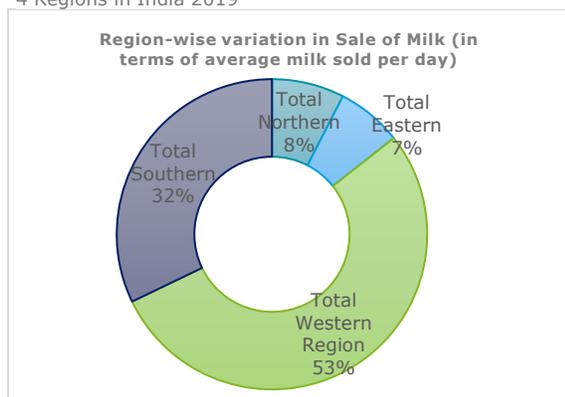
The price of milk and milk products also varies across various states. The analysis of the milk procurement and sale of milk (including full cream milk, toned milk and double toned milk) data of all leading milk cooperatives in the country has been shown below to depict the variations observed in different states and regions.

Figure 121: Variations in Milk Sale Prices and margin with the Procurement Cost of All Leading Milk Cooperatives



Source: Data provided by the Department of Animal Husbandry and Dairying

Figure 122: Region-wise Variations in Milk Demand across 4 Regions in India 2019



Source: Data provided by the Department of Animal Husbandry and Dairying

A higher margin in full cream milk accounts for the procurement cost of milk. The region-wise sale of milk depicts the distinct skewedness in Western and Southern region. Western region has the largest share of milk sale followed by Southern states. In the Western region, Gujarat is the largest consumer of milk with 102.96 lakh litres of sale per day as against 174 lakh litre sale from Western region.

## Discussion on Cross Sectional Thematic Areas

### *i. Accountability and Transparency*

Livestock sector in India is an important domain providing nutritional security to millions of people, and generating gainful employment in the rural sector, particularly among the landless, small and marginal farmers and women. The vast source of livestock and poultry resources have been contributing to the livelihoods of rural masses. Animal husbandry and dairying is a state subject. The Department of Animal Husbandry and Dairying assists the growth and sustainable development of this sector to each State Government for control of animal diseases, scientific management and upgradation of genetic resources, increasing availability of nutritious feed and fodder, sustainable development of processing and marketing facilities and enhancement of production and profitability of livestock enterprises. The Department is responsible for livestock production, preservation, protection & improvement of stocks and dairy development. Some of the key institutions responsible for a holistic development of the sector includes:

- National Dairy Development Board: assisting in accelerating the pace of dairy development through farmers' cooperatives
- Veterinary Council of India: assisting in regulation of veterinary practices as well as for maintaining uniform standards of veterinary education

The Department of Animal Husbandry and Dairying is responsible for the subjects such as Livestock Census, Livestock Statistics, matters relating to loss of livestock due to natural calamities, regulation of livestock importation, animal quarantine and certification. The maintenance of data on the livestock sector growth is available in the following formats:

- The physical progress in the livestock sector across various schemes, livestock statistics, and livestock health is published in the DADF Online portal<sup>186</sup> of the department.

<sup>186</sup> <http://dadfonline.gov.in/>

- NADRS (National Animal Disease Reporting System) captures animal disease information in terms of First Information Report(FIR), Daily Incidence (DI) cases and Vaccination coverage.
- e-pashuhaat is the one-stop portal for bovine breeders, sellers and buyers.
- ENSURE portal by NABARD to enable Direct Benefit Transfer (DBT) for beneficiaries under Dairy Entrepreneurship Development Scheme.
- INAPH portal by NDDDB facilitates the capturing of real time reliable data on breeding, nutrition and health services delivered at farmer's doorstep.

Under the Direct Benefit Transfer (DBT) facility, the financial benefits of farmers are transferred electronically through an accountable and transparent process, ensuring better delivery of services to people. In the livestock sector, 4 centrally sponsored schemes are reported on the DBT portal. The list of schemes along with the DBT transfers done in 2018-19 are given below:

Table 37: Livestock Schemes reporting in DBT Portal along with Transfers made in 2018-19

Scheme Name	Benefit Type	DBT Fund Transfer (in Rs.)
Dairy Entrepreneurship Development Scheme	Cash	2,30,43,30,900
Livestock Health and Diseases Control	In Kind	-
National Livestock Mission - Entrepreneurship Development and Employment Generation	Cash	47,03,73,300
Rashtriya Gokul Mission	Cash and In Kind	44,30,000

Source: <https://dbtbharat.gov.in/page/frontcontentview/?id=NjU=>

## **ii. Direct/ indirect employment generation**

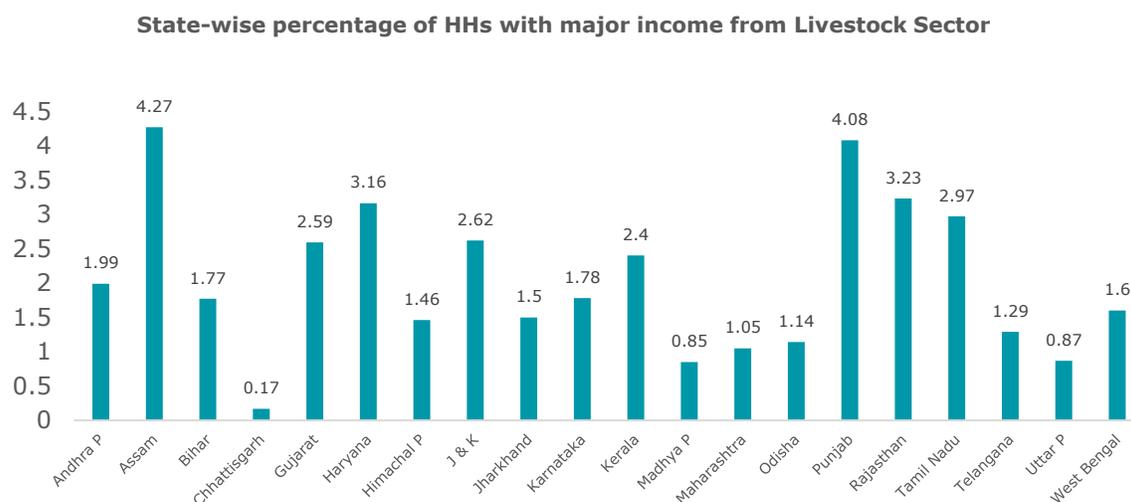
Dairy subsector engages landless, small & marginal farmers particularly women as an occupation. Around 95% of milk producers in India holds 1 to 5 milch animals per household as a part of subsistence farming system. The livestock sub-sector contributes significantly to the rural income – around 12% of income in rural households comes from animal farming. Out of 12% of income derived from livestock rearing about 69% comes from dairying (milk). As per 70th round of NSSO, livestock rearing was the principal source of income to about 3.7 per cent of the agricultural households.<sup>187</sup> Among agricultural households with very small parcels of land (less than 0.01 hectare), one-fifth households reported livestock as their principal source of income. The resource poor rural households' own majority of the livestock resources to supplement their income in lean seasons.

In India, around 2.733 million households are self-employed in livestock sector with major source of earnings coming from this occupation<sup>188</sup>. The state-wise distribution of households having major source of income from livestock sector has been shown below:

<sup>187</sup> Economic Survey 2018-19, Agriculture and Food Management

<sup>188</sup> NSS 70<sup>th</sup> Round 2013, Livestock Ownership in India, [http://mospi.nic.in/sites/default/files/publication\\_reports/nss\\_rep\\_572.pdf](http://mospi.nic.in/sites/default/files/publication_reports/nss_rep_572.pdf)

Figure 1238: State-wise percentage of HHs dependent on Livestock Sector



Source: NSS 70th Round 2013, Livestock Ownership in India

Assam has the highest percentage of households dependent on livestock rearing, followed by Punjab and Rajasthan. Indian dairy industry employs about 8.47 million people on yearly basis out of which 71% are women.<sup>189</sup>

The distribution of livestock rearing among different categories of households (by operational holding) as per 70th round of NSSO is given below:

Table 38: Distribution of Livestock among various HH categorized by operational holdings

Sl.	Livestock/poultry	Average no. of livestock/poultry owned per 1000 household by category of operational holding					
		Landless	Marginal	Small	Semi-medium	Medium	Large
1	Cattle	536	1044	1702	1958	2663	4800
2	Buffalo	1050	474	873	1320	1747	2653
3	Bovine (cattle + buffalo)	1586	1518	2575	3278	4409	7453
4	sheep and goat	527	815	909	992	3627	2271
5	Pig	0	47	92	69	26	15
6	Poultry	2357	2166	3397	2979	1878	570

Source: NSSO 70<sup>th</sup> Round

While the households with larger operational holdings (e.g., medium or large) have higher number of bovine, sheep and goat, the households with smaller operational holdings (e.g., landless, marginal, small or semi-medium), have higher ownership of pig and poultry.

It is also observed from the primary survey that 98% of livestock farmers are engaged as self-employed or unpaid workers within their own households for livestock related activities.

<sup>189</sup> Agriculture Skill Council of India. 2012. LMIS Report on Dairy Sector. Retrieved from <https://asci-india.com/LMIS.php>

### iii. Gender Mainstreaming

Livestock rearing is an important source of livelihoods for rural communities and livestock is considered as a critical asset for the household. The upkeep of livestock is divided among the rural men and women based on their knowledge. Often the responsibilities in livestock rearing is assigned according to the customary gender roles. Women comprise about 43% of the agricultural labour force globally and in developing countries<sup>190</sup> and its even higher in livestock rearing activities. In rural livestock-based economies women represent two-thirds (approximately 400 million people)<sup>191</sup> of low-income livestock keepers, mostly carrying out activities around milking, processing of milk, and background poultry.

Women constitute about 69% of workforce engaged in livestock sector<sup>192</sup>, playing a dominant role in most of the livestock rearing activities. The tasks involve feeding, taking care of young and sick animals, milking, etc. It is estimated that in the dairying sector more than 70% of women are employed and over 90% care & management of livestock are carried out by women.<sup>193</sup>

Table 39: Participation of Women in Livestock Sector

Parameter	Data
Total Women Population	587.58 million
Total Rural Women Population	405.97 million
Total Women in Livestock, Forestry, Fishing, Hunting, Plantation, Orchards and activities	2.50 million (30% of all workers in Livestock, Forestry, Fishing, Hunting, Plantation, Orchards and activities)

Source: Census 2011

The participation of women in duties across production in livestock sector, processing of primary products for household consumption is represented through the NSS 68th round survey findings.

Table 40: Participation of women in livestock activities in India

Types of Work	Number of females (per 1000 females of age 5 years and above usually engaged in domestic duties in the usual principal status) who carried out specified activities	
	Rural	Urban
Work in HH poultry, dairy, etc.	215	24
Preservation of meat (own produce)	7	1
Preservation of meat etc. (acquired)	32	13
Preparing cowdung cakes	409	46
Engaged in any kind of work including poultry, dairy, kitchen garden, husking and grinding of grains, basket making, tailoring, etc.	765	427

Source: NSS 68th round survey of Participation of Women in Specific Activities along with Domestic Duties

With women handling a significant amount of activities in the livestock sector activities, there has been emphasis from the Department of Animal Husbandry, Dairying and Fisheries to promote women empowerment. The role of men and women is perceived to be complementary in the field of

<sup>190</sup> Pushpa. 2016. Gender Issues in Indian Agriculture: The Structural Changes in Agriculture Labour Force Participation

<sup>191</sup> [http://www.fao.org/ag/againfo/home/en/news\\_archive/2013\\_Empower\\_women\\_livestock\\_keepers\\_key\\_to\\_food\\_security.html](http://www.fao.org/ag/againfo/home/en/news_archive/2013_Empower_women_livestock_keepers_key_to_food_security.html); Retrieved on 12.11.2019

<sup>192</sup> S.J. Patel<sup>1\*</sup>. 2016. Role of women gender in livestock sector: A review. Journal of Livestock Science

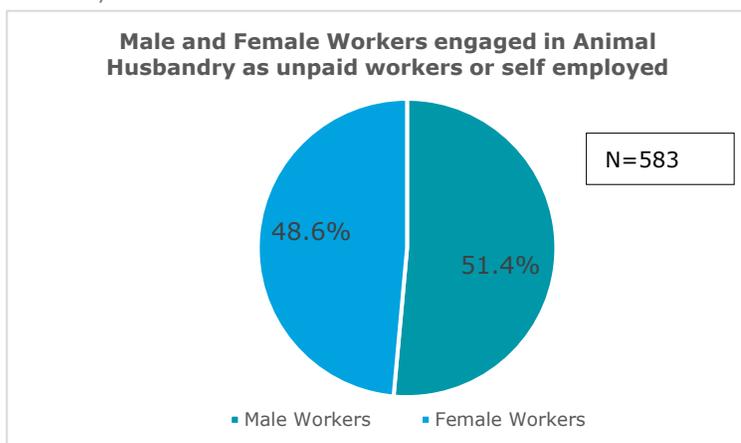
<sup>193</sup> Agriculture Skill Council of India. 2012. LMIS Report on Dairy Sector. Retrieved from <https://asci-india.com/LMIS.php>

animal husbandry. However, it is also understood that women have been at the fore front of dairy cooperative movement, which was initially carried under the Operation Flood Programme and later also under the Integrated Dairy Development Programme implemented by the Government.

In the poultry sector, especially in rural backyard poultry which is an income supplementing scheme mostly implemented by women, priority in training is being given to women. Women farmers are encouraged in rearing of small ruminants and the scheme for conservation of breeds, the conservation of sheep, goat and small ruminants has made the required provisions. The department has set up Gender Budget Cell in order to tackle gender imbalances, promote gender equality and development of women. However, the Department has not earmarked any specific funds for women component. It has only been advising States/ Implementing Agencies for utilizing around 30% of allocated funds towards women beneficiaries under the existing Centrally Sponsored/Central Sector schemes being implemented by the Department.

As observed in the HH survey, out of all animal livestock workers, 51.4% are women engaged in their own households in the animal husbandry activities as self-employed or unpaid workers. The analysis of male and female workers engaged in animal rearing activities as self-employed workers or unpaid workers working at their own households is given in the graph alongside.

Figure 1249: Share of Male and Female workers in Animal Husbandry Sector



***iv. Climate change & sustainability including adoption of climate-change resilient practices & diversification***

Climate change has impacts on productivity in the livestock sector like the agriculture sector. Production of dairy, meat and wool production is likely to be impacted negatively mainly due to lower availability of grass and grazing land leading to fodder scarcity. Heat Distress due to high temperature on animals can reduce the rate of animal feed intake and cause poor growth<sup>194</sup>. The productivity is adversely affected by water scarcity and extreme weather events such as droughts, dry spells, erratic rainfall, flood, etc. One of the studies on impact of climate change on livestock<sup>195</sup> has shown that annual rainfall is a highly significant determinant for productivity of milk, especially in buffaloes (buffaloes require comparatively more water than cows and hence termed water buffaloes). Climate change could further lead to increased emergence of livestock diseases and disease epidemics, as higher temperatures and changed rainfall patterns can alter the abundance, distribution and transmission of animal pathogens. With climatic variability having a negative influence on livestock productivity, it is critical to adopt rainwater conservation, harvesting, and recycling along with better

<sup>194</sup> Shalander Kumar. 2015. Sensitivity of Livestock Production to Climatic Variability under Indian Drylands and Future Perspective

<sup>195</sup> Shalander Kumar. 2015. Sensitivity of Livestock Production to Climatic Variability under Indian Drylands and Future Perspective

management of CPRs (common property resources) as an adaptation strategy. Some of the adaptation measures to climate variability has been discussed below:

**Effective Integration of Livestock with Agricultural Systems:** In order to address the impact of climate change, increasing livestock productivity and integrating it effectively into agricultural system is considered as an effective strategy. This would improve the soil health and water retention by returning the valuable biomass to the soil and would help in drought proofing. Such recycling of carbon into the soil would not only enhance the soil quality but also help in carbon sequestration. Use of livestock as draft power can reduce the need for fossil fuels. Methane generated from animal waste could provide cooking fuel for rural households through developing biogas energy solutions resulting into increased carbon sequestration.

**Germplasm Diversity:** Maintaining diversity in livestock breeds that perform well under adverse climatic conditions like high temperature, drought and feed scarcity can help address the phenomenon. Most of the indigenous breeds have high potential to adjust in adverse climate. Some of them have been mentioned below:

- Cattle: Kankrej, Tharparkar, Deoni, Ongole, Nagauri, Hallikar, etc
- Buffalo: Surti, Jaffrabadi; Goat: Sirohi, Osmanabadi, Jamunapari, Jhalawadi, Marwari; and
- Sheep: Patanwadi, Magra, Malpura, Mandya, etc.

Selection of the less vulnerable breeds of livestock can also help in combatting disease outbreaks caused by prolonged drought, exposure to novel pathogens etc.

### **Measures of Climate Change Mitigation**

Livestock sector is also responsible for contributing to the global warming by generating significant emissions of carbon dioxide (CO<sub>2</sub>), methane and nitrous oxide. As per FAO estimates, the global livestock sector annually emits about 8.1 gigatonnes of CO<sub>2</sub> equivalent (CO<sub>2</sub> eq.)<sup>196</sup>.

Emissions from livestock supply chains originate from four main processes: enteric fermentation, manure management, feed production and energy consumption<sup>197</sup>. According to the Global Livestock Environmental Assessment Model of FAO, Enteric fermentation<sup>198</sup> accounts for 44 percent of total sector's emissions, with about 3.5 gigatonnes CO<sub>2</sub>-eq. Feed production is the second largest source of emissions, with 3.3 gigatonnes CO<sub>2</sub>-eq or about 41 percent of total emissions. Manure management is responsible for almost 10 percent of the total, or 0.8 gigatonnes CO<sub>2</sub>-eq. Energy consumption, both on-farm and post-farm, account for 0.4 gigatonnes CO<sub>2</sub>-eq, or nearly 5 percent of the total.

The countries that contribute the most methane emissions related to livestock production are India, China, Brazil, and the United States. India, with the largest livestock population in the world, adds to the methane emission leading to global warming. Cattle and buffalo are the major sources of methane among India's livestock accounting for 98 per cent.<sup>199</sup> While agriculture in India is responsible for

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<sup>196</sup> <http://www.fao.org/gleam/results/en/>

<sup>197</sup> <http://www.fao.org/gleam/results/en/>

<sup>198</sup> Enteric fermentation accounts for the methane generated during the digestive process of ruminants

<sup>199</sup> <https://www.scidev.net/asia-pacific/livestock/news/methane-from-indian-livestock-adds-to-global-warming.html>

16% of total Greenhouse Gases (GHG) emissions in the country, 74% of this is due to methane produced from livestock – largely cows and buffalo – and rice cultivation<sup>200</sup>.

Estimated GHG emission based on livestock resources are as follows:

- Beef cattle contribute the most with 41% of the sector's emission
- Dairy cattle (20%)
- Swine (9%)
- Buffalo (8%)
- Poultry (8%)
- Small ruminant (6%).<sup>201</sup>

The adaptation and mitigation measures that can significantly impact in reducing the GHG emissions are discussed below:

**Modification in Production and Management Systems** in livestock rearing is done through diversification of livestock animals and crops, integration of livestock systems with forestry and crop production, and changing the timing and locations of farm operations. It can increase drought and heat wave tolerance and reduce diseases. Agroforestry can help in increasing productivity, and improve quality of air, soil, and water. Increase in afforestation can help in carbon sequestration.

**Changes in Breeding practices** reduces heat tolerance of livestock by adopting high resistant breeds of animal for breeding. Developing international gene banks to improve breeding programs implemented through international collaboration can help in achieving it.

**Capability Building of Farmers** can be done to enable them to recognize the problem and undertake climate change adaptation and mitigation measures.

**Manure Management** is a mitigation measure which can be practiced through shortening storage duration, improving timing and application of manure, use of anaerobic digesters, covering the storage, and changing the animal diets. Similar mitigation measures can be taken through fertilizer management adopting practices like opting organic, fertilizers and conducting regular soil testing.

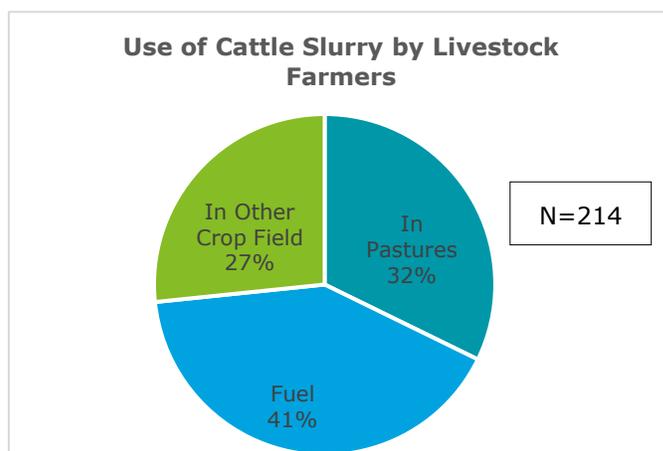
Currently the cattle slurry is being used as manure for fields or being processed for fuel use in households in India. As per the findings of the HH survey, around 34% of livestock farmers use cattle slurry in pasture fields while 36% of livestock farmers use the resource for fuel use in household.

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<sup>200</sup> Retrieved from <https://www.carbonbrief.org/the-carbon-brief-profile-india> on 13th November 2019

<sup>201</sup> M. Melissa Rojas-Downing. 2017. Climate change and livestock: Impacts, adaptation, and mitigation. <https://doi.org/10.1016/j.crm.2017.02.001>

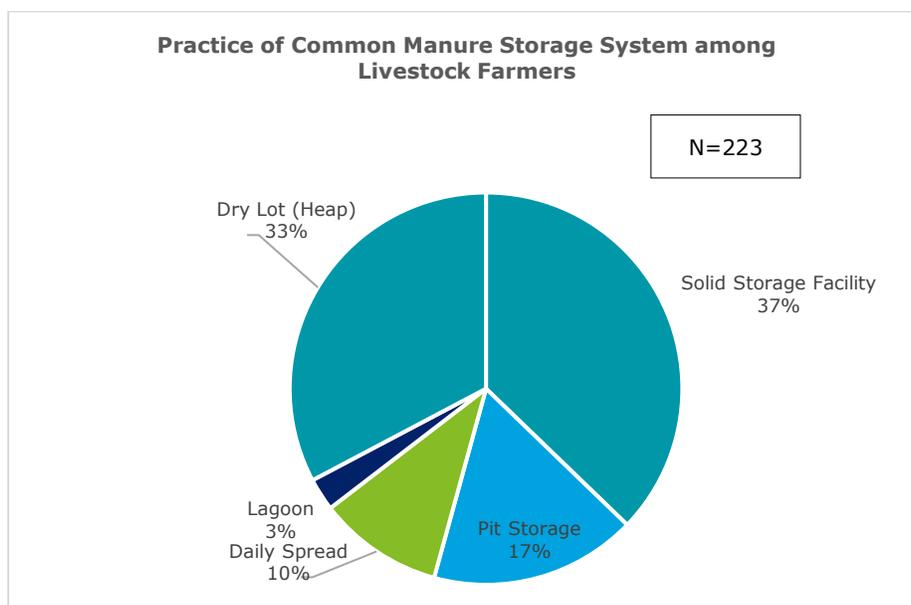
Figure 125: Use of Cattle Slurry by Livestock Farmers



Source: HH Survey, Deloitte Analysis

In the HH survey, the manure storage practices being taken up by livestock farmers has been analyzed. Livestock farmers are found to be mostly using dry lot, followed by solid storage facilities and pit storage for manure management. The trend of practices of manure management among livestock farmers as observed in the primary survey is shown in the chart alongside. Around 37% livestock farmers use solid storage facility which is a good practice. Around 17% livestock farmers opt for pit storage and 10% practice daily spread.

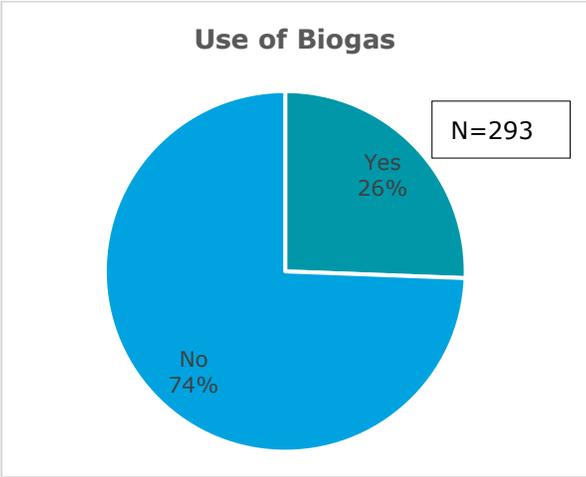
Figure 126: Practice of Manure Storage among Livestock Farmers



Source: HH Survey, Deloitte Analysis

It is also found that around 26% of livestock farmers produce biogas in their farm using farm waste including cattle slurry<sup>202</sup>. The graph showing the share of livestock farmers producing biogas in their farms has been given below.

Figure 127: Use of Biogas by Livestock Farmers

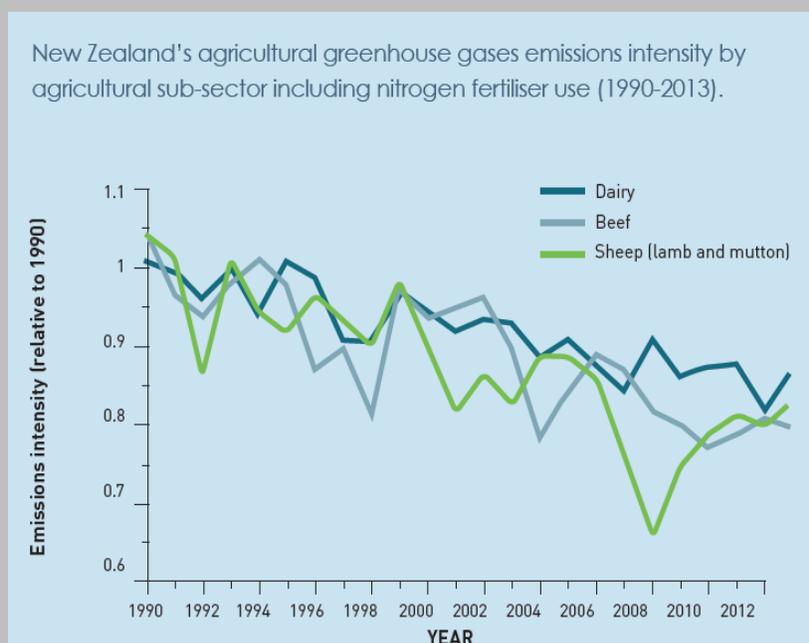


Source: HH Survey, Deloitte Analysis

<sup>202</sup> It may be noted that household surveys are currently ongoing and the analysis will be updated on completion of survey.

### Case Study on Climate change & sustainability including adoption of climate-change resilient practices & diversifications

**Introduction:** The impact of livestock rearing on global warming has been found to be significantly high. One of the key factors causing is the methane emission from the enteric fermentation of ruminant livestock, which is a main source of greenhouse gas (GHG) emission. Methane emission is also associated with dietary energy loss; hence, reduce feed efficiency. To address the issue of methane emission from ruminants, changing fermentation pattern through dietary alteration has been proved one of the most effective ways of methane abatement. Desirable dietary changes provide two fold benefits i.e. improve production and reduce GHG emissions. Overall dietary manipulation by selecting more starch and less fibre in the animal feed is found to be producing less methane per kg feed DM but also form a basis for higher feed intake and higher production per animal. In New Zealand, on-farm emissions intensity of livestock production across the New Zealand dairy, sheep and beef sectors has reduced by approximately 1% per annum between 1990 and 2013 .



**Solution:** In New Zealand, on-farm emissions intensity of livestock production across the New Zealand dairy, sheep and beef sectors has reduced by approximately 1% per annum between 1990 and 2013<sup>1</sup>. New Zealand has a high dependence on its agricultural activities and the emissions from agriculture sector has one of the highest contribution to New Zealand's greenhouse gas emissions (48% in 2012). Measures were taken up to impact the efficiency of animal rearing including supplementary feeding practices which increase resilience against climate variability, in particular droughts, irrigation measures and reduced use of chemical fertilizers for grazing land. The effects of actions on emissions intensity of livestock production resulted in increasing per animal production and increased efficiency of fertiliser use per animal. The steady reduction of greenhouse gas emissions per unit of product by about 1% per year (across the dairy, sheep and beef sectors) for at least the last 20 years is thus attributed to the feed consumed by animals is used for production than for animal maintenance as well as the fertiliser use per cow. This was ensured through close interaction between farmers, government and research programmes focusing on productivity and on GHG emissions monitoring and mitigation. The solutions, which led to the successful reduction in emission, thus focused on feed and nutrition, genetics and breeding, rumen modification, manure and fertiliser management, animal health and increasing the carbon content of soils.

**Learnings for India:** India owns around 11.8% of the total cattle and hence poses serious threat in terms of GHG emissions. The strategy of addressing the existing issue of cattle feed and fodder shortage in the country needs to include the learnings from the New Zealand model. Currently, the feed and fodder for ruminants is already facing a severe shortage issue which is predicted to increase in the upcoming years. With green fodder facing the most severe shortage, focus can be drawn on preparation and use of starch rich concentration feed. The innovative hydroponic technology being piloted to produce fodder can also ensure controlled use of nitrogen based fertilizers content reducing the GHG emissions from the enteric fermentation of ruminant livestock.

Source: Global Research Alliance. 2017. Reducing The Emissions Intensity Of Livestock Production. Retrieved from [https://globalresearchalliance.org/wp-content/uploads/2017/04/New-Zealand-Sheep-Beef-Dairy\\_LRG-case-study.pdf](https://globalresearchalliance.org/wp-content/uploads/2017/04/New-Zealand-Sheep-Beef-Dairy_LRG-case-study.pdf)

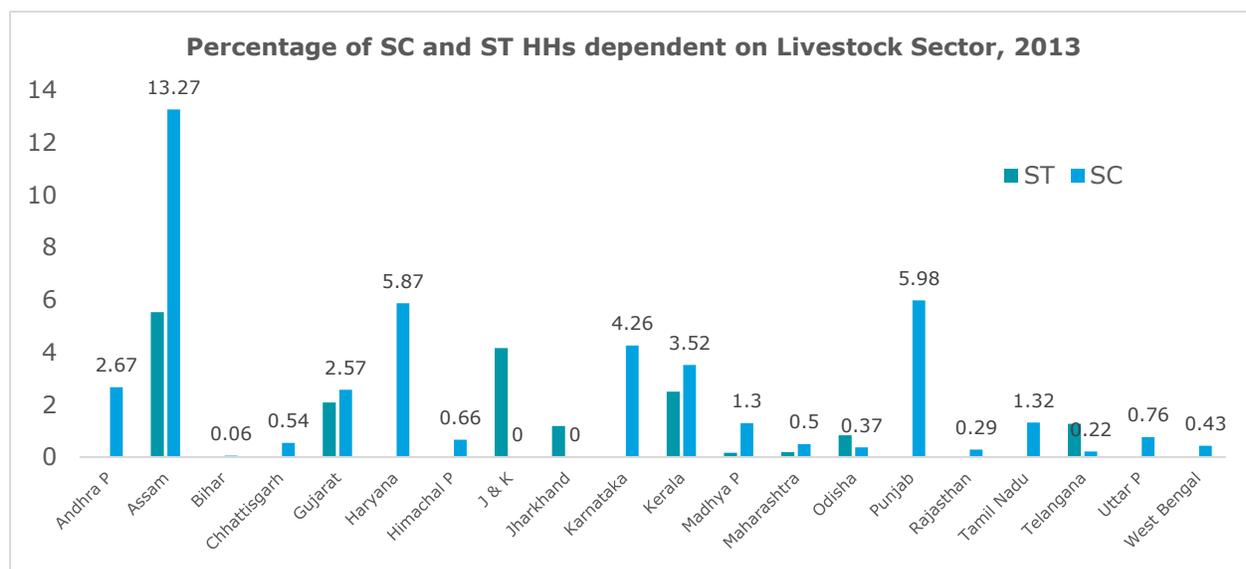
**v. *Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan Component of the Scheme in Mainstreaming of Tribal and Scheduled Caste Population***

The Schedules Tribes, and Scheduled Castes constitute around 8.2% and 16.2% respectively. They cover a significantly large proportion of the population and is considered as one of the most economically deprived section of the society. The farmers belonging to these social groups have low availability of land and do not have much income generating options. Across the country, percentage of ST and SC households dependent on livestock are 0.75% and 1.5% respectively<sup>203</sup>. The state wise percentages of ST and SC households dependent on livestock sector have been shown in the graph below:

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<sup>203</sup> Livestock Ownership in India, NSS 70th Round

Figure 128: State-wise percentage of HHs dependent on Livestock Sector



Source: Livestock Ownership in India, NSS 70<sup>th</sup> Round

As depicted in the graph above, 5.54 percent of the total ST households and 13.27 percent of total SC households in Assam reported their livelihood dependence on animal rearing, which is the highest among the major states, for both the social groups.

The Department of Animal Husbandry and Fisheries has earmarked 8.2% of the funds under Tribal Sub Plan and 16.2% of the funds under Scheduled Caste Sub Plan as per the guidelines issued by the Planning Commission vide D.O. letter No.N- 11016/12(1)/ 2009-PC dated 15.12.2010. The budget allocation includes animal husbandry, dairying & fisheries schemes.

The year-wise allocation and expenditure under Tribal Sub Plan and Scheduled Caste Sub Plan has been given below:

Table 41: Budget Allocation and Expenditure under TSP and SCSP

Year	SCSP		TSP	
	Allocation	Expenditure	Allocation	Expenditure
2016-17	205.12	152.59		
2017-18	329.3	309.88		
2018-19	503.09	485.7	261.6	250.98

Source: Annual Report 2018-19, DAHD

The Department had been exempted for earmarking of funds under Tribal Sub Plan (TSP) up to 2017-18.

However, there has been several constraints in the livestock farming in the tribal areas in India<sup>204</sup>. The tribal population has insufficient pastureland for cattle rearing which led to insufficient green

<sup>204</sup> N. Meganathan. 2010. Constraint Analysis Of Tribal Livestock Farming In Tamil Nadu; ICAR-National Institute of Abiotic Stress Management. 2017. A step towards Improving Livelihood of Tribal Farmers Through Integrated Farming

fodder for animals. The milk productivity is also affected as they usually own non-descript poor quality animals. The ST population is usually dispersed in isolated locations. They have limited access to marketing infrastructure facilities and hence the households have little incentive to produce more milk than needed for their family consumption. Lack of knowledge about scientific animal rearing practices and backyard poultry rearing, particularly about feeding and economic management among the tribal farmers has been found to be a critical constraint. Access to credit is also a major problem faced by these communities.

As it is observed in the HH survey, participation of the livestock farmers belonging to the all disadvantaged groups including Scheduled Castes and Other Backward Castes in dairy cooperatives is similar to that of the overall participation of livestock farmers in dairy cooperatives. While 72% of all respondents among livestock farmers have been found to be part of dairy cooperatives, 73% of all livestock farmers from disadvantaged groups have participated in dairy cooperatives.

Adoption of innovative practices for breed improvement like Artificial Insemination (AI) is lower among Livestock Farmers from disadvantaged groups (including Scheduled Castes and Other Backward Castes) compared to the overall AI adoption. Among all respondents comprising of livestock farmers, 79% have adopted AI for breed improvement whereas the rate of adoption dropped to 68% among livestock farmers belonging to disadvantaged social groups which includes Scheduled Castes and Other Backward Classes.

Figure 129: Participation of Backward Caste Livestock Farmers in Dairy Cooperatives

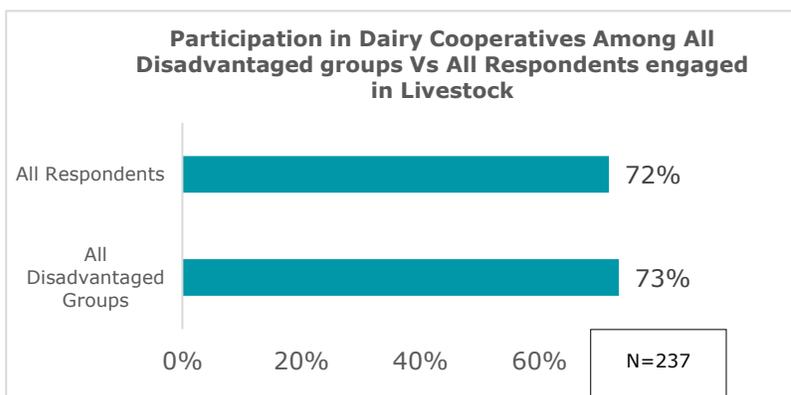
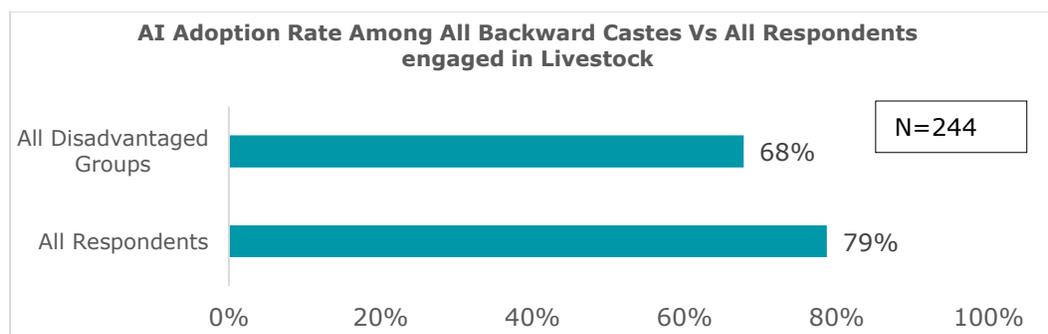


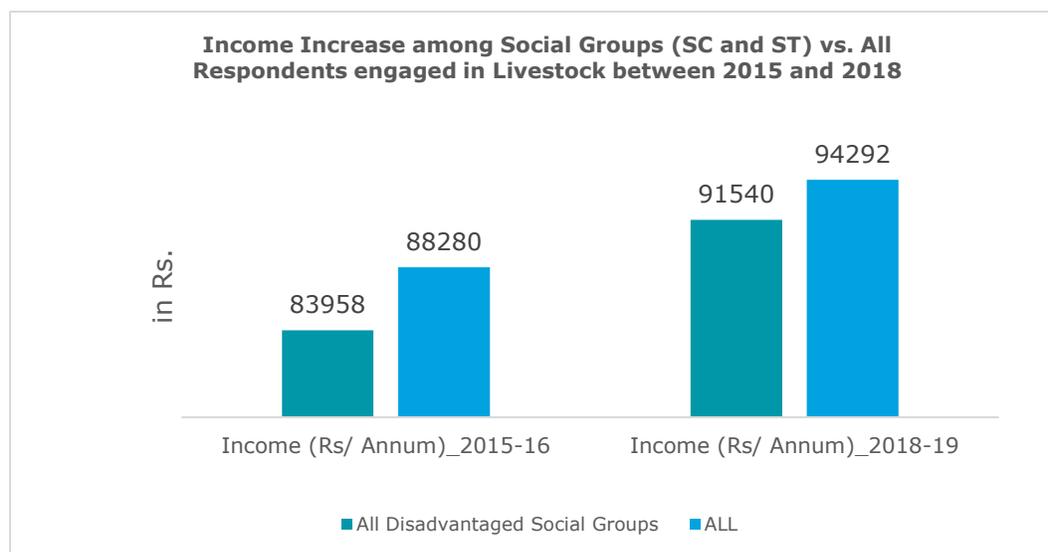
Figure 130: AI Adoption among All Backward Castes and All Respondents



Source: HH Survey, Deloitte Analysis

It has been observed in the HH survey that the income level of all disadvantaged social groups including Scheduled Castes, Scheduled Tribes and Other Backward Classes have increased by 9.0% during the period of 2015-16 and 2018-19, while the overall income of all groups have increased by 6.8%.

Figure 131: Change in Income among All disadvantaged social groups



Source: HH Survey, Deloitte Analysis

#### vi. Use of IT/Technology in driving efficiency

Technology is disrupting all industries in the modern age and has made break-through ideas come into shape impacting the global social and economic growth. Productivity in the livestock sector can be enhanced through introduction of various technological interventions. Some of the key technological interventions have been discussed below.

**Animal Breed Improvement** is being done in order to enhance milk production, feed conversion efficiency, growth, reproduction, disease resistance. Artificial Insemination is one the most used technology implemented for genetic progress in the bovine population. There are around 113264 AI centers<sup>205</sup> along with 60 semen production centres and 179 frozen semen banks in the country which cater to 1,332.71 lakh breedable female bovines. By adopting AI technology in breeding of animals not only the milk productivity has been enhanced, genital and non-genital diseases in the farm stock has also been reduced considerably. However, in order to implement AI for all breedable bovines, the existing infrastructure has to be increased by at least 25%.

The genetic improvement can be further enhanced by promoting advanced technological interventions like, **Genome Selection, Embryo Transfer (ET)/IVF**, etc. Embryo Transfer (ET)/In-Vitro-Fertilization (IVF) is used to increase the reproduction rate of cows and buffaloes. The National Dairy Development Board (NDDB) started using ET as a tool in 1986 and established for the first time in the country an embryo transfer technology at Sabarmati Ashram Gaushala, Bidaj, Gujarat. Similarly, genomic selection technology needs to be implemented to gain higher reliability of pedigree bull selection.

<sup>205</sup> Annual Report 2018-19, DAHD

## Hydroponic Fodder

**Production:** Hydroponic technology in fodder development ensures 98% reduction in water usage and is also more nutritious than conventionally grown green fodder. It is a suitable technology for low water areas and scarce land. In comparison to conventional green fodders, hydroponics based green fodders contained more crude protein (13.6 per cent vs 10.7 per cent) and less crude fibre (14.1 per cent vs 25.9 per cent)<sup>206</sup>. Hydroponic technology thus can result in reduced cost of farm input in livestock sector, fodder being one of the cost intensive

inputs in livestock rearing. However, this technology requires continuous power supply to ensure optimum fodder production.

**Dairy Herd Management through Radio Frequency Identification (RFID) Technology** tagging of animals is practiced for identification and tracking. The process is useful in verification of ownership, biosecurity control, record keeping, efficient farm management, registration, insurance and presentation of theft of animals. Electronic animal identification technologies are a growing trend in the livestock industry. The use of RFID for automation also helps in minimizing labour input, thus allowing each farmer to cater for more cows, or enabling farmers to have more time to spend on other activities – either way, maximizing results from their input. In India RFID tagging has started in cattle insurance through NABFIN<sup>207</sup>.

RFID is used as Ear tagging in livestock for animal identification by NDDDB has developed an Information Network for Animal Productivity & Health (INAPH). 24,769,902 animal have been registered<sup>208</sup>

till November 2019. The animal identification is used for delivery of services to farmer, animal health

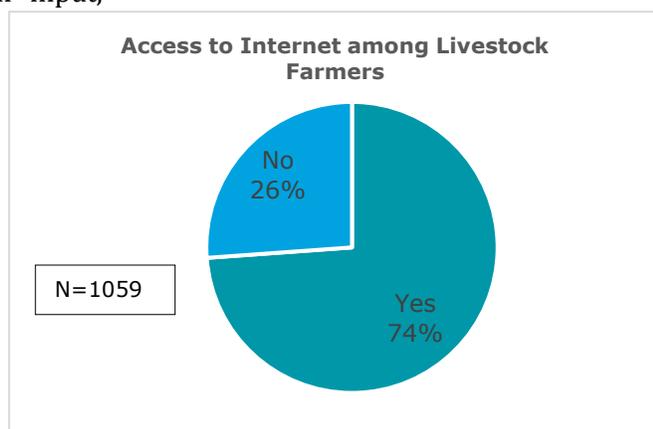
Box 11: Hydroponics Technology introduction for Fodder Development in Tamil Nadu

### Case Study on Hydroponics Technology introduction for Fodder Development in Tamil Nadu

Hydroponic technology for development of fodder for livestock has been adopted in Tamil Nadu under National Agriculture Development Programme after conducting an intervention in a model unit in 2014-15. Hydroponic fodder production requires less water, less land, has very short growth period and results in highly nutritious feed for animals. It can be done across the year and is extremely effective in augmenting livestock productivity. The intervention concluded with recommendations of using hydroponic maize fodder replacing conventional green fodder for cattle without affecting its milk yield and using hydroponic horse gram and sun hemp fodder for calves. Through the use of this technology, the challenge of fodder scarcity in the country can be better addressed. The low cost hydroponic machine produces hydroponic green forage which ensures the nutrient requirement of livestock.

Source: State of Indian Agriculture, 2017

Figure 132: Access to Internet among Livestock Owner Households



<sup>206</sup> Doubling Farmers' Income Report- Volume VIII, Animal Husbandry, Dairying & Fisheries

<sup>207</sup> <http://nabfins.org/cattle-insurance-through-paperless-and-digital-process-using-rfid-technology/>

<sup>208</sup> The number of animal registration at INAPH portal in NDDDB is noted as of 13.11.2019

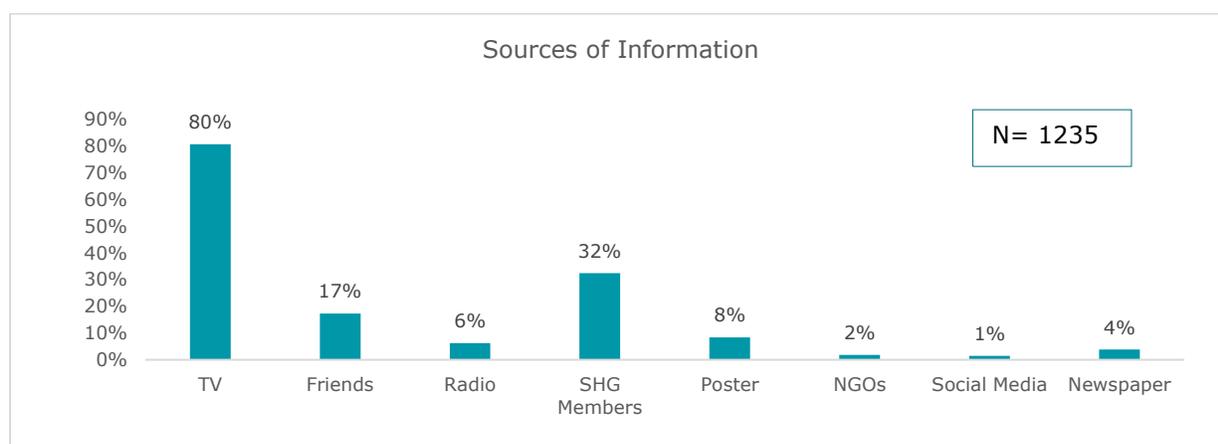
surveillance, implementation of different social welfare schemes, traceability of imported germplasm, and trading of livestock.

It has been seen in the HH Survey that 74% of livestock owner households have access to internet either through mobile phones or through broadband. Other recent studies on internet access<sup>209</sup> in India shows the rural internet penetration is around 26% as of 2017 and is expected to witness double digit growth for next few years. The internet penetration is estimated at individual level while our survey estimate is made at household level and hence shows a higher access to internet.

However in spite of having good internet penetration, use of internet for seeking information is still not one of the popular means among livestock farmers.

As observed from the HH survey, the analysis of the sources of information accessed by livestock owners shows television is the most popular source followed by information available from SHG members and peer groups. These sources have been accessed to gather information and generate awareness on various government schemes such as Swachh Bharat, PM-KISAN, Jan Dhan Yojna etc.

Figure 133: Sources of Information as accessed by Livestock Farmers



Source: HH Survey, Deloitte Analysis

The top sources i.e. television, information dissemination through SHG Members and peer groups may be used further to generate awareness among the target groups.

<sup>209</sup> [https://imrbint.com/images/common/ICUBE%E2%84%A2\\_2019\\_Highlights.pdf](https://imrbint.com/images/common/ICUBE%E2%84%A2_2019_Highlights.pdf) accessed as of 01<sup>th</sup> January 2020

### **Case Study: Increasing nutritional content of milk using technology**

#### **Introduction/Challenge:**

Some of the most important constituents of milk include fat, protein, SNF, lactose and ash. It has been noted in various studies that cattle are not raised in ideal conditions in the country. In a typical cow shed, cows are tied in congested areas, fed factory-made artificial fodder, and injected with steroids and artificial hormones. While these lead to an increase in milk supply, it decreases its nutritional value. Further, most of the branded milk available in the market is pasteurised since not all farmers can afford in-house chilling units. However, the pasteurisation process destroys many vital elements such as vitamin A, B6 and B12, calcium and iodine.

#### **Solution:**

Acknowledging this, Dr. GNS Reddy, a veterinary expert, founded Akshayakalpa Farms and Foods in 2010 in Karnataka's Tiptur district, with the aim of offering nutrient-rich milk to consumers.

An Akshayakalpa farm comprises of 20 – 25 cows, an advanced cowshed, an automated milking system, fodder chopper and chilling unit, bio-gas plant and generator. The entire farm is completely automated. Apart from this, the focus is on the cows' health. All cows are stress-free and have the freedom to graze whenever they like. Their sheds are cleaned regularly – limiting the risk of diseases and each cow is monitored electronically for its health and overall milk production regularly. The cows are fed a mix of organic fodder; monocots (maize, ragi and local jowar) and dicots (cow pea and velvet beans) along with tree fodder (moringa), all of which are grown organically by the farmers themselves. Further, all processes, from milking the cow to chilling it, are done through machines without the touch of a human hand, eliminating the need for pasteurisation completely. As a move towards sustainability, cow dung and urine are diverted to the biogas plant, which effectively produces enough methane gas that can operate the farm for eight hours every day, largely reducing the dependency on the state's power grid, which is often a challenge in the rural areas.

As of April 2018, there were 160 farmers registered with Akshayakalpa.

#### **Impact:**

- The model has brought entrepreneurial culture to agriculture – Akshayakalpa handholds farmers on sourcing equipment, accessing vaccinations, and cultivating/buying fodder.
- The farmers typically earn between Rs 40,000 – Rs 1,00,000 monthly, depending on the scale of their farms.
- The cows are healthier and stress-free, resulting in better milk production.
- Milking machines ensure hygiene and enable better nutritional content of milk by eliminating pasteurisation.

Source:

1. Akshayakalpa Farms – how IT professionals are turning into farm-based entrepreneurs in Karnataka's Tiptur, YourStory, 16 February 2016, accessed on 29 December 2019;

2. Why The Akshayakalpa Agri-Experiment in Karnataka may well grow into a movement, Swarajya Mag, 28 November 2016, accessed on 29 December 2019

### **vii. Reforms and Regulations**

The regulatory framework of a nation is designed to take into account responses of all spheres of activity with respect to the changes in the economic, social and technical conditions surrounding them. Regulatory reforms are brought in the form of policy by the government to oversee market activity and ensure socio-economic efficiencies, arrest redundancies in the system and particularly

aid and medium-sized enterprises for equity. Regulatory reforms are usually implemented through increased level of government surveillance, deregulation, privatization or opening a market to increased competition. The reforms and regulations are intended to yield benefits in terms of reducing costs, enhancing efficiency and stimulating innovation. Some of the recent reforms in the agriculture and allied domain that has impacted the growth in the livestock sector in India has been discussed below:

**Upcoming regulations impacting livestock marketing:** The agricultural marketing is regulated with well-defined mechanisms for marketing infrastructure, rules and regulations. Agricultural marketing which also includes trade of dairy, meat, eggs as well livestock strives to ensure an efficient system to enable primary producers (farmers) reap maximum benefit, provide facilities for lifting all the produce the farmers are willing to sell, reduce the price spread between the primary producer and ultimate consumer, and make all products available at reasonable price to consumers. It should also contribute to the doubling the farmers' income by 2022-23. However, livestock market is not regulated across the country. Only a few states have brought marketing of livestock under Agriculture Produce Market Committee (APMC) Act to allow trade in regulated wholesale mandis. To address this concern a model law Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act (APLM), 2017 has been drafted. The law provides wider options of selling produce to fetch better price includes market infrastructure for livestock trade. Under this act, states can create provisions for marketing infrastructure of livestock trade, facilitate alternate marketing channels including opening up the system to private sector as well for alternate online marketing platform.

**Dairy Trade Reforms:** Under the Regional Comprehensive Economic Partnership (RCEP), a free trade agreement would be made between 10 ASEAN member states and 6 FTA partners (Australia, China, India, Japan, New Zealand and South Korea), including massive manufacturers like China which would slash import duties in all trade between the countries. This pact could impact the dairy industry by reducing the cost of milk and milk products. India is the largest producer of milk in the world and has the largest network of small dairy farmers collectivized through cooperatives. RCEP could potentially benefit the transnational dairy corporations from some of the largest exporters of dairy products by accessing India's markets. However it would bring cheap imported dairy products in India and affect the interests of the local dairy farmers. Given the trade imbalance the RCEP pact could cause in the economy, the Government of India did not join the RCEP in the 3<sup>rd</sup> RCEP Summit in Bangkok<sup>210</sup>. The decision is believed to protect the interest of 150 million dairy farmers who covers nearly one-quarter of Indian agricultural households. This move would also protect India's growing dairy industry, which is the most remunerative farm product in India.

**Ban on Battery Cages in Poultry Subsector:** A recent draft rule under the Prohibitions of Cruelty to Animals (Egg Laying Hens) Rules, 2019, has laid down prohibitions of keeping hens in cramped 'battery cages', use of growth promoters, and restricts the use of antibiotics for treatment purpose only. The rules specify the mandatory requirement of minimum 550 sq cm of floor space per bird to ensure reasonable space for the poultry. This regulation is expected to promote cage-free rearing, improve stocking density, feed, and hygiene.

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<sup>210</sup> <https://www.indiatoday.in/india/story/india-pm-modi-decide-to-not-join-rcep-agreement-1615655-2019-11-04>

viii. ***Development, Dissemination & Adoption of Innovative Practices, Technology & Know-how***

Some of the innovative practices which can enhance the productivity of livestock commodities as well make this sector remunerative for farmers in India has been discussed below:

Practice of using **Sexed Semen** in Artificial Insemination of bovines have been an effective technique to produce more female calves. This breakthrough technology ensures sorting of semen to produce more progenies of a desired sex (with about 80-90% accuracy). The sexed semen technology has several advantages like production of more female calves and more milk, lowered risk of dystocia, increased efficiency of progeny testing (PT), embryo transfer and in-vitro fertilization program. Sexed semen with proper management practices on dairy farms will help to grow herd internally with improved traits of female calves. However, high cost (Rs 1,200 to Rs 1,500<sup>211</sup>) and reduced conception rate with sexed semen are the major hurdles in adoption of this technology<sup>212</sup>.

Use of sexed semen in India is being done mainly through imported semen for specific breeds namely HF and Jersey breeds and requires approval from the State Animal Husbandry department for keeping complete records of progeny born out of imported semen.<sup>213</sup> However, very recently sexed semen production has started in the country in a laboratory of the Uttarakhand Livestock Development Board at Rishikesh under Rashtriya Gokul Mission of the Government of India<sup>214</sup> has been taken up production of sex sorted semen of various Indigenous Breeds. Production of sexed semen in the country is expected to cost Rs 350 and increase birth of female calf by 50%. This can potentially boost the industry to increase in milk supply and achieve the target of doubling the income of farmers. Another project for establishing sex sorted semen facility at Pune, Maharashtra has been approved.<sup>215</sup>

**Embryo Transfer Technology** in animal husbandry is a powerful mechanism to improve genetic construction of their animal herds and increase pedigree breeds. In this technology embryo from collected from a donor female and are transferred to recipient females. The embryo transfer technique can also be used for detecting recessive traits, the production of twins in beef cows, salvage of genetic material from terminally ill cows or infected herds. The technology of embryo transfer has been benefited from the establishment of newer, more efficient procedures for the superovulation of donors, embryo retrieval and transfer through low-invasive methods.<sup>216</sup> In India, the embryo transfer technology is implemented by National Dairy Development Board (NDDB), under which ET laboratories were setup in Ahmedabad, Salon (UP), Nasik (Maharashtra), Nekarikallu (Andhra Pradesh) and in Central Frozen Semen Production Station and Training Institute, Hesserghatta (Karnataka). Under the Rashtriya Gokul Mission scheme, further strengthening of Embryo Transfer Technology (ETT) is being done used to create Nucleus Herd. Under the scheme it is envisaged to strengthen/establish 20 ETT/ IVF laboratories. It is envisaged that these ETT/IVF laboratories will

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<sup>211</sup> <https://www.nddb.coop/farmer/animal-breeding/faq>

<sup>212</sup> Talokar Amol J. 2017. Sexed Semen: A Boon for Indian Dairy Farming. Research and Reviews: Journal of Dairy Science and Technology

<sup>213</sup> <https://www.nddb.coop/farmer/animal-breeding/faq>

<sup>214</sup> <https://www.dailypioneer.com/2019/state-editions/sexed-semen-production-lab-to-be-a-game-changer.html>

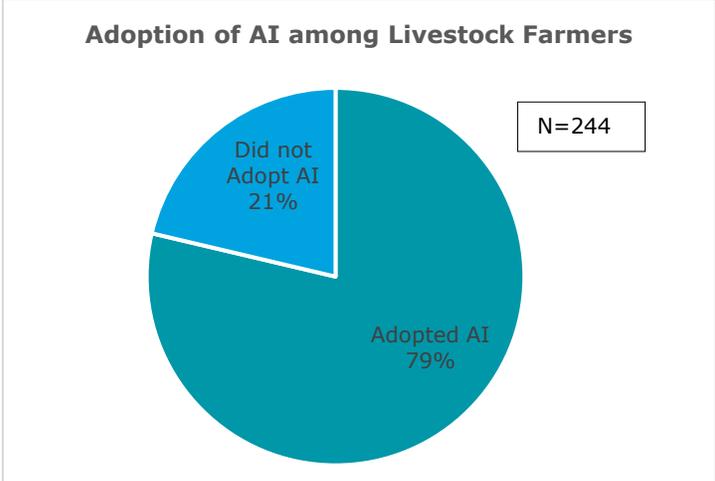
<sup>215</sup> Rashtriya Gokul Mission Guidelines, <http://dadf.gov.in/sites/default/files/RGM-1.pdf>

<sup>216</sup> Dhavalkumar Patel. 2017. Implication of Embryo Transfer Technology in Livestock Productivity. International Journal of Current Microbiology and Applied Sciences

produce 3000 High Genetic Merit Indigenous Breed Bulls which will be supplied for Semen Production or Natural Service.

The analysis of the HH Survey has thrown light on the adoption of artificial insemination among all livestock farmers. The graph below shows the adoption rate of AI among livestock farmers which is 79% recorded among all respondents.

Figure 134: Use of AI among Livestock Farmers



Source: HH Survey, Deloitte Analysis

### **Case Study: Producing sexed sperm for increasing milk production through RKVY funds**

#### **Introduction/Challenge:**

The case study pertains to interventions in West Bengal using RKVY funds in 2008-09. West Bengal has traditionally been a low milk producing state (producing 4.4MT in 2010-11, compared to 13.2MT in Rajasthan, 11.2MT in Andhra Pradesh, and 6.5MT in Bihar in the same year). The state wished to increase its milk producing capacity to become self-sufficient, and improve dairy processing potential in the state.

The actual requirement of milk was about 5.7MT, which called for an increase in per cattle milk production. This required targeted quantitative, qualitative and genetic improvement of cattle population along with strengthening of infrastructure for collection and processing of milk from the rural producers and marketing to the urban consumers by cooperatives, private sectors as well as government.

#### **Solution:**

In 2002, the Paschim Banga Go-Sampad Bikash Sanstha (PBGBS) set out to increase production of milk. The primary approach was to increase Artificial Insemination (AI) coverage in rural areas. PBGBS hence undertook production of sexed sperm by introducing 'BD Influx High Speed Cell Sorter' in the Frozen Semen Laboratory, at the Haringhata Farm. The project was taken up under RKVY with a total outlay of Rs. 2.90 crores, during 2007-08 and 2008-09 and completed in November, 2009.

The process involved pre-determination of sex by sorting 'X' and 'Y' chromosome bearing live sperm cells using the DNA content of sperm as the discriminatory parameter. This helped in production of large number of female calves, which ultimately boosted milk production. The production reached 4.47MT in 2010-11, and stood at 5.38MT in 2017-18.

#### **Impact:**

- RKVY funding was critical in the intervention as no other scheme was functioning in the sector to enable such an investment.
- The Haringhata Farms became the breeding grounds for the birth of India's first pre-determined male calf in January 2011.
- Sorted sexed semen is marketed in many countries like US, New Zealand, Denmark, and Australia at very high prices. By replicating this technology, the animal husbandry department was able to exploit the benefits of this technology at an affordable and subsidised cost.

Source: Department of Agriculture and Cooperation, Ministry of Agriculture, Incentivising Agriculture: RKVY initiatives, April 2012; Agrotechnology, an open access journal, Sexed Semen Technique: A Revolution in Indian Dairy Industry, ISSN: 2168-9881, Volume 6, Issue 3, October 2017

### **Case Study: Funding dairy research through innovation fund**

**Introduction:** The dairy industry is one of the largest food industries in Canada and is an important contributor to the country's economy. In 2017, the industry fetched \$6.56 billion in total net farm cash receipts and produced 89.8 million hectolitre milk. As of August 2018, there were 10,593 dairy farms in country. The industry is also vital for many Western and Atlantic rural communities. Given the importance of the sector in the country, it wishes to stay updated in terms of latest technology and innovative practices.

The government funds its research in the sector through Canada Foundation for Innovation (CFI). The CFI makes financial contributions to Canada's universities, colleges, research hospitals and non-profit research organizations to increase their capability to carry out high-quality research. CFI contributes up to 40% of a project's research infrastructure costs. Matching funds are often provided by provincial governments in combination with the host institution or private partners. Between 1998 and 2015, CFI invested in cutting-edge labs, facilities and equipment for 18 dairy research projects at seven universities, totalling \$11.3 million. The investment is spread across a wide spectrum, such as, acquisition of state-of-the-art research equipment, funding for creation of Institute of Nutrition and Functional Foods (INAF), and funding of research on the effect of nutrients on the metabolism of ruminants.

#### **Impact:**

- CFI investments in dairy infrastructure have resulted in social benefits through improved animal welfare practices and food health and safety, economic benefits through improved efficiency in milk and cheese processing as well as new feed research, and environmental benefits through the development of sustainable practices.
- The variety in focus of these dairy projects has resulted in the acquisition of diverse types of infrastructure. The breadth of infrastructure shall advance specific areas of dairy farming research.
- A noteworthy aspect of the research projects is the interconnected networks between dairy researchers and the dairy sector. In some cases, through collaborations, industry partners have adopted and implemented innovative solutions developed with the CFI-funded infrastructure.
- The strong alignment of research projects with industry needs creates an ideal training environment and contributes to the knowledge and skill development of the next generation of researchers.
- The availability of CFI infrastructure has enabled Canadian researchers working in dairy to secure additional funding to advance their research.

#### **Relevance/Learnings for India:**

A unique and important aspect of CFI is that it enables investment from private players, and the governments. This ensures that the government does not bear 100% of the cost of research funds. It also ensures that the research is relevant to industry requirement. Creation of a dedicated research fund, with collaboration from multiple parties can support research in Indian animal husbandry and dairy sector.

Source: 1 Dairy Reporter, Largest US research dairy set for Idaho, Dairy Reporter.co, retrieved from <https://www.dairyreporter.com/Article/2019/09/02/Largest-US-research-dairy-set-for-Idaho>, accessed on 29 December 2019;

2 The Spokesman Review, University of Idaho plans for largest research dairy in the US, , 14 March 2019, retrieved from <https://www.spokesman.com/stories/2019/mar/14/universitv-of-idaho-plans-for-largest->

### ***ix. Stakeholder and Beneficiary Behavioral Change***

Animal husbandry requires healthy rearing of animals with proper care given for prevention of diseases, development of superior germplasm leading to higher productivity of animals (in terms of milk and meat). It is also important to assess the impact of increasing inputs for productivity enhancement on environment and take sustainable measures.

In the dairy sector, increase in profitability along with ensuring it as a sustainable venture can be promoted among the dairy farmers by adopting healthy practices at optimum costs. It is critical to impart knowledge to animal rearers on the basic tenets of animal health, breeding and feeding. Several ongoing schemes like National Dairy Plan-I, Rashtriya Gokul Mission, Livestock Health and Disease Control, Assistance to Animal Health Institutes focus on the aspects of increasing productivity while ensuring prevention of diseases. Several of these schemes focus on increasing artificial insemination using disease free semen from high genetic merit bulls and at the same time optimizing the utilization of feed resources in order to reduce the cost of milk production through balancing the ration of animals. Most of the schemes cover aspects of training and sensitizing farmers on the best practices of animal husbandry. In order to provide information on breeding healthcare, management, nutrition, fodder production etc. based on existing and new technologies; National Dairy Development Board has published the Handbook of Good Dairy Husbandry Practices for farmers<sup>217</sup>. The comprehensive manual consists of information and recommendations on bovine health and breeding, bovine nutrition and animal information network for better productivity.

### ***x. Research and Development***

Research priorities in the livestock sector focuses on the enhancement of livestock productivity, which leads to a more efficient utilization of available resources and translates into economic development both at the household and national levels. The strategies undertaken to bring improvement in production should also result in a more efficient and sustainable use of natural resources. The selected strategies should include increasing feed and residue yields from crops grown on farmlands, arrest losses from disease and improving the genetic potential for milk and meat yields of animals. These improvements also should have positive consequences for long-term sustainability - both environmental and economic. The research areas in this sector prioritizes on the following areas: feed supply, animal health, genetic improvement, livestock management, livestock farming systems, natural resources and policy.

Some of the key research institutes in livestock management in India are National Dairy Institute, Indian Veterinary Research Institute, National Institute of Animal Nutrition and Physiology, Bengaluru, ICAR-National Institute of High Security Animal Diseases, Bhopal along with National Research Centres on various animals and Veterinary & Animal Science Universities. Under the Department of Agricultural Research and Education, Indian Council of Agricultural Research conducts various research in animal science to increase productivity and double farmer's income. Some of the critical research strategies taken up by the institute include improvement of indigenous cattle breeds and poultry, prevention of livestock diseases in the country and capacity building of human resources in livestock science. There has been registrations of around 184 indigenous breeds

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<sup>217</sup> Retrieved from <https://www.nddb.coop/sites/default/files/pdfs/Handbook-of-Good-Dairy-Husbandry-Practices.pdf>

of animals and poultry in the country<sup>218</sup> including 43 of cattle, 16 of buffalo, 34 of goat, 43 of sheep, 7 of horses and ponies, 9 of camel, 8 pig, 2 of donkey, 1 of yak, 19 of chicken, 1 of duck, and 1 of geese. Some of the recent developments in research by ICAR includes the following achievements:

- Selection in indigenous breeds like Gir, Kankrej and Sahiwal improved the average age at first calving, lactation days, lactation length, and peak yield.
- Development of Himsamridhi - a backyard poultry breed suitable for hilly areas.
- Development and facilitation of dairy farmers “Forewarning Mobile Application” to extend the reach of National Animal Disease Referral Expert System which provides forewarning report for 13 economically important livestock diseases in the country.

Under the livestock improvement researches<sup>219</sup>, there has been significant effort in breed improvement through selection of indigenous breeds of cattle along with conducting network project on buffalo improvement.

- Efforts on genetic improvement of breeds of sheep and goat through selective breeding are being pursued in various agro-climatic zones. In order to improve the quality and availability of animal feed, research is being conducted around profiling bio-geography of gut microbes of all ruminants including cattle, buffalo, sheep, and goat.
- Under this domain, alternative feed sources from modified hydroponically developed mould-free sprouts on local crop residue bedding has been developed to supplement the animal feed in a cost effective way. Supplementation of cattle feed through adding by-products of silkworm pupae has been evaluated in crossbred cattle and has been concluded to be beneficial in enhancing the nutrition utilization. There has been diverse studies in feed management of other animals like buffalo, camel, pigs, mithun and poultry.
- ICAR-Central Institute has pursued artificial insemination in bovines on Research in Cattle by collecting frozen semen of indigenous and cross breeds for utilization of farm animals. Fertility prediction models in cattle and buffalo have been developed which have shown high accuracy for selection of superior quality semen facilitating high conception rates.
- Research around genetic disease detection and screening, drug resistance in animals, evaluation of udder health and milk quality are being extensively pursued.

The development and application of new innovative methods are disseminated through trials, frontline demonstrations with farmers and practitioners. In 2018-19, ICAR has conducted 656 technology interventions across 842 locations covering 6818 trials on animals under the thematic areas of disease management, evaluation of breeds, feed and fodder management, nutrition management, production management and processing. Demonstrations of fodder crop production on berseem, maize, sorghum and napier grass has been conducted on farmers’ land.

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<sup>218</sup> Annual Report of DARE-ICAR 2018-19. Retrieved from <https://icar.org.in/content/dare-icar-annual-report-2018-19>

<sup>219</sup> Annual Report of DARE-ICAR 2018-19. Retrieved from <https://icar.org.in/content/dare-icar-annual-report-2018-19>

ICAR in its future endeavours intends to pursue research in the frontier areas like stem cells, pharmacokinetics and nutrigenomics, transgenic animals, proteome analysis, SIRNA technology, bio-sensor applications, targeted nano-delivery of drugs and IVF-ETT.<sup>220</sup> Some of the critical areas of investigation and research identified in the Vision 2050 of ICAR include livestock genetic improvement using phenomics, genomics and bioinformatics tools; breeding transgenic animals capable of producing tailor-made milk/ meat to cater to the specific needs; understanding of the basis of genetic resistance in domestic species of livestock with DNA markers for disease-resistant genes. Livestock feed, healthcare and management are to be addressed in an integrated manner. Changes in livestock production, increase the potential for new pathogens to emerge, grow and spread from animals to humans on a global scale. Effective phytosanitary and animal health regimes aided by new vaccines, diagnostic products and tools, and epidemiological information are necessary to survive in the emerging regulatory regime.<sup>221</sup>

***xi. Impact on and Role of Private Sector, Community/ Collectives/ Cooperatives and Civil Society***

The dairy sector contributes significantly to rural income nearly 26% in case of the poorest households and 12% for overall rural income. For the marginal and even landless farmer, livestock is a source of income as well as ensures nutritional security of the family.

**Cooperatives and SHGs for milk production**

Dairy cooperatives and farmer producer organizations have been able to collectivize the small and marginal livestock farmers to form an autonomous enterprise. This platform offers economies of scale in the dairy produce and helps them market the dairy products (milk or processed milk products) at a competitive price. The dairy value chain thus formed by the cooperative/FPO manages milk procurement, processing & marketing. The socio-economic benefits derived from the FPO formation impacts in improving farmers' income, ensuring women empowerment, generating employment and increase access to credit.

In India, about 52% of the milk produced is available for sale to organised and un-organised players involved in sale and marketing of milk and dairy products.<sup>222</sup> The cooperative organised sector in India follows a three-tier structure with village cooperatives societies at the core. 210 dairy cooperative unions covering 1,90,516 village level cooperative societies and 16.93 million farmers are active in the country. These cooperatives have reported a sale of 354.53 lakh litres per day in 2018-19. Summary tables on region-wise number of cooperative societies operational in India, total number of members and overall milk procurement in 2018-19 are given below<sup>223</sup>.

Table 42: Number of members, overall milk procurement and marketing in 2018-19

<b>Zone</b>	<b>North</b>	<b>East</b>	<b>West</b>	<b>South</b>	<b>India</b>	<b>Top 3 states</b>
No. of Societies	66,795	34,154	50,951	38,616	1,90,516	UP, Bihar, Gujarat

<sup>220</sup> ICAR Vision Document 2050, Retrieved from <https://icar.org.in/node/117>.

<sup>221</sup> ICAR Vision Document 2050, Retrieved from <https://icar.org.in/node/117>

<sup>222</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2018-19. Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

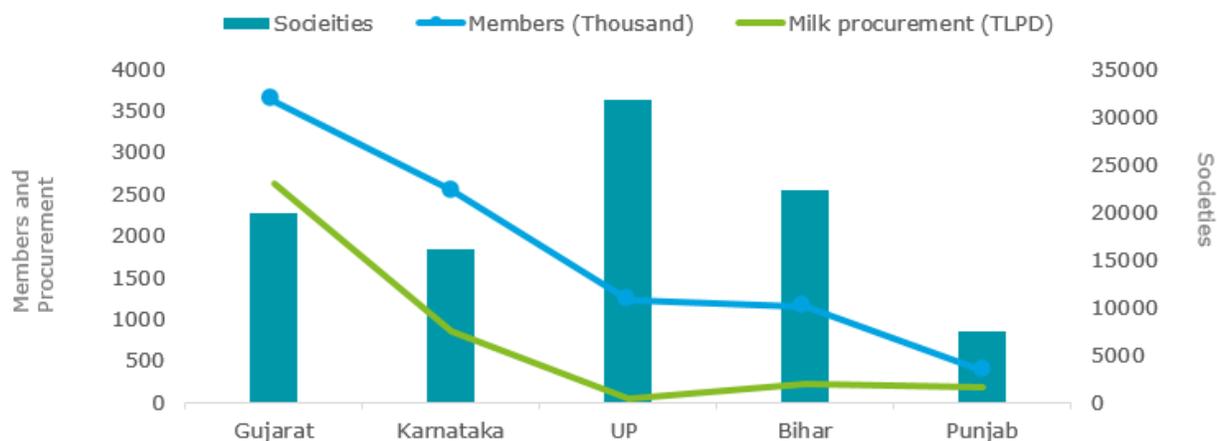
<sup>223</sup> Analysis of data from Annual report, 2017-18 National Dairy Development Board

Zone	North	East	West	South	India	Top 3 states
No. of Members (in thousands)	3,114	1,756	5,799	6,261	16,929	Gujarat, Karnataka, Tamil Nadu
Procurement (000 kg per day)	5,624	2,871	28,098	14,175	50,769	Gujarat, Karnataka, Maharashtra
Liquid milk marketing (TLPD)	11,311	3,175	11,177	9,790	35,453	Delhi, Gujarat, Karnataka

Source: Analysis of data from Annual report, 2018-19 National Dairy Development Board

North zone comprising of states of Punjab, Haryana, Uttar Pradesh, Uttarakhand, Delhi, Himachal Pradesh and Jammu & Kashmir leads in terms of no. of registered milk cooperative societies (66,355). UP, Bihar and Gujarat are top three states in India in terms of number of registered societies. States in Southern Zone (Karnataka, Tamil Nadu, Kerala, Andhra Pradesh and Telangana) lead in terms of total number of members in societies while states in West Zone lead in terms of total procurement. However, the high number of milk cooperatives and large membership is not an indicator of success as can be seen from the chart below<sup>224</sup>.

Figure 105: Societies, members and milk procurement



Source: Analysis of data from Annual report, 2018-19 National Dairy Development Board

UP and Bihar, which are the top two states in terms of registered number of cooperatives societies but have reported very low procurement of 403 and 1891 TLPD. State of Gujarat has the highest procurement of 22,920 TLPD it is important to note that overall milk procurement through cooperatives is heavily skewed towards Gujarat as daily procurement in Gujarat alone is almost equals to daily procurement from North, East and South Zone. Comparison of data across multiple states shows that increasing number of dairy societies may not translate into required results. Good infrastructure, better marketing and processing facilities are necessary perquisites for boosting milk procurement and development of robust dairy sector.

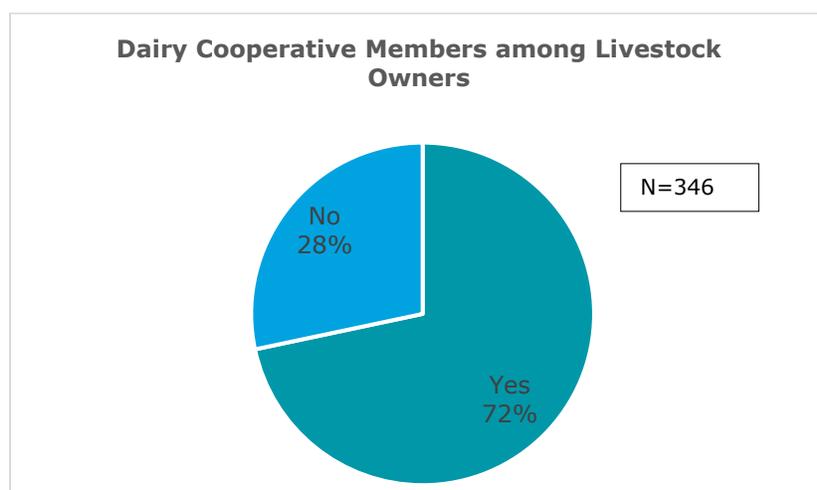
<sup>224</sup> Analysis of data from Annual report, 2017-18 National Dairy Development Board

In addition to the dairy cooperatives, NDDDB Dairy Services (NDS), wholly-owned subsidiary of NDDDB, is facilitating incorporation of milk producer companies. Presently there are 14 milk producing companies spread over 11,920 villages, comprising of over four lakh members<sup>225</sup>. These producer companies procure 26 lakh kg of milk per day. Out of these 14 milk producing companies, six are being supported under National Dairy Plan (NDP), five are getting support from Tata Trusts and remaining three are being supported by NRLM/SRLM.

In addition to the cooperatives, multiple private players engaged in procurement of processing of milk have evolved. These companies usually procure milk through middlemen which affects the price remuneration to farmers.

It has been observed in the HH Survey analysis that around 72% of the livestock farmers are part of a dairy cooperative. The graph below depicts the rate of participation in dairy cooperatives among livestock farmers.

Figure 136: Dairy Cooperative Participation among Livestock Farmers



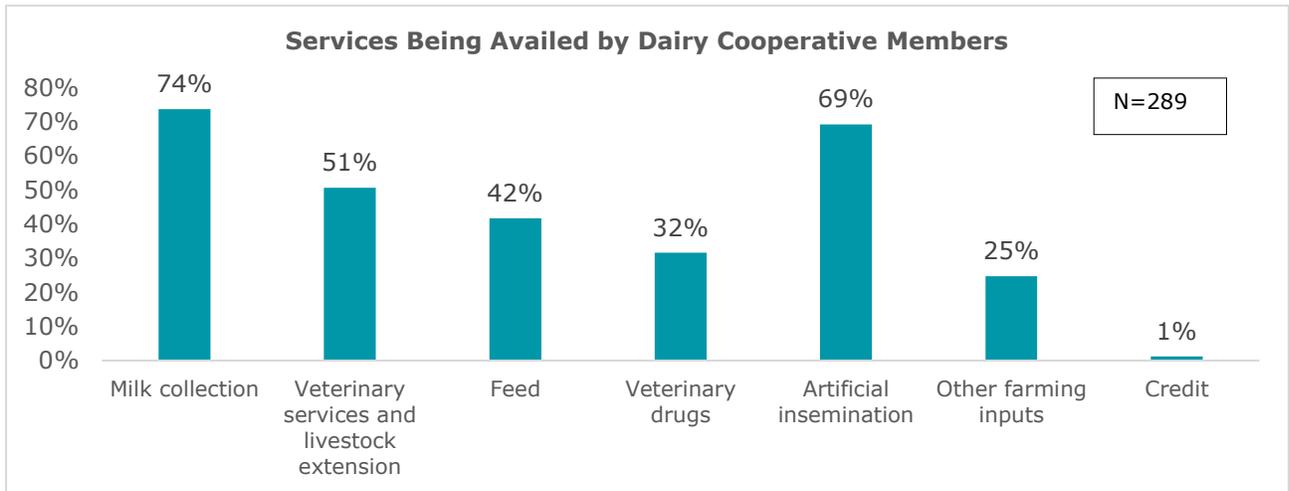
Source: HH Survey, Deloitte Analysis

Further analysis of the survey reveals the popular services being availed by the livestock farmers who are member of a cooperative.

The percentage of dairy cooperative members availing various services such as milk collection, veterinary services, feed, artificial insemination and other services from the cooperatives have been depicted in the graph below.

<sup>225</sup> Department of Animal husbandry, dairy and fisheries. 2018. Annual Report 2018-19. Retrieved from <http://dahd.nic.in/>

Figure 137: Services from Dairy Cooperative as availed livestock farmers



Source: HH Survey, Deloitte Analysis

### **Case Study: Resolving issue of fodder supply in dairy sector through women FPO**

#### **Introduction/Challenge:**

The scarcity of green fodder posed as one of the major hindrances for achieving sustainable livelihood through dairy-based activities in a small village named Lata in Uttarkashi, Uttarakhand. The community was entirely dependent on forests for its fodder supply. Given that women dominate the dairy sector in India, it was difficult for them (women) to fetch fodder from far-off forest areas on a regular basis. This deterred the village women from taking up dairying as a business activity.

#### **Solution:**

In the year 2012-13, the model focussed on bringing together women producers, who were dependent on traditional income sources as the scale of economies from the dairy sector was at subsistence level.

Given that fodder is a critical input for the dairy sector, the village women were organized to form five producer groups (FPOs). The groups sought to resolve the issue of fodder scarcity by collectively cultivating green grass fodder in the 'van panchayat' land. The 48-member group of Lata village collectively started the cultivation of green fodder, which was able to fulfil the village's fodder requirement to a great extent (from the initial 3 tonnes to 9 tonnes in a season). The groups were assisted by the veterinary department in the creation of infrastructure, such as fencing and land development, to upscale the commercial fodder activity.

The women's dairy cooperative received recognition from the district administration, and the veterinary department was awarded Rs. 50,000 for this innovation. The women dairy producers were also helped by other line departments — with machinery and equipment — to upscale the dairy sector.

#### **Impact:**

- The collective commercial production of perennial grass on van panchayat land provided an additional income to the dairy producers.
- This also increased milk production, further leading to an increase in dairy farmers' income.
- As of 2013, the dairy producers were able to earn Rs. 20,000-30,000 annually from the commercial cultivation of fodder and Rs. 1,000-1,200 a month from the sale of fresh milk.
- The organization of women as dairy producer groups paved the way for business development services (BDS) and helped them move the activities to business levels.
- Cultivation of fodder on fallow van panchayat land led to reduction in intensity of soil erosion, specifically during the monsoon season.

Source: Krishi Sutra 2, Success stories of Farmer Producer Organisations, 2013

### 1.3 Issues and Challenges

Some of the key issues and challenges that impact the development of the sector including improved productivity and restrict income of farmers from livestock rearing include a host of animal management practices such as effective control of animal diseases, shortage of feed and fodder, breed improvement while preserving diverse genetic resources and dissemination of technology, skills and quality services to farmers, etc. These issues and challenges have been elaborated below.

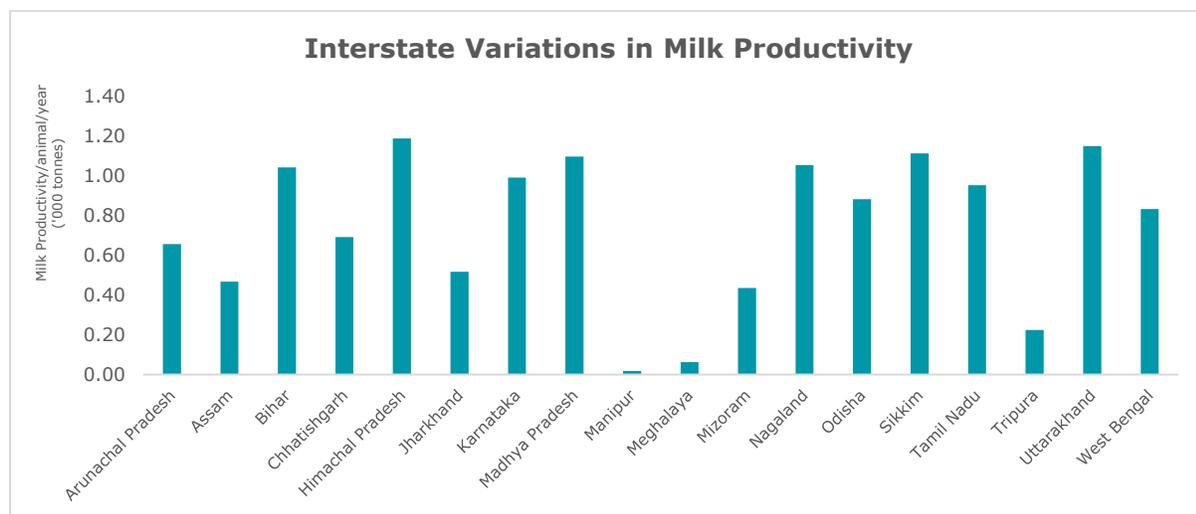
**Lack of Resources:** Resources allocated to sector have not been proportional to the contribution of the sector to the agriculture and allied sector economy. Over the years, less than five per cent of the total financial resources allocated to the agriculture and allied sector have been allocated to the livestock sector. This has resulted in inadequate human resource deployment as well. These have limited the sector to achieve a much higher growth.

**Low Productivity of Milch Animals:** The factors that impede higher productivity are genetic potential, shortage of feed, poor understanding of animal health, inadequate health care facilities, inadequate breeding infrastructure and lack of extension activities to build the capacities of farmers.

Improvement of genetic varieties of cattle and buffaloes also requires recognition of local breeds and prioritization by their economic importance. Practices like progeny testing and pedigree recording are largely absent.

In addition to the challenge of low productivity, there is also the issue of the sharp inter-state variations in the yield of dairy animals. The interstate variations in milk yield is prevalent in crossbred cows, indigenous cows as well as buffaloes. The total milk productivity from all dairy animals including crossbred cows, indigenous cows, buffaloes and goats across all states shows substantial variations as depicted in the graph below:

Figure 138: Interstate Variations in Milk Productivity



Source: Department of Animal husbandry, dairy and fisheries. 2019. Basic Animal Husbandry and Fisheries statistics, 2018. Retrieved from <http://dahd.nic.in/>

18 states have milk productivity lower than the national average productivity. In agriculturally underdeveloped states, although farmers are more dependent on livestock, the milk productivity is

generally observed to be low.<sup>226</sup> Improvement of productivity of milch animals in these low yield states are required since they account for major share in the total milk production. The feeding pattern<sup>227</sup> of cattle and buffaloes have a direct relation with increase in productivity of milk along with the factor of herd size. A larger herd size is observed to have a higher milk yield owing to better management of animals by the larger farmers.

**Lack of Real Time MIS and Database:** The sector lacks a comprehensive Centralised MIS system for smooth monitoring of various interventions being undertaken by the Government as also a better analysis of information to monitor the performance of the sector. Databases are either not present or there are no interlinkages and as such function in isolation. There is a need to develop to create databases on various sub-sector and components/activities therein and develop a mechanism to link these databases for analysis and mid-course corrections to be undertaken if any.

**Lack of Registered Livestock Markets:** Livestock markets in India are neither organized nor regulated markets, though some states have brought marketing of livestock under Agriculture Produce Market Committee (APMC) Act.<sup>228</sup>

There are about 2,000 markets for live animals, falling under the jurisdiction of state governments and managed by local bodies such as Municipal Corporations and Gram Panchayats. Most of these markets are irregular, lack transparency in transactions and are short of basic infrastructure, marketing facilities, transportation facilities and other basic facilities like housing for animals, etc. Additionally, in some states the livestock and livestock products are not notified commodities<sup>229</sup>.

It has been observed from the HH Survey, that only 7.9% of the livestock farmers are aware of a nearby market for Sale and purchase of livestock products.

The draft model law Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act (APLM), 2017 provides wider options of selling livestock to fetch better prices and includes market infrastructure for livestock trade<sup>230</sup>. The Model Act can be supplemented through facilitation of alternate marketing channels including opening up the system to private sector as well for alternate online marketing platform. Inclusion of livestock trade under this Act can help the current situation<sup>231</sup>.

**Limitation in Animal Healthcare Services:** There is an urgent need to strengthen the health infrastructures catering to animals and poultry in the country. Currently, there are around 65,815 veterinary institutions in the country each of which caters to 5071 livestock units, totalling to 330.84 million livestock, against population of 535.82 million in the country.

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<sup>226</sup> Observations drawn from Doubling Farmers' Income Report- Volume VIIIID, Chapter 2 Dairy

<sup>227</sup> Green fodder and compound cattle feed

<sup>228</sup> NABARD, 2018, Sectoral Paper on Animal Husbandry

<sup>229</sup> NABARD. 2018. Status Of Marketing Infrastructure Under Electronic National Agriculture Markets: A Quick Study, [https://www.nabard.org/auth/writereaddata/tender/0904195131Status%20of%20Marketing%20Infrastructure%20under%20Electronic%20National%20Agriculture%20Market\\_A%20Quick%20Study.pdf](https://www.nabard.org/auth/writereaddata/tender/0904195131Status%20of%20Marketing%20Infrastructure%20under%20Electronic%20National%20Agriculture%20Market_A%20Quick%20Study.pdf)

<sup>230</sup> The Economic Times, 2017, Government aims to end APMC monopoly with new model agri-market law, Retrieved from:

[economictimes.indiatimes.com/articleshow/58346291.cms?utm\\_source=contentofinterest&utm\\_medium=text&utm\\_campaign=cppst](http://economictimes.indiatimes.com/articleshow/58346291.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)

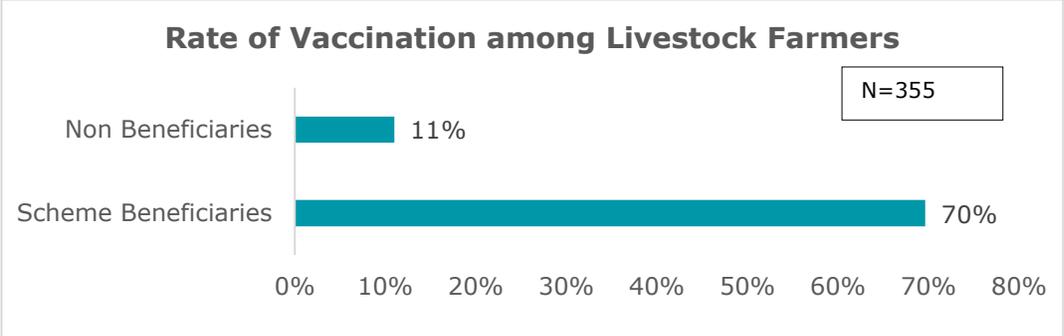
<sup>231</sup> Doubling Farmers' Income – Volume IV, Evolution of Agricultural Marketing

The poor status of animal healthcare system is attributed to the inefficiencies in provision of curative health services and limited attention towards preventive health system. In the case of curative health services, a large gap also exists between the need and the availability of animal health service providers for cows and buffaloes. This has led to farmers opting for local alternatives such as untrained personnel or self-medication, which often results in more harm than good.

The veterinary services also do not cover costs of the medicines which has to be borne by farmers. An estimated 85% of the annual non-planned state budgets are spent on salaries and other establishment cost, leaving relatively lower funds for drugs and vaccines.<sup>232</sup>

In the HH Survey, a similar picture is observed in terms of animal healthcare services availed by livestock farmers. Around 70% of livestock farmers have vaccinated their animals. The vaccination rate is much higher among scheme beneficiaries. The graph below shows the comparative analysis of scheme beneficiaries and non-beneficiaries vaccination rate. This further implies that there remains a huge scope to improve vaccination services.

Figure 139: Rate of Vaccination done by Livestock Farmers

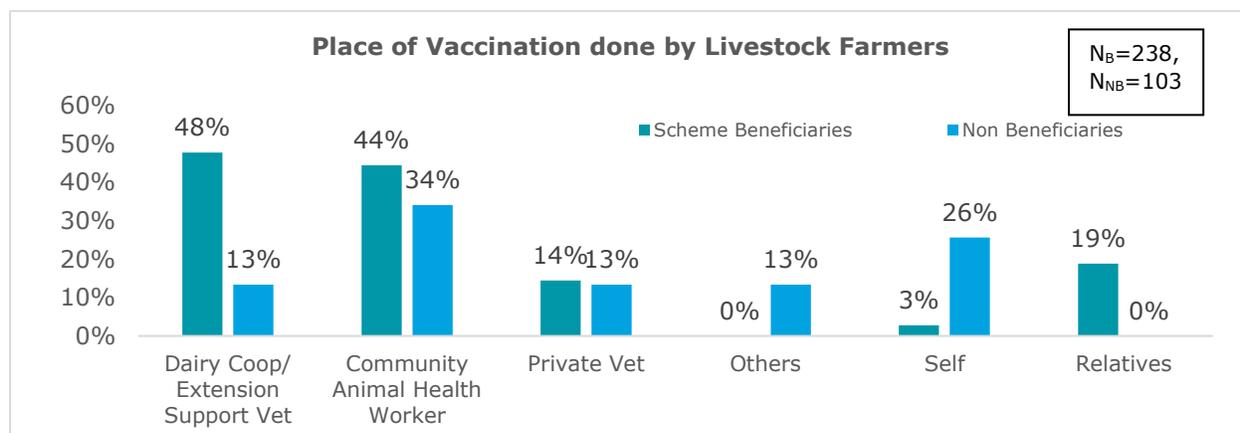


Source: HH Survey, Deloitte Analysis

<sup>232</sup> Doubling Farmers’ Income – Volume VIIIID, Chapter 2

The place of vaccination of animals by livestock owners have been analysed from the survey below.

Figure 140: Places of vaccination availed by Livestock Farmers



Source: HH Survey, Deloitte Analysis

Among scheme beneficiaries more than 90% are reaching out to Community Health Workers or Dairy Cooperatives or Extension Support Veterinarians. However, among eligible non beneficiaries, around 52% are getting their livestock treated at home or reaching out to relatives and other local sources including private veterinarians. The practices of availing treatment is evidently poorer among eligible non-beneficiaries and it shows that the beneficiaries have much better access to animal health services. This highlights that the animal health services need to be strengthened further.

**Livestock Insurance and Access to Credit:** Livestock insurance is a critical aspect for protecting the livestock assets of the farmers against vulnerabilities and diseases. However, the penetration of livestock insurance is very low at less than 7% of cattle population<sup>233</sup>. As per the Government of India, 14.80 lakh animals were insured in 2014-15 which declined to 7.65 lakh in 2015-16 and 7.44 lakh in 2016-17<sup>234</sup>.

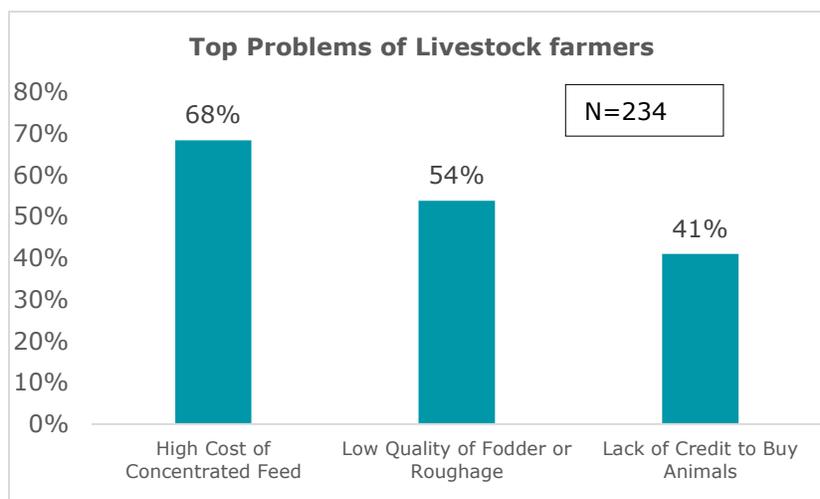
The livestock insurance sector faces issues such as high operational costs, difficulties in verification of claims, high insurance premiums and lack of awareness about products.

Along with the issue of livestock insurance, lack of credit in the livestock sector is also expressed as one of the top 3 issues faced by livestock beneficiaries as analyzed in the HH Survey. The graph below shows around 41% livestock farmers have expressed lack of credit to buy new animals is one of the key problems faced by the farmers. The high cost of concentrated feed was seen as the top-most problem by most respondents.

<sup>233</sup> <https://ifmrllead.org/evaluating-the-efficacy-of-an-app-based-livestock-insurance-scheme-in-rural-india/>

<sup>234</sup> <https://thewire.in/government/why-livestock-insurance-is-yet-to-take-off-in-rural-india>

Figure 141: Top Issues of Livestock Farmers



Source: HH Survey, Deloitte Analysis

**Inefficiency in Extension Services:** The extension services in the livestock sector is weak. The state departments have limitations in terms of resources for effective coverage of extension activities and also in many instances lack expertise to operate technology transfer packages.

The current institutional arrangement has mixed extension activities with curative activities, wherein, the focus is on providing information on animal health care and breeding at the expense of information dissemination on feeding and management practices which also are important components of livestock productivity.

**Access to Infrastructure:** The livestock sector suffers a post-harvest loss of 0.92% – 7.19% which is largely due to inefficiencies of processing and inadequate post-harvest processing, storage and distribution facilities.

In the dairy sector, around 40% of milk produced is processed either in cooperative or private sector. Most of the processing facilities in the cooperative sector have been established during Operation Flood period (1970-1996) and have not been expanded or modernized thereafter.

It is expected that milk producer institutions would procure 670 lakh kg per day with peak of 800 lakh kg per day by 2021-22<sup>235</sup>. Compared with processing level of milk in developed country which is pegged at 90%, there is huge scope to increase the processing of milk through organized sector and also utilize the surplus for various milk products like butter, clarified butter, cheese, skimmed milk powder which has a longer shelf life.

Similarly, the meat industry also requires establishment of modern abattoirs for clean and hygienic meat processing. There are 1,783 registered slaughter houses in the country<sup>236</sup> and nearly 78% of them are concentrated in 8 states<sup>237</sup>, thus, there is an urgent need to strengthen the slaughter houses. The processing level of meat is also low at 1% of the total meat produced in the country<sup>238</sup>.

<sup>235</sup> NABARD. 2018. Sector Paper on Livestock Sector

<sup>236</sup> As of 2017, NABARD. 2018. Sector Paper on Livestock Sector

<sup>237</sup> (Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttarakhand)

<sup>238</sup> NABARD. 2018. Sector Paper on Livestock Sector

**Shortage of Feed and Fodder:** The major factor that affects the livestock sector is the shortage and increasing cost of animal feed and fodder. The year-wise trend in the feed cost of livestock is shown below:

Table 43: Trend of feed cost of livestock during 2011-12 to 2017-18

2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
51%	51%	51%	50%	50%	50%	49%

Source: National Account Statistics 2019- Disaggregated Statement of Output & Value Added from crop sector & Output & Value Added from livestock; <http://mospi.nic.in/publication/national-accounts-statistics-2019>

Availability of fodder and feed both in terms of quantity and quality is a major constraint. The area under fodder crops has stagnated at about 8.5 to 9 million hectares. Expected shortfall in demand for Dry, Green and Concentrates is 11%, 35% and 45% respectively. Overall, the deficit of feed and fodder in the country is as high as 57%<sup>239</sup> and increasing. It is also becoming a challenge due to the constant trade-off between cultivation for human food and fodder in the farmland. The feed and fodder shortage is more acute in the dry states with limited rainfall. It is anticipated that feed balance may worsen further as production of green fodder is projected to decline by 2030<sup>240</sup>.

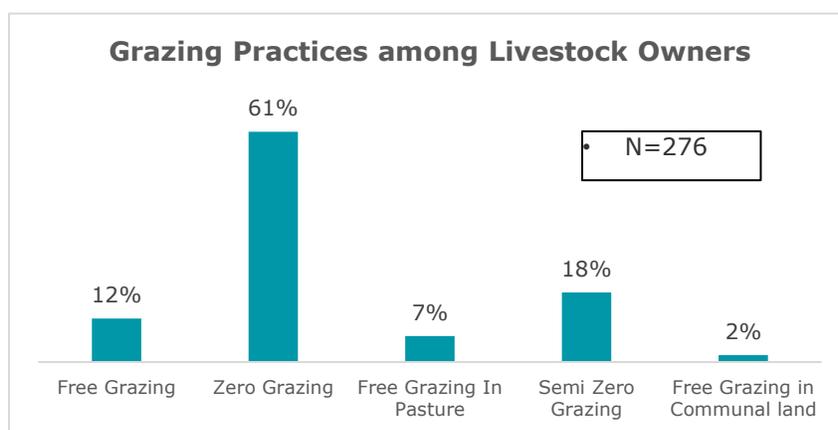
The pasture lands in India are overgrazed and not properly managed which lead to lower productivity. In many states the grazing pressure is very high compared to carrying capacity with 70% of grazing land falling in poor and very poor condition.

In the HH Survey the grazing practices of livestock farmers has been analyzed. As per the analysis, around 61% of livestock farmers are found to practice zero grazing which is comparatively a better and sustainable practice. The graph shown below shows the share of different grazing practices taken up by farmers.<sup>241</sup>

Fertilization of grazing land is not practiced by most of the livestock farmers. As observed from the HH Survey, around 73% of livestock farmers who have been practicing grazing of animals do not fertilize the grazing land.

In addition to the above issues, there is a supply-demand gap in respect of quality forage seeds as well. There is a need to increase the productivity of

Figure 14211: Grazing Practices among Livestock Owners



Source: HH Survey, Deloitte Analysis

<sup>239</sup> NABARD. 2018. Sectoral Paper on Animal Husbandry. <https://www.nabard.org/auth/writereaddata/tender/1103195107AH%20Final.pdf>

<sup>240</sup> Doubling Farmers Income Report, Volume VIIID

<sup>241</sup> It may be noted that household surveys are currently ongoing and the analysis will be updated on completion of survey.

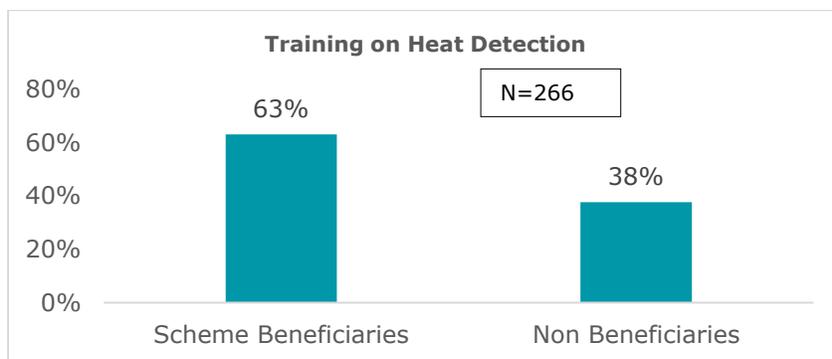
forage and fodder crops as well ensure consist supply across the year.

The lack of feed and fodder has also been expressed as a critical issue by beneficiaries. As observed in the HH Survey, two of the top 3 issues faced by livestock beneficiaries are around feed and fodder as shown in the Figure 141: Top Issues of Livestock Farmers. Around 68% of respondents among livestock farmers expressed cost of concentrate feed as the top issue followed by 54% of respondents mentioning low quality of fodder as the 2<sup>nd</sup> most critical issue.

**Lack of focus on Integrated Animal Management Systems:** The development efforts in the sector have primarily been on increasing production and productivity and not on management of resources. As a result, many aspects have either received attention in isolation or have just been ignored. Animal management practices have largely been left from the development efforts. Practices on systemized management of animal health, nutrition packages, animal hygiene, manure management etc. have largely been ignored.

As observed from the HH Survey, it has been found training on breeding such as training on heat detection is very low. The analysis of training on heat detection has been depicted below which shows slight increase among scheme beneficiaries than eligible non-beneficiaries.

Figure 143: Training on Heat Detection among Livestock Farmers



Source: HH Survey, Deloitte Analysis

### **Case Study on Dairy Industry of New Zealand**

#### **Background**

New Zealand is the eight largest milk producing country in the world and accounts for 2.6% of global milk production by producing 21.3 million tonnes in 2017. New Zealand produces a similar amount of milk to other temperate countries of a similar size (e.g. the UK, France). However, as it only has a small population (similar to Singapore), the excess is exported. The country is world's largest exporter of milk and dairy products, accounting for a fifth of the global total at \$5.4 billion in 2018, according to the International Trade Centre. New Zealand is the world's leading exporter of butter, whole milk powder and products of natural milk constituents (such as the protein casein), the second largest exporter of skimmed milk powder, and the sixth largest exporter of infant formula. Dairy products from New Zealand are exported to over 140 countries with China being the largest market, followed by United States. The success of New Zealand in dairy is attributed to various factors. The dairy industry in the country is built around a natural environment conducive to agriculture. The dairy collection model is a natural monopsony with all milk collection and primary processing through farmer owned cooperatives. About 84% of New Zealand milk supply is controlled by Fonterra, a farmer-owned cooperative which was formed in 2001 in a megamerger of dairy cooperatives and the export dairy board.

#### **Key Drivers**

The key drivers of New Zealand's dairy industry that have ensured success are:

- Conducive climate with ensuring low production cost: The temperate climate has allowed development of grass-fed production system at low cost
- Efficient people skilled in dairy management: With a long history of dairy production of over 100 years, the industry boasts of highly skilled personnel and strong dairy management system
- Location and proximity to global markets: The country enjoys a privilege in terms of its location and connection with East & South-East Asian market

The expansion of export markets required the dairy industry of New Zealand to strengthen its infrastructure, improve its processing capacities, transportation upgrading of port facilities, and the expansion of shipping provided by transnational shipping firms such as Maersk. These steps were taken alongside doubling the milk production over 15 years since 2000. Increase in milk production was done by increasing dairy farmland by 74% and dairy cows by 65%. Conversions of sheep and beef farms into dairy farms had to be done which required significant investment in re-construction. Alongside, fodder production had to be increased by planting maize crops as well as procurement of supplement such as palm kernel meal from Indonesia and Malaysia. Dairy farm being more labour intensive than sheep or beef cattle farms, employed migrant labour in the country's dairy industry. The successful dairy model of New Zealand showcases how dairy farming can leverage the opportunities presented by globalization by assembling several factors in the competitive environment. Being an export-oriented industry from the beginning, the industry explored new geographies to expand which was coupled with building Fonterra to support the humongous milk supply.

#### **Learnings for India**

New Zealand dairy development model has some lessons for Indian dairy sector – global market oriented production and manufacturing facilities, emphasis on all aspects of the industry and not just production to bring efficiency across the value chain and explore appropriate low-cost innovations to tap export markets.

(Source:

- <https://www.dcanz.com/about-the-nz-dairy-industry/>;
- <https://www.gtreview.com/magazine/volume-15issue-5>;
- <https://www.gtreview.com/magazine/volume-15issue-5/milk-new-zealands-dairy-exports-conquered-world/>)

## Chapter 2: Sector Level Recommendation: Animal Husbandry

### 2.1 Recommendation at Sectoral Level

Post consultations with the department officials at central, state and district level; sector experts; and our analysis of the issues and challenges faced by the Livestock sector, the recommendations and solutions have been provided below across the Value Chain. The investments need to be mobilized from public and private resources wherein the private sector is expected to invest in processing, value addition, and marketing and public investment needs to be made to make production cost competitive and reduce involved input cost. The input cost would be reduced through disease control, better nutrition, and breed improvement, which will lead to increase in investment from private sector.

#### Production

- In India, the growth in milk production has largely been due to large number of milch animals as compared to developed economies such as Israel, USA, Korea, etc., where the average yield rate of animals is much higher than India. For example, the average yield rate of milch animals is much higher in some of the other countries such as Israel (36.11Kg/day), USA (28.65 Kg/day), Republic of Korea (27.49 Kg/day)<sup>242</sup> as against 4.5 Kg/ day in India. This leads to high pressure on resources such as land for fodder and grazing, animal housing, etc. This also leads to a higher carbon footprint. Considering the resource scarcity in India, there is a need to increase productivity significantly to encourage “technology-driven livestock economy” as against “animal population-driven livestock economy”. Examples of some of the technologies which are being used are:
  - Use of bio-sensors and machine-to-machine technology to continuously automatically monitor health productivity and reproduction of livestock
  - AI and the use of sexed semen
  - Hydroponics to increase fodder prod.
  - Balanced diet including ration balancing, feeding of Azolla, etc. for improved nutrition
  - Use of milk bacteria analyser which allows farmers or milk testing laboratories to take fast action to preserve and enhance milk quality. It also helps to diagnose udder diseases at an early stage leading to faster treatment and recovery.

Box 77: Milk Production- Example from USA

#### Example of USA: More Milk from Fewer Cows

**1944:** Production – 53 Mn MT from 25.6 Mn Cows  
**2007:** Production - 84 Mn MT (+60%) from 9.2 Mn Cows (-64%)

**How:** This was achieved primarily through technology induction for improving genetic capacity for production, better nutrition and improved cow health.

#### Impact:

About 41% reduction in total carbon footprint associated with milk production

Reduction in Resource Use to produce the same amount of milk as in 1944 (53 mil. metric tons), the U.S. dairy industry uses:

- 10% of the land
- 23% of the feedstuffs by weight
- 35% of the water

Per litre of milk:

- Making 75% less manure and
- Creating 57% less methane.

#### Learnings for India:

Focus on breed improvement, technology, health and nutrition can lead to more efficient and environment friendly milk production.

Source: Capper, Cady & Bauman. 2009. The environmental impact of dairy production: 1944 compared with 2007. Journal of Animal

<sup>242</sup> FAO Statistics

- Considering the scarcity of land in the country, many times different departments come in conflict with each other as all of them have their own targets in terms of land use. For example, Departments of Forest, Revenue, Agriculture, Animal Husbandry, etc., all have their own targets of increasing the land use for their respective activities. These targets are mostly set by the respective departments individually without consultations with the other concerned departments. It is imperative to involve all these departments at the planning stage itself (at state and district levels) to set the targets which would be practically achievable without least overlaps and optimizing resource use. This will also help optimize the trade-off between cultivation for human food and fodder in the farmland.
- Gram panchayats may be incentivized to hand over land areas with grazing rights, cultivable fallow lands to FPO/ cooperatives/ private individuals with proper support and training for preparation of silage and hay. The fodder may then be sold to the local dairy farmers at a cost plus basis ensuring sustainability of the project. This will also help in ameliorating the feed/ fodder shortage during the dry season.
- Similarly, barren/ non-cultivable lands may be leased out by the panchayat to FPOs/ cooperatives/ private individuals for setting up of low investment hydroponic based fodder production systems.
- Crop stubble has become a perennial problem for the environment. The stubble, if treated properly can be used as a minor component of the fibre portion of animal feed.
- One of the major constraints in transfer of hay over large distances is the low bulk density of the fodder. Baling solutions customized to Indian environment will address the shortage of fodder in fodder deficient states due to increased transportability.
- Unconventional protein sources like mesquites (crushed *Keekar* seeds) have been used on a semi commercial basis in drier states such as Rajasthan by certain agri start-ups. Promoting such non-conventional resources especially in arid and semi-arid areas will reduce the cost of protein as a nutrient, increasing milk quantity while reducing cost of production.
- The efficacy of hydroponic (which is generally capital intensive) in green fodder production has been established by the private sector where land is scarce. However, low-cost hydroponics solutions are now also available in the sector. There are several advantages of hydroponic fodder production which include requirement of less water and land, short growth period, higher nutrition and round the year production<sup>243</sup>. An example of low cost hydroponics is being undertaken by some farmers associated with the Dairy Industry in Phaltan Taluka in Satara district of Maharashtra. An ICAR study undertaken in 2013 revealed that there was an increase in milk yield by 0.5-2.5 litres per animal per day apart from increase in fat and SNF content, improvement in health and conception rate, reduction in cattle feed requirement by 25%, increase in sweetness of the milk, whiter milk, reduction in labour cost, requirement of less space and water when

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<https://rkvy.nic.in/Uploads/SuccessStory/TAMILNADU/2016/2016101741OUTCOME%20OF%20HYDROPONIC%20FODDER%20PRODUCTION%20TECHNOLOGY.pdf> (accessed on 02.01.2020)

hydroponics fodder is used.<sup>244</sup> The Government of India may consider incentivising this type of technologies under Public Private Community Partnership (PPCP) or any other relevant model to overcome shortage of fodder and limit conflict on land use.

- Another mechanism that can be considered is the promotion of algae cultivation including Azolla as demonstrated by some initiatives in Rajasthan, Kerala, etc. Azolla is rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, Beta Carotene), growth promoter intermediaries and minerals including calcium, phosphorous, iron, potassium, ferrous, copper, magnesium, etc. Several studies have concluded that Azolla is a highly suitable aquatic plant for livestock feed due to its ease of cultivation, nutritive value and high productivity.<sup>245</sup> Hence, it is a highly efficient and economic feed substitute for livestock, especially due to its high protein and low lignin content which makes it easily digestible for the livestock.<sup>246</sup> Certain trials have found an increase in milk yield when Azolla was combined with regular commercial feed leading to savings of 20-25%.<sup>247</sup>

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<sup>244</sup> Low cost devices for Hydroponics fodder production, 2013, Naik P. K. et al, Researchgate.net ([https://www.researchgate.net/publication/258241382\\_Low\\_cost\\_devices\\_for\\_Hydroponics\\_fodder\\_production](https://www.researchgate.net/publication/258241382_Low_cost_devices_for_Hydroponics_fodder_production))

<sup>245</sup> Becerra *et al.* (1995), Lumpkin & Plucknett (1982) and Van Hove & López (1983)

<sup>246</sup> <http://www.Azollafoundation.org>

<sup>247</sup> Kamalasanana Pillai, Premalatha, S. & Rajamony, S. 2002. *Azolla* – A sustainable feed substitute for livestock. Leisa India, March, 2002, pp. 15-17.

### **Case Study on Dairying in Israel**

**Introduction:** The experiments in dairy farming were initiated in Israel in 1910 when there were only about 1000 cattle in the country. While cross breeding efforts started in 1920s, the increased importance of dairy farming resulted in focus on cattle health and eradication of diseases in 1930s. This improved the production and by the end of 1940s Israel had more than 33,000 cows with 75 million litres of milk production. In 1956, Israeli dairy board was formed to promote exports and organise dairying in the country. Israel has two farming systems: The Kibbutz and the Moshav. Kibbutz are large farm collective units, whereas Moshav are family herds organised as cooperative society.

**Challenges:** The unfavourable climatic conditions, desert conditions, heat, humidity, endemic diseases and limited land & water resources poses challenge in rearing and maintenance of cows.

**Solution:** Dairying is much organised in Israel with focus on cattle health, Hygiene and nutrition. Region specific nutrition strategy is developed based on the climatic conditions and energy needs of cows. Proper management of feed is seen as critical for maintaining body weight and sustained milk production. Feed management by maintaining forage and storing silage also form important part of feeding strategy. For better health and productivity, balanced energy rich diet through a mixture of wheat, barley, sorghum rice and other grains is provided. Sufficient intake of fat rich diet (upto 6%) through cottonseed, brewer grain and oilseeds are ensured for lactating cows. Fresh forage act as an important source of vitamins and minerals. Israeli dairy board and associated institutions also supports and publishes research and paper on nutrition & feeding and region specific feeding strategies are consistently updated on the basis of the findings. Herd diet is based on scientific, online feed analysis, for highest nutritional value and economic efficiency. Herd management, disease control and strong veterinary services are at the core of the dairy industry success in Israel. This are complemented by genetic improvement measures and AI support, training on heat detection, proper practices on calf rearing. The Israeli herd book contains information of about 90% dairy cows in the country. The health details, production and other aspects of cows are consistently recorded and analysed in Israeli dairy farms.

#### **Impact:**

- Highest per cow milk production annually in the world at 11,970 Kg (3.75% Fat, 3.45% protein)
- Improved milk quality with reduced somatic and bacterial count per unit reduced by more than 50% since 1999
- Average milk yield per cow is tripled since 1940, yield has been consistently above 10,000 kg per year since 1995

#### **Learnings for India**

- Region specific balanced diet plan needs to be developed for Buffaloes and Cows.
- Silage making and forage management practices needs to be encouraged
- Strengthening of health services and hygiene has immediate impact on health and productivity of cattle
- Awareness building and training among producers on importance of right diet, proper drinking water and hygiene in rearing of cattle can be encouraged
- Dairy herd nutrition management studies from Israel shows that increasing proportion of high energy foods in ration can be counterproductive for production and yield as it may reduce pH value, impact metabolism. The diet needs to be a balance between forage and fibrous structure

- It is important to note that Israel has different climatic conditions and very small geographical area and 100% of cattle are stall fed. Therefore, Indian strategy needs to be developed based on India local conditions and different strategy may be developed for stall fed animals and grazing animals.
- To prevent indigestion and toxins, it is important to minimize humidity while storing and transporting food and silage
- Millets (Barley, Sorghum etc), maize, alfalfa and oilseeds are important sources of nutrition and these crops may be promoted in addition to wheat in integrated farming systems

Source: <https://www.dairyschool.co.il/israeli-dairy-industry/>; Dairy herd nutrition management by Dr Ofer Kroll, 2015

### Processing and Value Addition

- Promotion of modern technologies like IQF, spiral freezers for enhancing the shelf life (even up to 1 year) of other milk products (canned rasgulla/ gulab jamuns) like kalakand, milk cakes, burfis, etc. and maintain freshness of these products. These kind of products would also be suitable for export markets catering to the Indian diaspora settled abroad.
- Efforts should be made for the scaling up of the small scale model of dairy farming at village level through a collective approach, wherein several individuals who own 2-3 animals can come together and increase their herd strength up to 40-50 animals. The farms can be set up on the panchayat land or any other common land, where additional infrastructural facilities such as milking machines, milk chillers, etc. can be installed for achieving economies of scale and better socio-economic status of milk producers. For example, a community dairy farm has been operational in Uttar Pradesh with involvement of business incubators, social venture capital fund and community. The activities undertaken are dairy farm to house cattle of the members, mechanised milking unit, chilling plant, fodder stores and veterinary services. Moreover, the cattle sourcing, fodder management and cattle health are managed professionally. Similar initiatives may be promoted through a replicable and scalable model.

### Insurance and Credit

Livestock plays an important productive asset in rural economy, especially for small and marginal farmers in India. Increasing livestock population and intensive rearing practices expose livestock to risk of diseases and shortage of fodder. Diseases can lead to productivity losses and even death. Livestock insurance can play an important role in risk mitigation for livestock owners by providing security from financial losses due to death and disability of productive livestock.

In India, organised cattle insurance was initiated in 1971 through Small Farmers Development Agency. In 1983, cattle insurance was provided for poor at subsidized rates through Integrated Rural Development Program (IRDP)<sup>248</sup>; in the same year livestock insurance was also being provided as per General Insurance Council (GIC) guidelines under market agreement. The initial intake was very low due to high premium, therefore, the premium was reduced to encourage intake but the coverage remained low with slight improvements<sup>249</sup>. The insurance industry was liberalised in 1999 and in 2001 private players entered market. A key reform was introduced in

<sup>248</sup> Landscape of crop and livestock insurance in India, Swiss Agency for Development and cooperation and IFMR lead, April 2018

<sup>249</sup> Status and determinants of livestock insurance in India: a micro level insurance from Haryana and Rajasthan, Subhash chand et al, Indian Journal of Agricultural Economics, July 2016

2003 when cattle insurance was freed from market agreements and the insurance companies were given flexibility in deciding premium and policy conditions. Further reforms were introduced in 2005 with introduction of micro insurance regulation act which encouraged involvement of NGOs, MFIs and SHGs as insurance provider. Subsequently, Livestock Insurance Scheme was launched in 2006 - first implemented in 100 districts and later extended to other areas. In 2014, livestock insurance became an integral part of National Livestock Mission as a risk mitigation measure.

Livestock insurance has been around for nearly 50 years and has gone through several transformations. Yet, the coverage of livestock insurance remains very poor at less than 7% of total cattle population<sup>250</sup>. More than 90% are compulsory credit linked products and only 10% sold through direct sales, despite the fact that most of the schemes subsidize livestock insurance premium by about 50%<sup>251</sup>. The premium rates paid by livestock owners in India ranges from 2.25% to 5%. The premiums are lower for dairy cooperatives and dairies. Additional premium are to be paid for disability cover and transit cover. In states like Kerala, it is also bundled with non-financial instruments such as subsidized cattle feed.

Some of the reasons attributed for low penetration of livestock insurance product in India are as under<sup>252</sup>

- The most prevalent model of insurance is credit linked subsidized insurance, which while helps in increased uptake, limits further product development and leads to potential malpractices or fraud.
- The low set premium leads to under-priced policies requiring several riders. This results in the risk being effectively transferred to insurees as the risk mitigation facilities such as vaccination, deworming, etc. are not widespread.
- Malpractices occurring with livestock have put insurance companies at financial risks. Companies engaged in providing livestock insurance have reported a high loss ratio ranging between 40-80%<sup>253</sup>. For example, in unorganised markets the agents often employ malpractices such as scrubbing teeth and horns to hide the age of the animal, tampering with ear tags, claims lodged on non-working days to avoid verification by veterinarians within 24 hours, etc.
- Limited market for insurance products due to perceived high premium cost and short cycle of animal rearing.
- Tedious claim settlement process resulting in farmers and stakeholders not opting for insurance due to their past experience.
- One of the mandatory requirements of credit linked insurance is ear-tagging of animal and health certification which is found to be tedious and cumbersome by the farmers. The process of valuation of animal is also not well understood by the farmers as the valuation

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<sup>250</sup> Livestock Insurance, Lessons from the Indian Experience, Dr Anupama Sharma, Institute for Financial Management and Research Centre for Insurance and Risk Management

<sup>251</sup> *ibid*

<sup>252</sup> *ibid*

<sup>253</sup> Livestock Insurance, Lessons from the Indian Experience, Dr Anupama Sharma, Institute for Financial Management and Research Centre for Insurance and Risk Management; KIIs, FGD; <sup>253</sup> Landscape of crop and livestock insurance in India, Swiss Agency for Development and Cooperation and IFMR lead, April 2018

<sup>253</sup> Status and determinants of livestock insurance in India: a micro level insurance from Haryana and Rajasthan, Subhash Chand et al, Indian Journal of Agricultural Economics, July 2016

is dependent on age as well as potential productivity of the animal which in unorganized markets are subjective and based on experience.

- Insurance companies are reluctant to extend insurance in regions with high climatic vulnerability and diseases, as they increase the associated risks of cattle owners and insurance companies alike.
- The process of claim settlement for disability cover or instances of diseases is also complicated and often leads to rejection of claims.

In addition to the above constraints, it was also observed that the beneficiaries who have opted for livestock insurance once typically do not go for renewal - a micro-level study of livestock insurance in Haryana and Rajasthan revealed that only 9% of the surveyed HHs have renewed their livestock insurance policy. The reasons reported for non-renewal are mentioned below.

- Claim settlement is complicated (Haryana (92.4%), Rajasthan (95.2%))
- Very high premium (Haryana (82.2%), Rajasthan (65.9%))
- Not useful (Haryana (61.5%), Rajasthan (69.1%))
- Lack of trust on insurance providers (Haryana (50.4%), Rajasthan (53.8%))
- Rejection of claims (Haryana (46.5%), Rajasthan (55.1%))
- Lack of information about renewal process (Haryana (93.9%), Rajasthan (95.1%))

An analysis of policy documents of few major cattle insurance provider companies in India reveal that the detailed policy documents have many exclusions, for instance, no product is available that can take care of disease outbreak/ epidemics of Foot and Mouth Disease (FMD), Hemorrhagic Septicemia (HS), Anthrax, etc., theft, wilful injury or neglect, unskilful treatment, partial disability, transportation of animals beyond 50 Km from place of purchase, etc. which lead the policies open to interpretations which is a deterrent for a population which is largely non-conversant with the legal language of the policy documents.

The suggestive measures to reduce risks for livestock owners are provided below:

- Need to sensitize that livestock insurance is seen as one of the measures and not the only measure. Livestock insurance needs to be complemented with other measures such as disease control, better nutrition and breed improvement.
- Need to understand the requirement of both the farmers and the insurance products for inputs into designing the policy, schemes and insurance product accordingly<sup>254</sup>
- A pre-requisite for development of market based insurance product is the existence of a well-functioning disease prevention and control programme<sup>255</sup>; therefore, a better veterinary infrastructure, access to vaccination and deworming for animals need to be ensured. Initiatives such as LHDC and NADCP needs to be strengthened in this regard.

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<sup>254</sup> Status and determinants of livestock insurance in India: a micro level insurance from Haryana and Rajasthan, Subhash Chand et al, Indian Journal of Agricultural Economics, July 2016

<sup>255</sup> The World Organisation for Animal Health (OIE), Prevention and control of animal diseases worldwide, Pre-feasibility study – Supporting insurance of disease losses, Final Report Part III, Civic Consulting - Agra CEAS Consulting September 2007,

- Creation of database on livestock, variety and productivity and associated risk for estimating accurate premium and risk profiling.
- Expansion of product risk cover which encapsulate disease cover to include diseases like FMD, zoonotic diseases, etc.
- Adequate mechanism for indemnity payment to cattle owners for reporting disease outbreak in time should be encouraged<sup>256</sup>.
- Tamper-proof systems with use of technologies such as RFID/ chip – IoT based sub-dermal implants, nano-stamping, facial/ muzzle recognition, etc. needs to be leveraged for fraud control.
- Community based insurance model such as the Loan Protection Scheme by Vizianagaram District Poverty Initiatives Project (DPIP) in Andhra Pradesh, India needs to be encouraged.

Box 99: Community Based Insurance Model

**Community Based Insurance Model**

The project was initiated as loan protection scheme in 2003 as a social risk management system. The Vizainagaram district programme management unit and Zila Samakhya (ZS) conceptualised this program to encourage community involvement and address issue of false claims. A transparent process of insurance for submission of claims was developed for SHG members. One Bima Mitra was responsible for each mandal of the district. Bima Mitra played a central role from insurance application to verification and settlement process of claim. Once the ZS started booking profits the premium was reduced from 4% to 2% in 2009-10. The higher transparency and accessibility of Bima mitra and involvement of village organisation helped in increasing greater participation as community as a whole became a major stakeholder. The increased willingness of SHG members to pay for insurance helped in increasing insurance coverage to more than 80% of SHG members with loss ratio of less than 40% which is rarely observed in partner-agent model in the country.

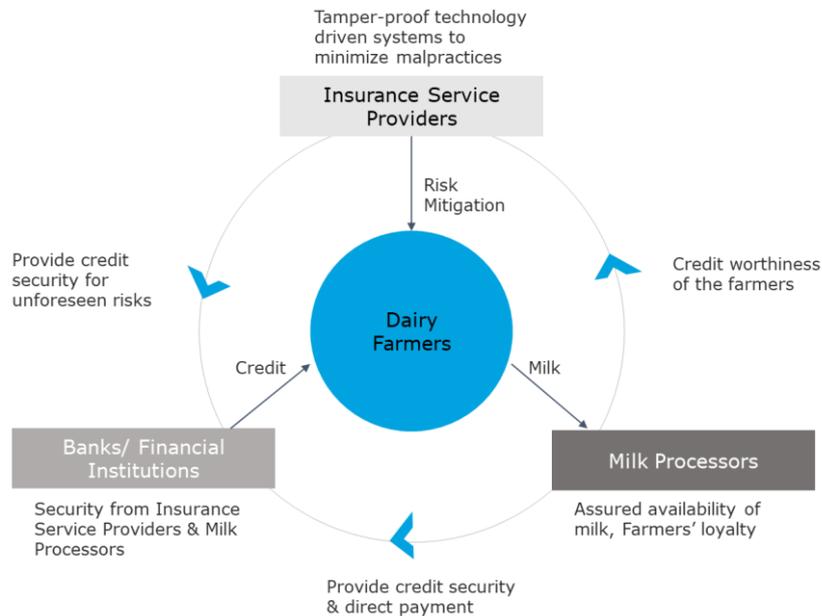
Source: An exploration of community based livestock insurance, Vizainagaram by Anupama Sharma and Alok Shukla, IFMR lead

- Along with the issue of livestock insurance, lack of credit in the livestock sector is also one of the major challenges faced by livestock farmers. While Priority Sector Lending includes proprietorship firms of farmers directly engaged in Agriculture and Allied Activities, viz., dairy, fishery, animal husbandry, poultry, bee-keeping and sericulture, the targets have been defined overall and the focus largely remains on agriculture. Therefore, separate targets for livestock sector under Priority Sector Lending needs to be included. The Working Group Report on Animal Husbandry and Dairying for 12<sup>th</sup> Five Year Plan highlights that the Livestock sector receives about 12% of total public expenditure of agriculture and allied sector and 4-5% of total institutional credit. The report recommends encouraging share of institutional credit to livestock sector to at least 10%. Also, to boost easy credit at subsidised rates, in February 2019, the Government of India has extended the facility of Kisan Credit Cards to farmers engaged in Animal Husbandry and Fisheries activities.

<sup>256</sup> Livestock Insurance, Lessons from the Indian Experience, Dr Anupama Sharma, Institute for Financial Management and Research Centre for Insurance and Risk Management

- Moreover, a comprehensive tripartite (Banks/ FIs, Processors and Insurance Service Providers) credit and risk mitigation system may lead to easier credit access and financial risk coverage for the farmers as depicted in the figure below.

Infographic showing comprehensive tripartite credit and risk mitigation system for dairy farmers



- As highlighted above, the higher utilization/ deployment of tamper-proof technology systems to minimize malpractices in insurance claims would lead to increased uptake of livestock insurance which can act as credit security to banks for unforeseen risks. Furthermore, dairy farmers/ groups of dairy farmers can be linked to milk processors, wherein, the processors would affirm the credit worthiness of dairy farmers to insurance service providers. Also, a part of the payment to be made to dairy farmers by the processors can be provided to banks for additional credit security, while not affecting the regular operations of producers. This will also help the milk processors in scaling up their business with assured availability of milk and continued loyalty of farmers. Therefore, leading to easier access to credit for dairy farmers.

## Marketing

- A2 milk is perceived to be having better health benefits<sup>257</sup> than the A1 milk primarily derived from high yielding breed such as Holstein Friesian and some crossbreds. The Indian indigenous breeds and buffaloes mostly produce A2 milk and it fetches a higher price when marketed as A2 milk. Concerted efforts should be made to promote A2 milk as superior health product. A2 milk products can become a unique selling proposition for selling in export markets.
- Similarly, organic milk and milk products should also be promoted across the country as there is lack of focus on promotion of such products in the country.
- GI indicators/ breed based marketing can be promoted for higher value creation (e.g. Camel milk from Rajasthan, Sahiwal milk from Punjab/ Haryana, etc.).

<sup>257</sup> Although certain studies do not support the same

- GI indicators for other milk products such as Ghee produced from indigenous cattle can be explored.
- Facilitation for creation and Revitalization of livestock markets under the Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act (APLM), 2017.
- Promotion of Collateral Management Players in the sector along the lines of those in the agricultural commodity sector, especially for products with longer duration shelf life like butter, ghee, milk powder, etc.
- To develop access to neighbouring countries for liquid milk there is a need to explore appropriate low-cost innovations for quick transport (for example, development of barge mounted milk tankers as was done to develop rail milk tankers, to tap Sri Lankan liquid milk market from east coast) to these markets.
- Ensure traceability using techniques such as block chain/ unique ID/ QR code, which will lead to much better utilisation of e-Pashuhaat.
- The key foreign markets should be identified for exports which have potential for growth and should be engaged through targeted promotional campaigns.

### **Healthcare and Extension Activities**

As mentioned earlier, the animal healthcare system in the country has several challenges including inefficiencies in provision of curative health services and limited attention towards preventive health system. In the case of curative health services, a large gap also exists between the need and the availability of animal health service providers for cows and buffaloes. This has led to farmers opting for local alternatives such as untrained personnel or self-medication. Key recommendations for improving the animal healthcare system in the country are provided below.

- All the animals should be uniquely identified to ensure traceability. The surveillance system such as INAPH should be utilized to track the health of animals. System to be developed for annual diagnosis of all animals as regards the diseases such as TB, FMD, Brucellosis etc. apart from general animal health.
- This should be supported with animal quarantine facilities at village level across the country to avoid mixing of diseased animals from healthy animals.
- CHRS should be universally expanded and linked to INAPH for continuous disease surveillance system. Early warning systems need to be developed for early identification and containment of diseases from turning into epidemic.
- There should be emphasis on capacity building on improved animal management practices, breed improvement, fodder development, milk processing facilities, etc. contributing to the natural and physical livelihood assets. There is a need for faster multiplication of superior germplasm by adopting multiple ovulation, embryo transfer and sexed semen techniques is emphasized. Efforts should be made to develop skilled personnel in this area of specialization.
- Along with raising productivity of milch animals, it is important to improve quality, both in terms of input as well as output. There is an immediate need to educate the farmers about adoption of safe milk production practices, to receive higher milk prices based on the microbial quality apart from the chemical composition. Therefore, agricultural

practices, sanitation, quality of drinking water & fodder, type and quality of pipelines - all of these need to be aligned to the goal of healthy milk.

- Skill building should be initiated by combining vocational and entrepreneurship training programmes to facilitate the support to small animal husbandry and dairy enterprises by matching supply to current demand of workers with skill and competencies. The industry should partake in short-term trainings as well as Recognition of Prior Learning (RPL) programmes under National Schemes like PMKVY, DDUGKY, etc.

RPL is a platform to provide recognition to the informal learning or learning through work to get equal acceptance as the formal levels of education. The programme aims to impart skills training for existing workers to align the competencies of the regulated workforce
- As highlighted earlier that the current number of veterinary institutions in India have a capacity to cater to only 330.84 million livestock, against the population of 535.82 million. The shortfall/ gaps can be addressed by training of para-vets who can assist a veterinary physician in the performance of their duties or carry out animal management and preliminary healthcare procedures (e.g. AI, vaccination, delivery, etc.) as part of veterinary care system.
- The para-vets can be further connected through mobile based application/ IoT enabled platform on the lines of telemedicine with the veterinarians at district/ state/ central level to provide appropriate and quick animal healthcare services at the village/ hamlet levels.

## Research and Development

- R&D to promote sexed semen of indigenous breeds. The investment for the same may not necessarily come from public sector budget. Existing international and Indian companies in the sexed semen business may be guaranteed a minimal offtake by the State Governments/ Cooperatives/ Private sector to ensure viability. This will address the problem of male calves, at the same time ensuring genetic purity of indigenous breeds, while improving productivity.
- Development and promotion of standalone, low maintenance, multi-purpose micro cold-chains running on renewable energy sources (like solar PVCs, biomass) for ensuring the quality of milk immediately after milking. There are many start-ups which are working on mini cold-chains, however, there is need for customization of such systems for milk and milk products.
- There is a need to promote R&D on development of environment friendly packaging material for packaging of milk and milk products and other livestock products.
- As mentioned earlier, in the dairy sector in India, around 40% of marketable surplus of the milk is processed either in cooperative or private sector. Compared to the processing level of milk in developed country which is pegged at around 90%, there is huge scope to increase the processing of milk through organized sector and also utilize the surplus for various milk products. Moreover, most of the milk products

Austrian producer of plastic packaging solutions Alpla and Sweden's paper packaging materials provider Billerud Korsnäs have formed a joint venture to develop a completely bio-based and recyclable paper bottle for milk.

manufactured in India by the organized sector through mechanized process majorly include milk powder, butter, ghee, curd and cheese. However, there is a large market for traditional milk based products which is catered mainly by the unorganized sector (about 80-82% which is estimated to be about Rs. 1 lakh Crores).<sup>258</sup> Considering this, adequate attention should be given on research and development for technology induction to manufacture traditional value added products maintaining the intrinsic quality along with longer shelf life. This research should be supplemented by mechanizing the production to ensure GMP and incorporate HACCP.

- Research and Development on Manure Management to reduce the carbon foot prints of manure as also utilize it as fuel and manure.
- Promote product development and product incubation centres to encourage entrepreneurs to develop and test market new products and packaging solutions.
- Some of the important areas where focus needs to be provided for R&D are listed below.
  - Ethno-veterinary medicines
  - Broiler buffalo/ goat/ sheep similar to poultry (which is only reared for meat)
  - Dry dairy to address stray cattle (cow dung, urine for medicinal purpose, and organic manure)
  - Thermo stable FMD vaccines with longer immunity
  - Recovery of IVF embryos
  - Research on heat tolerance capabilities and disease-resistance capabilities of Indian breeds
  - Region specific animal nutrition strategy for cows and buffalos

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<sup>258</sup> <https://www.indianmirror.com/indian-industries/2018/dairy-2018.html> (accessed on 02.01.2020)

### **Research and Development: The Role of Private-Sector R&D in Agricultural and Allied Activities Innovation**

The efforts to improve agricultural R&D require the public and private sector to address several critical challenges. R&D cycles need to be accelerated to further the widespread adoption of promising innovations - particularly in low-income countries such as India - as a precursor to improving outputs. The lag between successful R&D efforts and the widespread adoption of agricultural innovations have tended to be long; at least 15 to 25 years before peak impacts. In the USA for hybrid corn, the total adoption cycle from early research to commercial adoption took over 40 years—or arguably longer.

Another challenge is that many of the most promising agricultural innovations are capital-intensive, and agriculture has historically been dominated by small businesses with low profitability and limited access to capital. In developed countries, some of the promising initiatives to overcome these challenges are:

- (1) Consolidation in agriculture to boost efficiency
- (2) More widespread use of crop insurance providing farmers with more financial security
- (3) Improving access to credit.

At present, in higher-income countries, 1.99% of agricultural GDP is spent on agricultural insurance, but that falls to 0.29% in upper-middle-income countries, 0.16% in lower-middle income countries, and 0.01% in low-income countries.

The government can foster an attractive environment for venture capital funds and corporate ventures focusing on agricultural innovation, and help ensure that the investments being made by the private sector can make a greater impact, by taking the following steps:

- (1) Support agricultural extension efforts to disseminate knowledge about new technologies and techniques and to demonstrate their business case. Publicly funded agricultural extension has been a key historical link between agricultural R&D and farmers in high-income countries. Government and multi-national organizations should prioritize implementing such programmes.
- (2) Streamline regulation to reduce lag times, provide targeted tax relief to enhance farmers' incomes and financial security, and offer preferential access to land and market support for promising agricultural techniques and technologies as a result of the R&D efforts.
- (3) Create public-private partnerships, which government can use to leverage public-sector investment, enhance private sector involvement in agriculture infrastructure, and fill gaps in the delivery and adoption of innovation by public- and private-sector entities acting independently.

(Source: The Global Innovation Index (2017), World Intellectual Property Organization (WIPO))

### **Policy Level Interventions**

- Over the years, the contribution of the sector to the agricultural GVA has increased manifold from 21.6% in 2011-12 to 27.4% in 2017-18. The sector also constitutes 11% of the agricultural exports. This clearly indicates the increasing contribution of livestock sector in the economy. However, the sector has not received adequate attention from the policy makers which is reflected in the budget for animal husbandry and dairying related

schemes constituting only 2.1% of the agricultural budget. Considering the increasing dependence of rural population and its overall contribution in GVA, the budget for animal husbandry and dairying may be rationalised more in line with its contribution.

- It has been observed that many times that the schemes are unable to perform as per the expectations due to lack of or delayed contribution of funds by the State Governments. This is mostly due to fiscal situation of the State Governments and their own development priorities. Considering this it is recommended that some of the major schemes which are critical for the growth of the sector may be funded as Central Sector Schemes.

Box 21: Milk: Production Excess of Consumption in the Future

- There is a need to shift the focus from “domestic market and consumption” to “export oriented production”. India is already a milk sufficient country, however, India’s share in the global exports is low.

One of the reasons for unacceptability of the Indian milk products including SMP in the international markets stems from quality issues. This can be addressed by clean milk production, traceability, micro level cold chains and quality-

#### **Milk: Production Excess of Consumption in the Future**

Exports of SMP from India is low as compared to exports from countries such as USA and NZ although, the overall milk production is much higher in India. The Indian SMP is considered to be of inferior quality which results primarily from the lower quality of milk produced and collected.

In the year 2018, a significant glut was observed in milk production in India leading to steeply falling prices of milk. To reduce the inventory of SMP in the country, Government of India approved a subsidy of 10% on export price while certain state governments such as Gujarat and Maharashtra offered Rs 50,000 per MT of SMP as additional subsidy for exports.

Source: Dairy sector reeling under low prices, high SMP inventory, Outlook, July 2018

based efficient production systems, with export market as a target to increase India’s share in the global milk products trade.

- The focus needs to be on promotion of entrepreneurship led sustainable models in the sector.
- OIE-World Organisation for Animal Health, within the framework of close collaboration and the development of joint strategies with FAO and WHO to prevent health risks at the human–animal–ecosystems interface, have set three priority areas which are animal influenza, antimicrobial resistance and rabies<sup>259</sup>. It is recommend that control of these diseases should be made a national priority as well with 100% central assistance.
- Information Network for Animal Productivity and Health (INAPH) should be the common system to be adopted by all the stakeholders to create data, carry out analysis and generate reports so that compiled data and required analysis would be available at national level which would further facilitate planning process with high accuracy in future. Presently, this network is not integrated across the different stakeholders of the sector and is being used in an isolated way by certain schemes. This leads to information

<sup>259</sup> The 3 priorities of the Tripartite Alliance, OIE <https://www.oie.int/en/for-the-media/onehealth/oie-involvement/stone-mountain/> accessed on 15 March, 2020

asymmetry. There is a need for further development of a comprehensive livestock database to capture real-time information on animal and various aspects of animal management practices to inform policy development. INAPH can be upgraded to capture this aspect also.

- The total value of output from livestock sector comprises of about 66% from milk group of products and less than 25% from eggs, meat and meat products. This sub-sector also needs to be given equal emphasis as the dairy sector, given that it contributes significantly to nutritional security, especially overcoming protein deficiency and continued significant contribution to exports. Most of the schemes in the sector are geared towards dairy with either a small component for other sub-sectors, except for NLM, where the focus is on small ruminants, piggery and poultry.
- Bringing White Revolution to Eastern and North-Eastern India: Operation Flood and White Revolution have spurred growth in milk production and dairying in India. Focus on dairy cooperative structure and infrastructure development has also helped in increasing per capita production and better productivity. However, as the sectoral statistics show, eastern states like Bihar, Odisha, Chhattisgarh still lag far behind to their western, northern and southern counterparts. It is observed that while states like Bihar have a very high number of dairy cooperative societies, it has limited infrastructure and procurement. Eastern and North Eastern States like Assam (71 gm/day), Orissa (132 gm/day), West Bengal (153 gm/day), and Bihar (239 gm/day) have low per capita availability of milk<sup>260</sup> and there is wide gap in infrastructure for procurement, processing and marketing of milk. **Considering this, a separate strategy needs to be developed for boosting milk production in eastern and north eastern states.** The dairy cooperatives in these states have to be supported financially and technically. Additionally private dairies can also be promoted.
  - It is observed that the milk procurement for entire eastern region is only 2871 (TLPD) most of which is concentrated in Bihar. This is lower than the total procurement in States of Maharashtra, Gujarat, Karnataka and Tamil Nadu. Therefore, adequate focus must be given on milk procurement through cooperatives to strengthen.
  - The state cooperatives can be handheld by central government or NDDB. A specialised technical team can be established at state level to assess the situation and develop strategy.
  - Studies can be financed to assess gaps, bottlenecks and opportunities in these states
  - Awareness generation on livestock health and productivity improvement should be promoted to boost production in these States
  - Separate breed improvement institute can be established for production of HGM bulls and increase coverage of AI in these states.
  - Region specific animal nutrition strategy have to be developed for better animal health, this will help in breed improvement and increasing production.

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<sup>260</sup> Department of Animal husbandry, dairy and fisheries. 2019. Basic Animal Husbandry and Fisheries statistics, 2018. Retrieved from <http://dahd.nic.in/>

- Tie-ups can be developed with the agricultural department for diversification and promotion of integrated farming and livestock management practices.
- More animals should be bought under INAPH portal and their health and nutrition have to be monitored
- New schemes such as NADCP needs to be promoted to control diseases like FMD, brucellosis. In addition, a focus needs to be provided for controlling bovine mastitis in these states.

**Key Recommendations at the Sector Level for Achieving Transformational Improvements  
Across the Value Chain**

- Availability of feed and fodder, both in terms of quantity and quality is a major constraint. The area under fodder crops has stagnated at about 8.5 to 9 million hectares. Expected shortfall in demand for dry, green and concentrates is 11%, 35% and 45% respectively . The pasture lands in India are overgrazed and not properly managed which leads to lower productivity. In many states the grazing pressure is very high compared to carrying capacity with 70% of grazing land identified in poor and very poor condition . Increasing cost of feed and fodder has been identified as the major constraint in dairy sector. Despite these constraints, very limited focus is there within the Animal Husbandry scheme on fodder development. Under NLM, it accounts for less than 15% of total funds spent. Considering the challenge, increasing feed and fodder availability for animals will help in reducing input costs. Focus should be on better management of grazing land and quality fodder production by bringing more area under green fodder cultivation. Diversified cultivation of crops including millets, legumes is not only beneficial for soil health but is essential for economical milk production as well.
- There are government animal farms which are not being utilized in an efficient and effective manner. It is suggested that these farms may be leased out to the youth/ FPOs in the area in a transparent manner to promote entrepreneurship development in the community.
- A comprehensive tripartite (Banks/ FIs, Processors and Insurance Service Providers) credit and risk mitigation system may lead to easier credit access and financial risk coverage for the farmers, a presented in Box #15.
- Business incubators should be promoted to handhold the grass-root organizations/ farmer collectives into viable businesses and scaling up of operations through effective go-to-market strategies and adoption of integrated farming model. For instance, Villgro, Intellicap, Encore, Center for Innovation, Incubation and Entrepreneurship (CUE IIMA), Start-up Oasis, SIDBI Innovation and Incubation Centre (SIIC) are some of the business incubators, which are presently incubating social enterprises including agri/ dairy enterprises across the country.
- Efforts need to be devoted towards rollout of countrywide vaccination campaigns for preventable communicable diseases prevention in cattle. Campaigns on the lines of “Pulse Polio” (immunization campaign established by the Government of India to eliminate poliomyelitis (polio) in India) may be undertaken for improving production and productivity along with better quality of milk. Diseases like FMD, Brucellosis can be eradicated from the country by adopting an intensive vaccination programme. This initiative can be taken at a state level by prioritization of geographies for eradication of diseases.
- Hydroponics generally involves high investment, many times rendering it unviable for fodder cultivation. Although there are certain low-cost hydroponic options, however, more R&D is

required for cost reduction of hydroponic technology for fodder production along with increased efficiency.

- More private sector players need to be attracted in breed improvement, diversification of products, processing and value addition of livestock products by providing subsidy and interest subvention in the initial period. Similar models/ schemes under implementation by a few of other central government ministries such as Setting up of Electronic Manufacturing Clusters by Ministry of Electronics and Information Technology, Scheme for Integrated Textile Parks by Ministry of Textiles, etc. aim at mobilizing investment from private players for development of respective sectors.
- As highlighted above, a separate strategy needs to be developed for boosting milk production in eastern and north eastern states.
- Technical support groups involving multi-disciplinary team needs to be created for project management, planning and implementation at the central and state level. Fixed term contracts/ tenures for scheme level officials for 3-4 years with yearly performance linked appraisal may be introduced for higher accountability.

## Part:C – Fisheries Sector

### Chapter 1: Sector Level Analysis: Fisheries

#### 1.1 Background of the Sector

Historically, fishing comprised artisanal inshore capture fishery using traditional sailboats and cataramans. The Indian Fisheries Act of 1897 was a milestone act in India's history, which delegated to the erstwhile Provinces (States) the responsibility of development and conservation of fisheries in the inland and territorial waters of the respective States. It also empowered the States to formulate their own rules and regulations for the protection and safeguard of their fisheries. Further, the Act provided adoption of conservation measures to prevent the destruction of resources. Consequently, the development, management and conservation of fish and fisheries became a State subject. India has come a long way since then. Fish production has increased from 0.75 Million Metric tonnes (MMT) in 1950-51 to 13.7 MMT during 2018-19<sup>261</sup>.

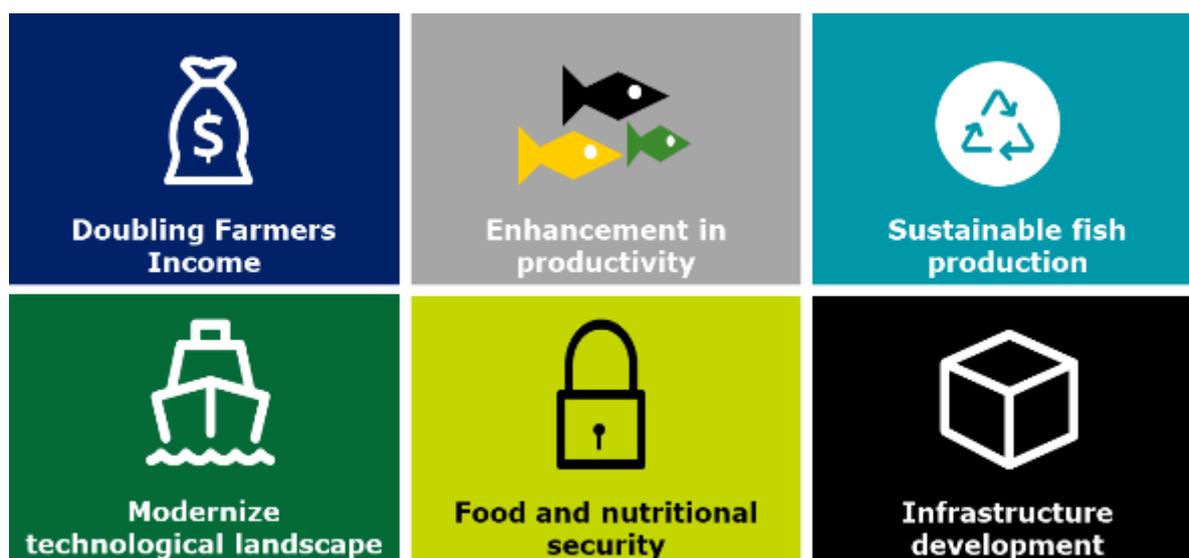
Fisheries and aquaculture sector provides employment to 14.5 million people, and contributes close to 1% to national GDP. India accounts for over 5% of global fish production, and is the second largest fish producer in the world (after China), with a total production of 13.7 million metric tons (MMT) in 2018-19. Despite this, India suffers from low remuneration for fisherfolk (as fish products are highly perishable and most small and marginal farmers cannot afford to invest in decent infrastructure to preserve quality), low yields compared to global standards, low technology penetration, limited infrastructure, and over exploitation of inland fisheries.

The government through its schemes intends to increase production and productivity of fisheries in a responsible and sustainable manner. To achieve this, it has strengthened focus on modernizing technology through use of motorized craft, onboard pre-processing facilities, satellite-based remote sensing techniques, and establishment of hatcheries, among other things. The government is also committed to ensure infrastructure development in the sector, particularly post-harvest infrastructure to ensure decent remuneration to fisherfolk. Lastly, an enhancement in fish production would not only increase food and nutritional security (as fish products are high in protein and Omega-3), but would also increase farmer income if the products can be exported internationally after value-addition. A representative illustrative of the sector's vision is given below:

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<sup>261</sup> Department of Animal husbandry, dairy and fisheries. 2019. Annual Report 2018-19

Figure 1244: Fisheries Sector Vision



Source: National Fisheries Development Board; Deloitte analysis

This chapter on sector analysis covers background on production trends, contribution of the sector to Gross Value Added (GVA), exports, and employment creation, as well as structure and key growth drivers. The section also covers sector performance in terms of storage and processing infrastructure, post-harvest infrastructure, price realisation by farmers, and the export trends. At the end, an analysis of major centrally sponsored schemes (CSS) is presented, covering the scheme objectives, components, and Deloitte’s assessment of the impact of these schemes on beneficiary groups, infrastructure creation/upgradation, and capacity building, etc. wherever available.

A number of previous studies, evaluation reports, and annual reports were reviewed through the course of the study, including those from UN Food and Agriculture Organisation (UNFAO), NABARD, Lok Sabha Standing Committee, NITI Aayog, Economic Survey, Ministry-level reports, Department annual reports, other independent evaluation reports and analysis, among others.

### *Fisheries Sector Assessment*

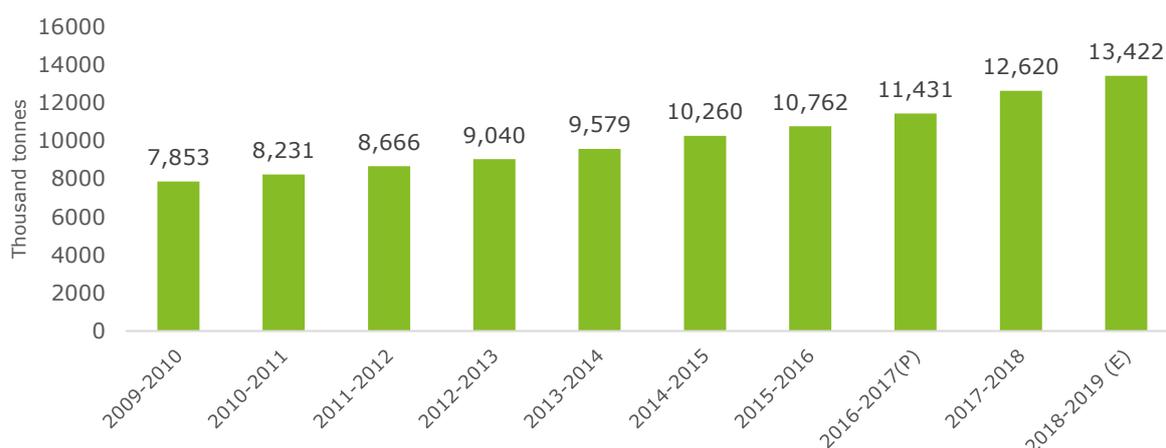
Fisheries and aquaculture is considered the sunrise sector in the Indian economy, providing employment to 14.5 million people, and contributing close to 1% to national GDP and 5.2% of agricultural GDP<sup>262</sup>. India accounts for over 5% of global fish production<sup>263</sup>, and is the second largest fish producer in the world (after China), with a total production of 13.7 million metric tons (MMT) in 2018-19<sup>264</sup>. More than 50 different types of fish and shellfish products are being exported to 75 countries around the world. Fish and fish products have emerged as the largest group in agricultural exports from India.

<sup>262</sup> Ministry of Finance Govt. of India (2019). Economic Survey 2018-19. Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

<sup>263</sup> Unless otherwise specified, the term ‘fish’ includes fish, crustaceans, molluscs and other aquatic animals, but excludes aquatic mammals, reptiles, seaweeds and other aquatic plants.

<sup>264</sup> Ministry of Finance Govt. of India. 2019. Economic Survey 2018-19. Retrieved from <https://www.indiabudget.gov.in/economicsurvey/index.php>

Figure 145: Fish production in India, 2009-10 to 2018-19e



Source: National Fisheries Development Board, Government of India; Economic Survey 2018-19; Marine Products Export Development Authority

India has been able to exploit and utilize only around 57 percent of potential in the Fresh Water Aquaculture and around 70 percent in Marine Fisheries. The fish production has increased to 12.61 MMT in 2017-18 with a contribution of 8.92 MMT from inland sector and 3.69 MMT from marine sector. The marine resources of the country comprise an Exclusive Economic Zone (EEZ) of 2.02 million sq. kms, a Continental Shelf Area of 5,30,000 sq. km and a Coastline of 8,118 kms<sup>265</sup>. The Marine Fishery Potential in the Indian waters have been estimated at 5.31 MMT constituting about 43.3% demersal, 49.5% pelagic and 4.3% oceanic groups.

Table 44: Fisheries landscape in India

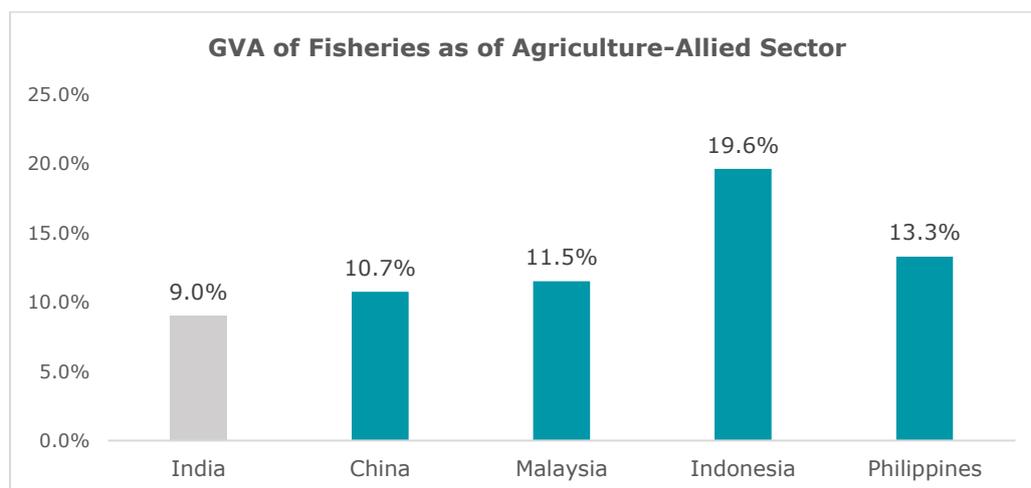
	2014-15	2015-16	2016-17	2017-18
<b>Contribution to total GVA</b>	0.8%	0.9%	0.9%	0.9%
<b>Annual Export earnings (In Rs. Crore)</b>	33,441.6	30,420.8	37,870.9	45,106.9
<b>Employment (In million)</b>	14.5	14.5	14.5	14.5

Source: National Fisheries Development Board, Government of India; Economic Survey 2018-19; Marine Products Export Development Authority

The contribution of the fisheries sector in the economy as represented through the Gross Value Added from Fisheries sector to that of Agriculture and Allied sector has been compared across different geographies to benchmark India's status. India's GVA of Fisheries in total Agri-Allied GVA ratio is compared with nations heavily dependent on fishery activity such as China, Indonesia, Malaysia and Philippines. The graph below compares the GVA of Fisheries as a share of GVA in Agri-Allied Sector.

<sup>265</sup> Fifth Report Standing Committee on Agriculture 2019-20, Ministry Of Fisheries, Animal Husbandry And Dairying (Department Of Fisheries), Demand for Grants

Figure 146: Comparison of Fisheries GVA as a share in Total Agri-Allied GVA of India and Other Countries



Source: EMIS Insights Industry Reports- China, Malaysia, Indonesia, and Philippines

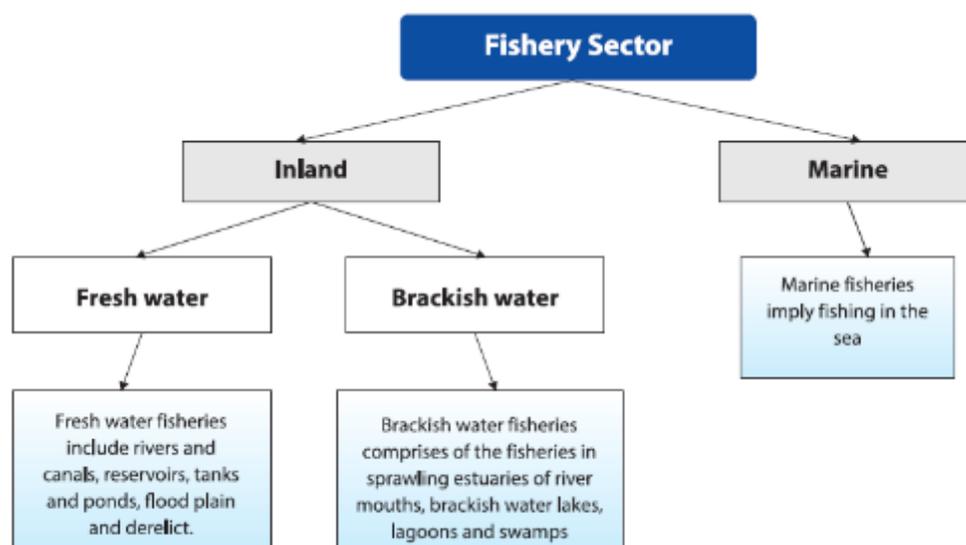
As it can be seen from above, India’s fisheries sector contribution to the total agriculture economy is similar to that of China and Malaysia, while other South East Asian countries like Philippines and Indonesia have a higher contribution from fisheries to its agriculture and allied sector.

*Key commodities of the sector*

**Fisheries**

There are two main types of fishing: Inland fishing, and Marine fishing. Inland fishing refers to fishing in freshwater (lakes and rivers) while marine fishing refers to fishing in saltwater (oceans). Traditionally, the output of marine fisheries was higher than that of inland fisheries<sup>266</sup>. However, since 1991, India’s Inland Fish production has increased gradually. In 2000-01, inland fisheries overtook marine fisheries in terms of production and the trend has endured since then.

Figure 13: Fisheries sector structure



Another way of categorizing fish cultivation is Capture and Culture fisheries.

<sup>266</sup> <https://www.gktoday.in/gk/success-of-inland-fisheries-in-india/>

**Capture fisheries** refer to exploitation of aquatic organisms without stocking the seed. Recruitment of the species occur naturally. This is carried out in the sea, rivers, reservoirs, etc. Fish yield decreases gradually in capture fisheries due to indiscriminate catching of fish including brooders and juveniles.

**Culture fisheries** refer to cultivation of selected fishes in confined areas with utmost care to get maximum yield. The seed is stocked, nursed and reared in confined waters, then the crop is harvested. Culture takes place in ponds, which are fertilized and supplementary feeds are provided to fish to get maximum yield. Due to the culture of a variety of aquatic organisms (prawns, crabs, molluscs, frogs, sea weeds, etc.), culture fisheries has been termed as **aquaculture**.

From a production level of 0.75 million tonnes in 1950-51, total fish production reached 13.4 million tonnes in 2018-19<sup>267</sup>. **Despite this tremendous increase, India still produces only a tenth of world's number one fish producer, China.**

The marine fisheries sector contributes 30% to total production, against 70% by the inland sector as of 2018-19. While inland sector is a major contributor in India, globally marine sector contributes the major share of 66% indicating the preponderance of the inland sector in India.<sup>268</sup> The inland sector has grown at a faster rate due to growth of aquaculture and because Indians tend to prefer low cost-high protein fish.

The fisheries and aquaculture sector has the potential to contribute to many of the Sustainable Development Goals covering poverty, hunger and food security, protection, restoration and management of inland water resources and ecosystems and biodiversity.<sup>269</sup> Hence, fisheries has been recognised as important component of integrated farming system being advocated as one of the strategies for doubling of farmers' income<sup>270</sup>.

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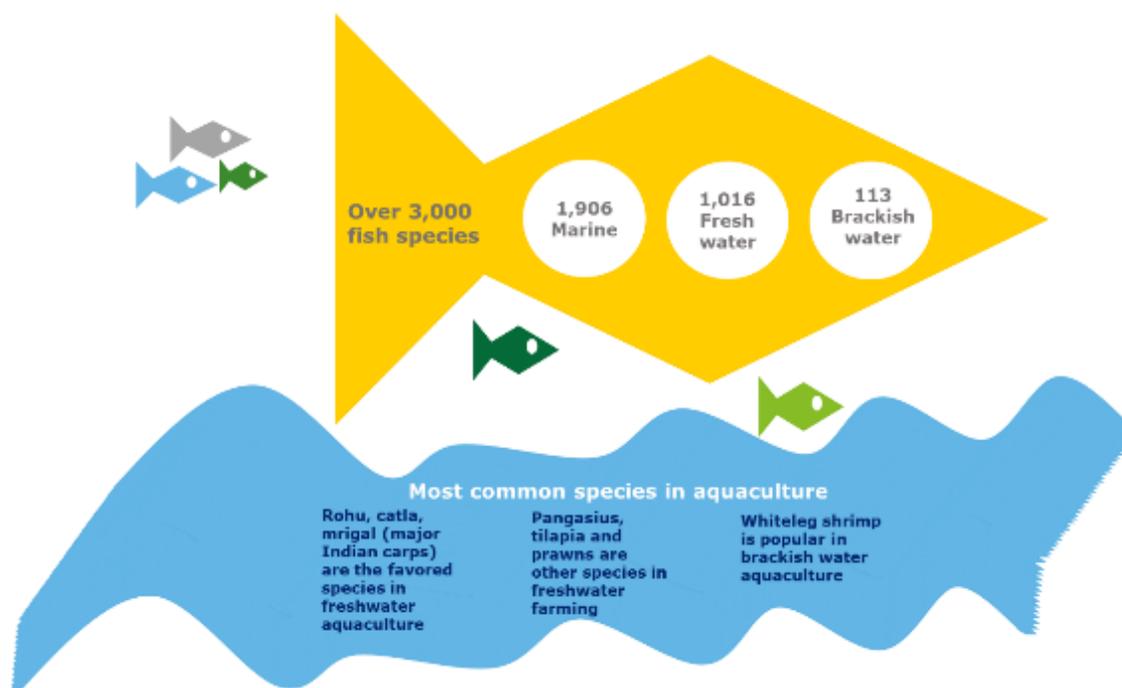
<sup>267</sup> Source: Lok Sabha Unstarred Question No. 457 and 578, dated 25.06.2019; Ministry of Agriculture & Farmers Welfare, GoI (ON1873) & Past issues

<sup>268</sup> NABARD. 2018. Sectoral Paper- Fisheries and Aquaculture. Retrieved from <https://www.nabard.org/auth/writereaddata/file/Fisheries%20and%20Aquaculture.pdf>

<sup>269</sup> Sampantamit. Links and Trade-Offs between Fisheries and Environmental Protection in Relation to the Sustainable Development Goals in Thailand. Retrieved from <https://www.mdpi.com/2073-4441/12/2/399/htm>

<sup>270</sup> NABARD. 2018. Sectoral Paper, Fisheries and Aquaculture. <https://www.nabard.org/auth/writereaddata/file/Fisheries%20and%20Aquaculture.pdf>

Figure 14: Fish species in India



Source: Department of Animal Husbandry & Dairying

### Aquaculture feed

The India Aquaculture Feed Market was valued at USD 1.20 billion (Rs. 7790 crore) in 2017 and is expected to register a CAGR of 10.4% during 2018-2023<sup>271</sup>. The Aquaculture Feed Market consists of fish feed, molluscs feed, crustacean feed. There are further sub-segments of carp feed, salmon feed, tilapia feed, catfish feed and others in fish feed. Major feed ingredients include de-oiled rice bran, wheat bran, cotton seed cake, and groundnut cake. In order to maintain quality of fish feed, quality control at fish feed mills and manufacturing units are maintained.

### Key drivers for growth

- **Low current per capita consumption:** The average per capita consumption of fish in India stands at 6.6kg/year while it stands at 20kg/year globally (UN FAO). This leaves immense scope for increase in domestic consumption, which can drive the market. The growing restaurant culture, greater product availability, and rising awareness on health benefits are expected to further support this trend.
- **Growth of aquaculture:** In 1980s, aquaculture contributed less than a fifth to India's fish production; by 2030, it is expected to be responsible for two-thirds of fish production. This increase will lead to higher overall production of fish, as well as higher demand for better quality feed. With the decline in demand for capture fish owing to overfishing and pollution issues, aquaculture has gained pace.
- **Improvement in infrastructure:** Currently, the fish industry utilizes only 1% of total cold chain infrastructure in the country<sup>272</sup>. Acknowledging this, The Marine Products

<sup>271</sup> Mordor Intelligence. 2019. India Aquaculture Feed Market - Segmented by Type - Growth, Trends, and Forecast (2020 - 2025)

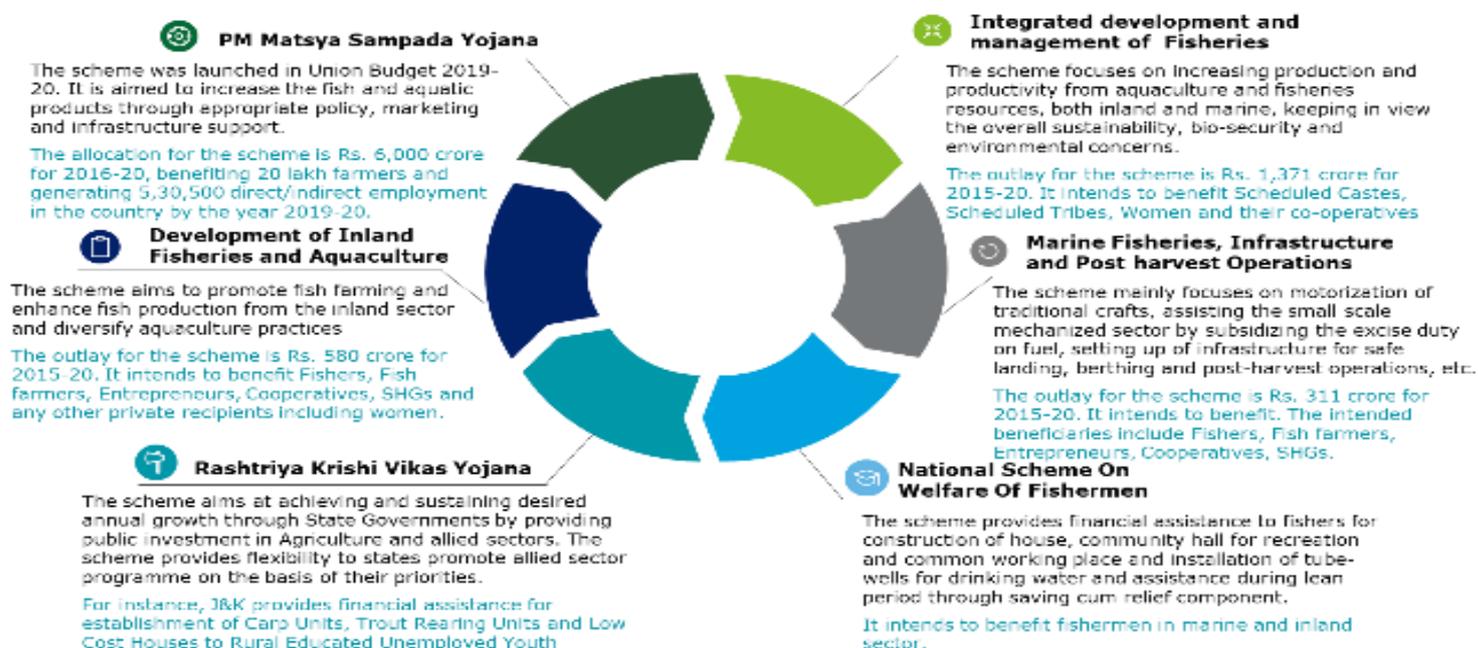
<sup>272</sup> Yes Bank. 2015. Indian Sea Food Industry: The Cold Chain Perspective. Retrieved from <https://www.yesbank.in/beyond-banking/knowledge-reports/food-and-agriculture/indian-sea-food-industry-the-cold-chain-perspective>

Export Development Authority (MPEDA) has identified development of cold chain infrastructure as a thrust area. It is now focusing on: monitoring of seafood quality in landing and pre-processing centers; setting up mini labs and pre-processing centers for preserving quality; evolving compliance standards, and upgrading existing fishing harbours.

- **Improved technology:** A switch towards more technology-driven and efficient intensive farming technologies has enabled fish farmers to increase production in the last few years. Yet, there is immense scope for modernization at ports and harbours, and hygienic handling facilities.
- **Favorable government policies:** The government has merged all schemes of fisheries sector into an umbrella scheme of “Blue Revolution: Integrated Development and Management of Fisheries”. This is expected to sharpen focus on fish production and productivity from aquaculture and fisheries resources. A Fisheries and Aquaculture Infrastructure Development Fund (FIDF) has also been approved with a corpus of Rs. 7,522.48 crore. A National Inland Fisheries and Aquaculture Policy (NIFAP) is also on the anvil.
- **Integration with Sagarmala programme:** Union ministry of shipping is expending Rs 4,142 crore on development of 28 fishing harbours across India under the Sagarmala Programme. The development of these harbours and consequent development of coastal regions will generate new employment opportunities and boost fish production in the country.
- **Large Exclusive Economic Zone (EEZ):** India has one of the largest EEZ of 2.02 million sq. km (compared to China’s 0.88 million sq. km), implying that India has exclusive jurisdiction over the resources present in this zone including navigation of seafaring trade. The fish resources in the EEZs are still underexploited due to limited resources with the fishers for buying deep-sea vessels.

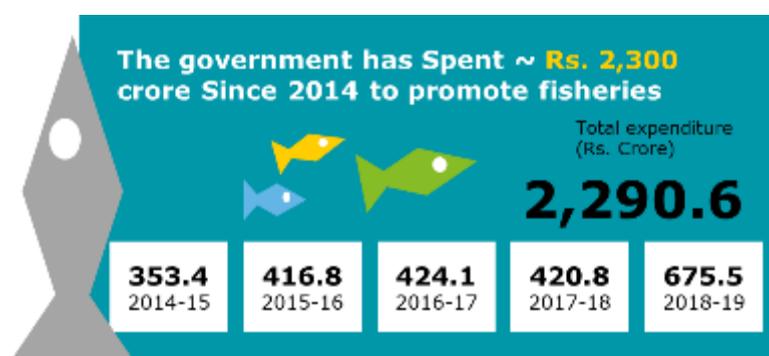
## Central and state government policies and reforms

Figure 14915: Select schemes for fisheries sector in India



Source: Press Information Bureau, Ministry of Agriculture & Farmers Welfare, dated 22 December 2015; Department of Animal Husbandry & Dairying; Ministry of Food Processing Industries

Figure 150: Government spend on fisheries since 2014-15



Source: Press Information Bureau, Ministry of Fisheries, Animal Husbandry & Dairying, dated 02 July 2019

## Agencies/ Infrastructure involved

Table 45: Agencies/Infrastructure involved in fisheries

Fish Farmers Development Agencies (FFDAs)	429
Brackish water Fish Farms Development Agencies (BFDAs)	39
Hatcheries	1,604
Landing centers	1,537
Major fishing harbours	7
Minor fishing harbours	75

Source: National Fisheries Development Board

### Employment profile

About 75% of fishers are engaged in inland fisheries activities while 25% are involved in marine fisheries activities<sup>273</sup>.

Table 46: Fishers profile

<b>Fishermen population (as per Livestock Census, 2003)</b>		
a)	Number of family members	
i	Males	4,696,158
ii	Females	4,033,963
iii	Children	5,755,233
	<b>Total</b>	<b>14,485,354</b>
b)	Engaged in fishing operations	
i	Full time	933,124
ii	Part time	1,072,079
c)	Engaged in fishing related activities other than actual fishing	
i	Marketing of fish	391,000
ii	Repair of fishing nets	245,100
iii	Processing of fish	46,200
iv	Other activities	334,700

Source: Department of Animal Husbandry, Dairying; Handbook of Fisheries Statistics

## 1.2 Performance of the Sector

### Production and productivity

India is the second largest fish-producing nation in the world. Combining the production of all types of fisheries (capture and culture), the total fish production in the country has reached at about 13.4 MMT in 2018-19e<sup>274</sup>. Over 70% of this production is from inland fisheries. India currently exports over 10% of its production.

Table 47: Fish production in India (in '000 tonnes)

	<b>2014-15</b>	<b>2015-16</b>	<b>2016-17</b>	<b>2017-18</b>	<b>2018-19e</b>
<b>Fish prod.</b>	10,260.3	10,761.8	11,430.8	12,620.4	13,421.6
<b>Inland fish</b>	6,690.8	7,162.1	7,805.8	8,932.5	9,709.5
<b>Marine fish</b>	3,569.5	3,599.7	3,625.0	3,687.9	3,712.1

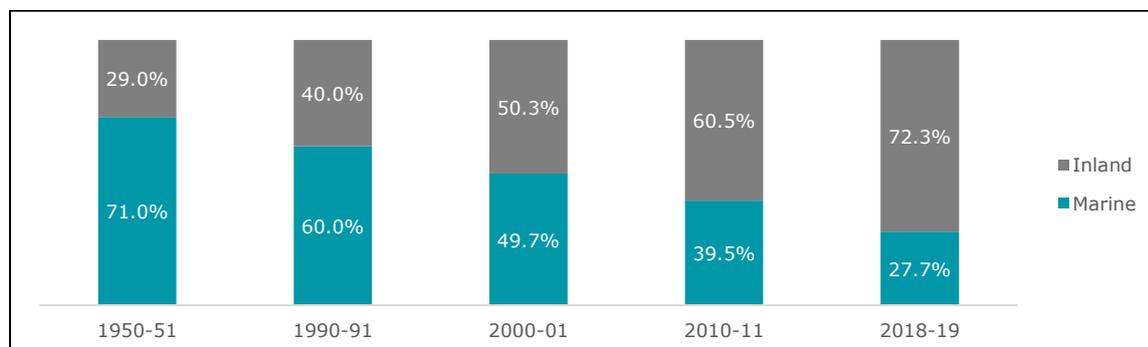
Source: Lok Sabha Starred Question No. 222, dated 02.08.2016; Lok Sabha Unstarred Question No. 457 and 578, dated 25.06.2019; Ministry of Agriculture & Farmers Welfare, GoI (ON1873) & Past issues

<sup>273</sup> Yes Bank. 2015. Indian Sea Food Industry: The Cold Chain Perspective. Retrieved from <https://www.yesbank.in/beyond-banking/knowledge-reports/food-and-agriculture/indian-sea-food-industry-the-cold-chain-perspective>

<sup>274</sup> National Fisheries Development Board

In India, a unique trend persists wherein the share of freshwater fishes is higher than that of marine fishes. This reflects the taste preferences of Indian consumers who prefer low cost-high protein alternatives.

Figure151: Share of marine and inland fisheries in total fish production, 1950-51 to 2018-19



Source: Ministry of Agriculture & Farmers Welfare, Govt. of India

Andhra Pradesh and West Bengal are the two largest states in India in terms of total fish production. These two states are also the largest producers of freshwater fish in the country. Gujarat and Andhra Pradesh lead in saltwater fish production.

Table 48: Selected Country-wise comparison of fish production (in '000 tonnes), 2016

Country	Inland fish	Marine fish	Total
China	2,318.0	15,246.0	17,564.0
India	1,462.1	3,599.7	5,061.8
Myanmar	886.8	1,185.6	2,072.4
Indonesia	432.5	6,109.8	6,542.3
Philippines	159.6	1,865.2	2,024.8
Thailand	187.3	1,343.3	1,530.6
Russian federation	292.8	4,466.5	4,759.3
Mexico	199.7	1,311.1	1,510.8

Source: The State of World Fisheries and Aquaculture, Food and Agriculture Organization of United Nations, 2018

The comparison of India's fish production with nations having considerable fish production reveals that India's share of marine fish production is lower than all other countries except Myanmar. This shows there is scope of improving marine fish production in India as well, given India's lengthy coastline.

### *Processing & Storage Infrastructure*

In India, many people still suffer from under-nourishment and poverty, therefore, it is imperative to minimize post-harvest losses. For fish and other seafood, the situation is even more crucial as the reduction in quality is quick. Fish for consumption in domestic market is not processed and is stored in ice flakes for transportation. Domestically, the vendors procure unprocessed fish from commission agents after primary sorting and grading to sell to consumers in local markets as soon as possible (due to high perishability). For export, the products are generally moved to flake ice/ block ice (farm to factory) to block processing/ blast freezing/ IQF (processing and freezing), to freezer cold storages (storage), and finally to cold chain containers (logistics and export).

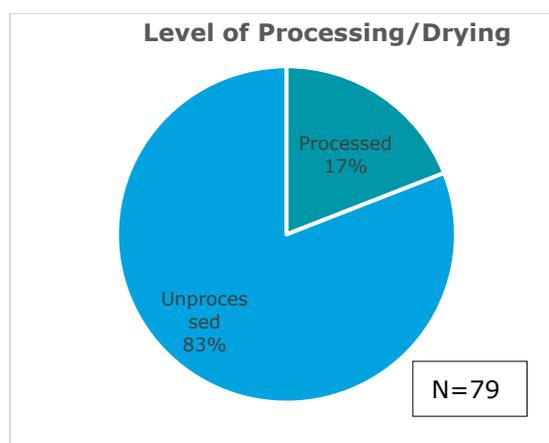
Table 49: Total Post-harvest infrastructure in India

Pre-processing facilities		Processing facilities		Storage facilities		Handling facilities		Ice Plant	
No.	Capacity (MMT)	No.	Capacity (MMT)	No.	Capacity (MMT)	No.	Capacity (MMT)	No.	Capacity (MMT)
706	8,680.1	579	30,631.5	779	415,748.7	269	4,042.8	81	2,355.4

Source: The Marine products Export Development Authority, as on 10 September 2019

Observations from the HH Survey has analysed the level of processing and drying of fish being done by fisherfolks. The graph below represents the findings.

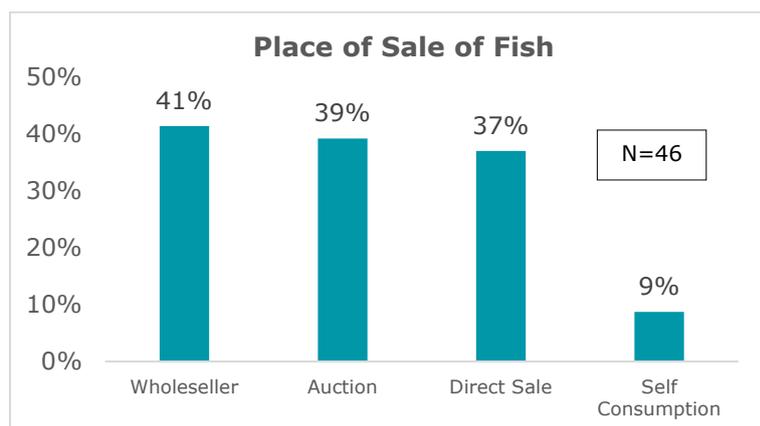
Figure 152: Level of Processing/Drying by fisherfolks



Source: HH Survey, Deloitte Analysis

The places of sale of fish has been analysed in the HH Survey. The graph below depicts the findings of the analysis.

Figure 153: Place of Sale of Fish



Note: Respondent adopted more than one place of sale. Hence total percentage may exceed 100%

Source: HH Survey, Deloitte Analysis

Around 41% fisherfolks have sold the fish produce to the wholesaler, 39% fisherfolks have sold the fish produce at the auction and 37% fisherfolks have sold the fish produce directly to consumers. Around 9% of fisherfolks consume the produce/ catch themselves.

### Post-harvest losses

Significant post-harvest losses occur due to lack of availability of storage infrastructure at many places. The losses tend to multiply in small-scale fisheries due to inadequate infrastructure. Facilities/ techniques such as ice flakes, smoking, solar drying may be used to reduce these losses. Some physical losses are caused by insects, which consume large quantities of fish flesh. CIPHET has conducted periodic studies to estimate post-harvest losses across the value chain in agriculture and allied sector. Two such studies have been conducted, the first study was published in 2012 and the second was published in 2015.

Table 50 Post-harvest losses for Fisheries reported in CIPHET studies

	2012	2015
Inland Fish	6.92%	5.23%
Marine Fish	2.78% (excluding losses in harvesting operations)	10.52% (including losses in harvesting operations)

As can be seen from the table above that the overall total losses reported in fisheries operations varies for Inland and Marine Fish. The reported losses reduced for inland fisheries from 6.92% to 5.23% and increased for marine fish. However, the difference in marine fish case is primarily due to the losses reported in harvesting operations (7.4%), which were not accounted for in the previous study. The status of post-harvest losses in fisheries for 2015 is presented below.

Table 51: Post-harvest losses in fish produce at national level

Losses reported in fisheries operation	Inland Fish (%)	Marine Fish (%)
Harvesting	1.74	7.40
Collection	0.37	0.75
Sorting Grading	1.72	0.41
Drying	-	0.13
Packaging	0.18	-
Transport	0.17	0.91
<b>Total loss in farm operations</b>	<b>4.18</b>	<b>9.61</b>
Farm level storage	0.09	-
Godown/ cold storage	-	-
Wholesaler	0.24	0.65
Retailers	0.72	0.26
<b>Total loss in storage</b>	<b>1.05</b>	<b>0.91</b>
<b>Overall total losses</b>	<b>5.23%</b>	<b>10.52%</b>

Source: Report on Assessment of Quantitative Harvest and Post-Harvest losses of major crops and commodities in India, CIPHET, 2015

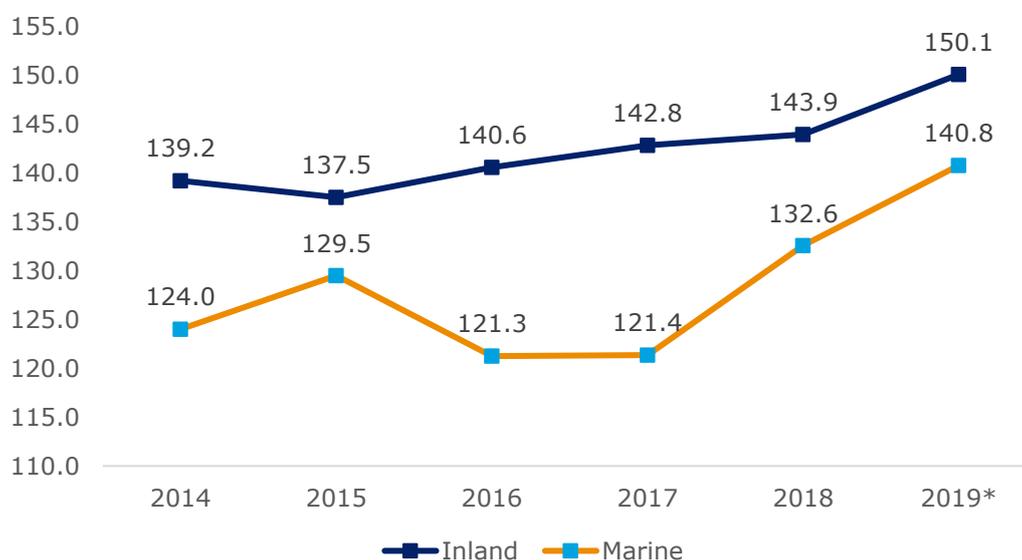
It is important to note that significant variation has been reported across regions within India. Lowest losses for inland fisheries were reported in West Bengal (1.62%) while highest were reported for Bihar (8.88%). Similarly higher losses were reported for marine fishes in southern plateau (11.41%) in comparison to east coast (3.83%). It may be noted that there are also instances where post-harvest losses of up to 20-25% have been reported across the value chain<sup>275</sup>.

<sup>275</sup> Cabinet approves Pradhan Mantri Matsya Sampada Yojana for boosting fisheries sector, <https://pib.gov.in/PressReleasePage.aspx?PRID=1625535>

### Price Realization

The per unit price realization has been gradually increasing in the inland sector, owing to rise in diversity and value added products coming from aquaculture.

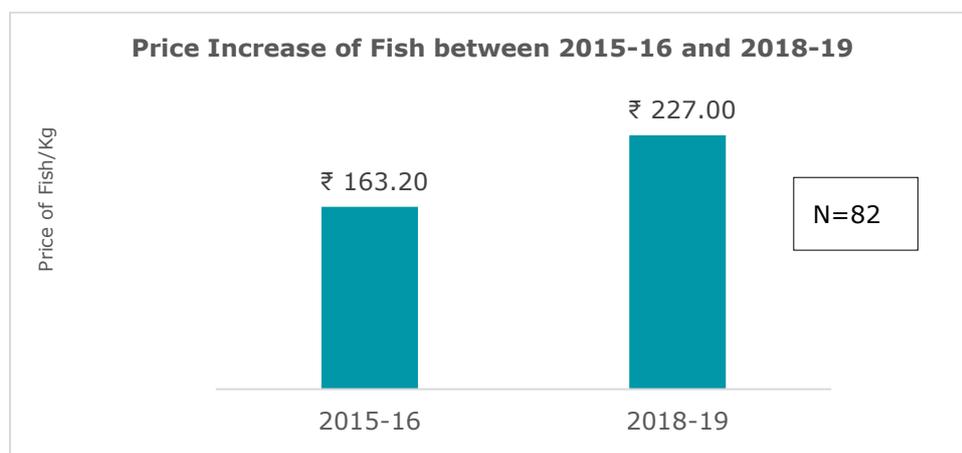
Figure 154: Average annual Wholesale price of fish



\*Data until June 2019; Source: Ministry of Commerce and Industry, Government of India

The price increase of fish as realized by fisherfolks has been analysed from the Household Survey. The findings of the increase in price of fish has been provided below.

Figure 15516: Price Increase of Fish between 2015-16 and 2018-19



Source: HH Survey, Deloitte Analysis

As it can be seen from the graph, there has been a 39.1% increase in price of fish between 2015-16 and 2018-19.

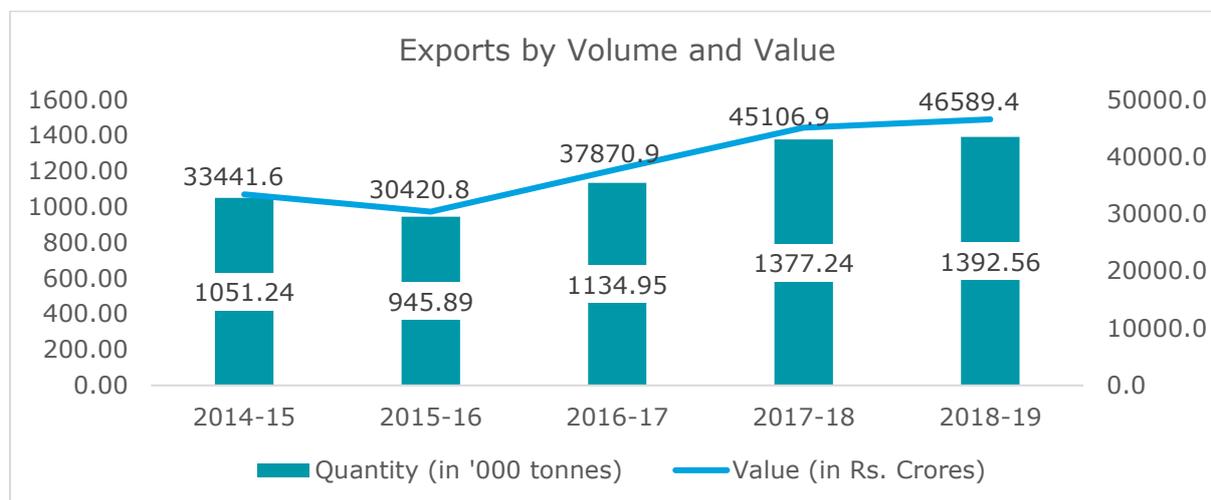
### Exports

While the world agricultural trade has been relatively stagnant during 2013-17 (majorly) due to fall in global prices, India's export of coffee, cereals, horticultural produce doubled; while exports of meat, fish, processed products grew between three to five times.

The Agriculture Export Policy 2018 was approved by Government of India in December 2018 which aims to increase India's agricultural exports to USD 60 billion by 2022 and USD 100 billion in the next few years with a stable trade policy regime. Many state governments have also introduced export policies, with special focus on agri exports, including fisheries. The trend of exports for the sector have been provided below.

### Trend of exports for the sector

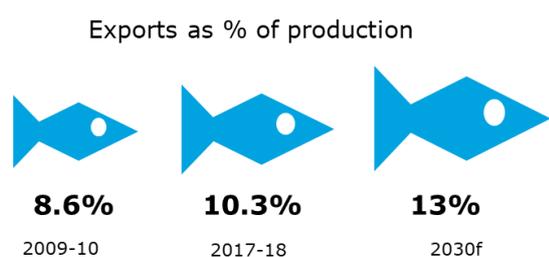
Figure 156: Exports by volume and value



Source: The Marine products Export Development Authority

The exports for the fisheries sector as a percentage of production has been increasing steadily since 2015-16 and is estimated to continue on the same trend in the future. Among various items being exported shrimp is the major contributor, having a share of 68% of the total value of the export as of 2018-19.

Figure 157: Exports as % of production

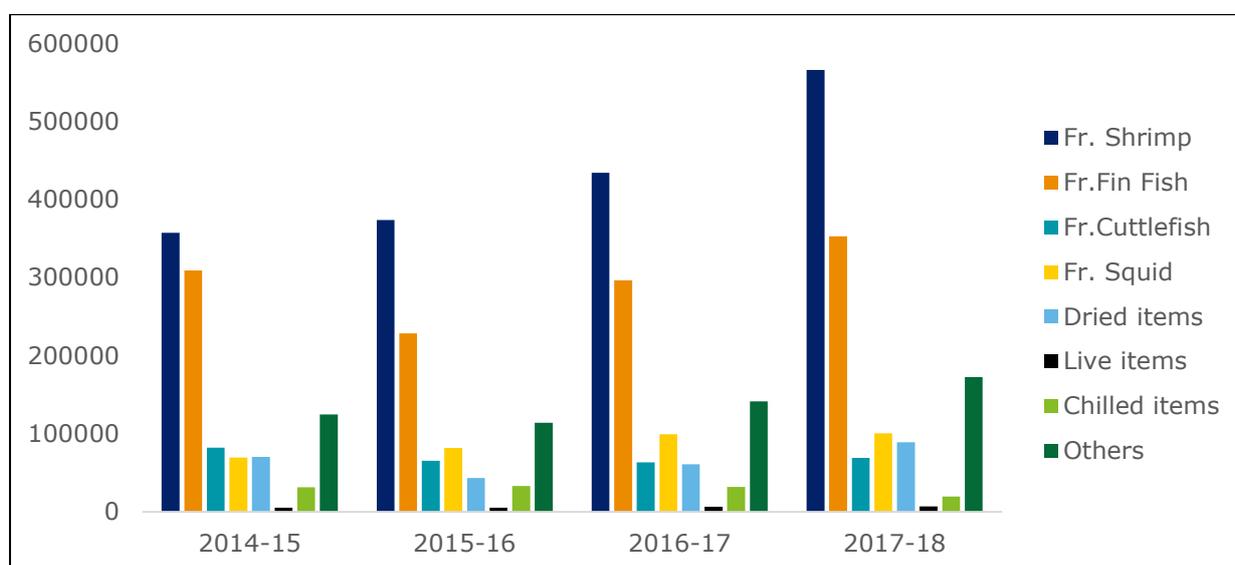


Source: The Marine products Export Development Authority; The State of World Fisheries and Agriculture, Food and Agriculture Organization of the United Nations; Ministry of Agriculture & Farmers Welfare, Govt. of India. (ON1873) & Past Issues

Fresh shrimp is the largest exported commodity in terms of volume (accounting for 30-40% of exports) as well as value (fetching over 68% of total fish exports). This is followed by fresh fin

fish, which accounts for close to 10% of exports in terms of value. Other commodities such as cuttlefish, squid, live items form relatively smaller portions of the export market.

Figure 158: Key commodities exported



Source: The Marine products Export Development Authority

China is the largest fish producer and since 2002 has also been the largest exporter of fish and fish products, although they represent only 1% of China's total merchandise trade. Since 2011 China has also been the world's third largest importer of fish and fish products, partly because large quantities of fish are imported for processing and then re-exported, but also because rising incomes and changes in consumption habits create markets for species not produced locally. Despite being the second largest producer, India stands 4<sup>th</sup> in terms of export of fish products in 2018. This is because of India's lagging storage and processing infrastructure, which causes huge post-harvest losses. Also, India is yet to match up to global quality standards required for exports. A comparison of top fish exporting countries and change in their contribution to global exports from 2006 to 2016 has been provided in the table below.

Table 52: Top ten fish exporting countries

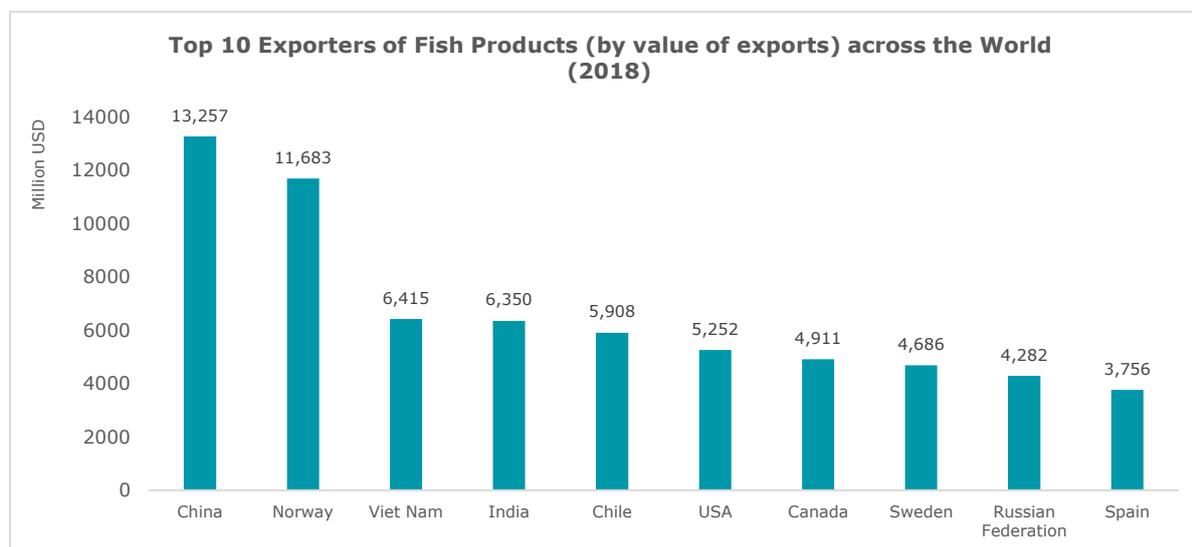
Country	2006		2016	
	Value (USD million)	Share (%)	Value (USD million)	Share (%)
<b>China</b>	8,968	10.4	20,131	14.1
<b>Norway</b>	5,503	6.4	10,770	7.6
<b>Vietnam</b>	3,372	3.9	7,320	5.1
<b>Thailand</b>	5,267	6.1	5,893	4.1
<b>USA</b>	4,143	4.8	5,812	4.1
<b>India</b>	1,763	2.0	5,546	3.9
<b>Chile</b>	3,557	4.1	5,143	3.6
<b>Canada</b>	3,660	4.2	5,004	3.5
<b>Denmark</b>	3,987	4.6	4,696	3.3
<b>Sweden</b>	1,551	1.8	4,418	3.1

Source: The State of World Fisheries and Aquaculture, Food and Agriculture Organization of United Nations, 2018

## Global Scenario

At the global level, the total export of fishery products (including fish and crustaceans, molluscs and other aquatic invertebrates<sup>276</sup>) from India has a share of 5.1% as of 2018 and is currently pegged at ~USD 6,349 million<sup>277</sup>. In the global trade of fishery products, India ranks 4<sup>th</sup>. The top 10 exporters of fishery products along with their respective share in the world fishery exports as of 2018 is shown in the following figure.

Figure 159: Top Exporters (Countries) of Fishery Products



Source: <https://www.trademap.org/> (International Trade Statistics referred from <http://www.intracen.org>)

## Discussion on Cross Sectional Thematic Areas

### i. Accountability and Transparency

The Department of Fisheries which is a constituent department under the Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW) is the apex institution providing assistance to all State Governments in terms of progress of marine and inland fish production, upgradation of genetic resources, increasing availability of nutritious feed, processing and profitability of fisheries enterprises. Under the Umbrella Scheme - Blue Revolution: Integrated Development and Management of Fisheries, strengthening of database and GIS along with monitoring, control and surveillance activities are being managed. The database of fishers is maintained by various agencies including the Department of Fisheries, NFDB, Central Marine Fisheries Research Institute.

The Marine Fisheries Census is comprehensive census database which includes 11 maritime states and union territories. The states and union territories covered in the census were West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, Gujarat, Puducherry, Daman and Diu. The report is published by the Department of Fisheries along with the Central Marine Fisheries Research Institute. The report covers the status of marine fishery resources, socio-economic status of fisherfolks and infrastructure facilities existing in fishing villages. The aspects highlighted in the report are:

<sup>276</sup> Classification of 03 Fish and crustaceans, molluscs and other aquatic invertebrates of UN Comtrade is referred for the group (<https://unstats.un.org/unsd/tradebase/Knowledgebase/50043/HS-2002-Classification-by-Section>)

<sup>277</sup> International Trade Statistics referred from <http://www.intracen.org>

- information on fisherfolks family, education, occupation and ownership of crafts and gears
- infrastructure facilities available in different marine fishing villages along with sub categories for collecting details of fishing harbour, boat building/repairing yards, ice factories/cold storages freezing/canning plants, curing yards/peeling sheds and extraction/fish meal plants
- landing centre/fishing harbour-wise information on fishing crafts and gears existing in the fishery

The Fisheries Resource Assessment Division of Central Marine Fisheries Research Institute contributed significantly to improve the database management of fisheries of the country. Some of the notable databases, monitoring mechanisms and assessments drawn by the organization are<sup>278</sup>:

1. Development of National Marine Fishery database using “Stratified Multistage Random Sampling” which collates vital input for fish stock assessment periodically for sustained marine fish production. The database is critical for policy planners, fishery managers, sea food exporters and research organizations.
2. Stock Assessment of different commercially marine fish species using six decades data (1950-2010) on landings by classifying the resources into 26 groups (classified as ‘abundant’ for 18 resource groups, ‘less abundant’ for 5 resource groups and 1 under each of ‘declining’, ‘depleted’ and ‘collapsed’).
3. Potential Yield and Optimum Fleet Size for the maritime states
4. Computer Software for processing marine fish landings data, estimation of individual species level landings and exporting of information into RDBMS database
5. Fish Watch- a new system of field information dissemination for fish landing figures and landing centre price range of important resources at 6 major fishing harbours of the country on a near real time basis.
6. Geo-referencing of major marine resources using satellite derived data and models.

Monitoring and evaluation projects have also been taken up by NFDB under the Blue Revolution scheme<sup>279</sup>. Evaluation of the Blue Revolution projects of six states namely Assam, Tripura, Mizoram, Nagaland, Madhya Pradesh, and Chhattisgarh have been conducted by NFDB while evaluation of 22 states have been conducted by external agencies in the year 2017-18.

Fisheries is an important livelihoods opportunity amongst the rural agrarian households. Among the households practicing livestock rearing in India, around 11%-18% of the land is used for fish rearing. The percentage distribution of area of land by type of animal farming as assessed in the NSS Livestock Ownership of India report has been shown below.

Table 53: Percentage distribution of area of land by type of animal farming

Period	Percentage distribution of area of land by type of animal farming					Total
	Dairy	Poultry	Piggery	Fishery	Farming of other animals	

<sup>278</sup> <http://www.cmfri.org.in/division/fishery-resources-assessment>

<sup>279</sup> NFDB Annual Report 2017-18, Retrieved from <http://nfdb.gov.in/annual-report.htm>

<b>Jul'12- Dec'12</b>	53.80	3.18	0.56	18.71	23.75	100
<b>Jan'13- Jun'13</b>	69.68	2.97	0.37	11.81	15.16	100

Source: NSS 70th Round: Livestock Ownership of India report. Retrieved from <https://mospi.nic.in>

The percentage share of land under fisheries is shown for both the periods Jul'12- Dec'12 and Jan'13-Jun'13 for each state below.

Table 54: State-wise distribution of land share on fisheries as of 2012-13

States	Period	% of land under Fishery	Estimated area used for animal farming (ha)	Estimated Area under Fishery (ha.)
<b>Andhra Pradesh</b>	Jul'12-Dec'12	77.76	76336	59359
	Jan'13-Jun'13	58.14	39463	22944
<b>Assam</b>	Jul'12-Dec'12	72.71	46284	33653
	Jan'13-Jun'13	73.61	47441	34921
<b>Bihar</b>	Jul'12-Dec'12	3.58	32331	1157
	Jan'13-Jun'13	1.33	32751	436
<b>Jammu &amp; Kashmir</b>	Jul'12-Dec'12	0.34	6229	21
	Jan'13-Jun'13	0	6943	0
<b>Jharkhand</b>	Jul'12-Dec'12	98.1	16214	15906
	Jan'13-Jun'13	31.05	51226	15906
<b>Kerala</b>	Jul'12-Dec'12	32.29	18547	5989
	Jan'13-Jun'13	24.65	20922	5157
<b>Madhya Pradesh</b>	Jul'12-Dec'12	0	16767	0
	Jan'13-Jun'13	10.6	15701	1664
<b>Odisha</b>	Jul'12-Dec'12	23.8	27936	6649
	Jan'13-Jun'13	15.11	42040	6352
<b>Rajasthan</b>	Jul'12-Dec'12	1.13	173206	1957
	Jan'13-Jun'13	0	594578	0
<b>Tamil Nadu</b>	Jul'12-Dec'12	0.28	107445	301
	Jan'13-Jun'13	0.91	33137	302
<b>Uttar Pradesh</b>	Jul'12-Dec'12	1.78	115598	2058
	Jan'13-Jun'13	2.17	94455	2050
<b>West Bengal</b>	Jul'12-Dec'12	43.77	85810	37559
	Jan'13-Jun'13	47.01	108407	50962
<b>N E States</b>	Jul'12-Dec'12	22.81	9592	2188
	Jan'13-Jun'13	67.5	11647	7862
<b>All India</b>	Jul'12-Dec'12	18.71	891331	166768
	Jan'13-Jun'13	11.81	1256860	148435

Source: NSS 70th Round: Livestock Ownership of India report. Retrieved from <https://mospi.nic.in>

As it can be observed from the table above, the states of Jharkhand (98.10 percent) and Andhra Pradesh (77.76 percent) registered the highest percentage of the land used for fishery during Jul'12-Dec'12. During Jan'13-Jun'13, Assam (73.61 percent) and Andhra Pradesh (58.14 percent) were the states showing the highest percentage<sup>280</sup>. In terms of absolute area under fisheries, Andhra Pradesh, West Bengal and Assam are the top states.

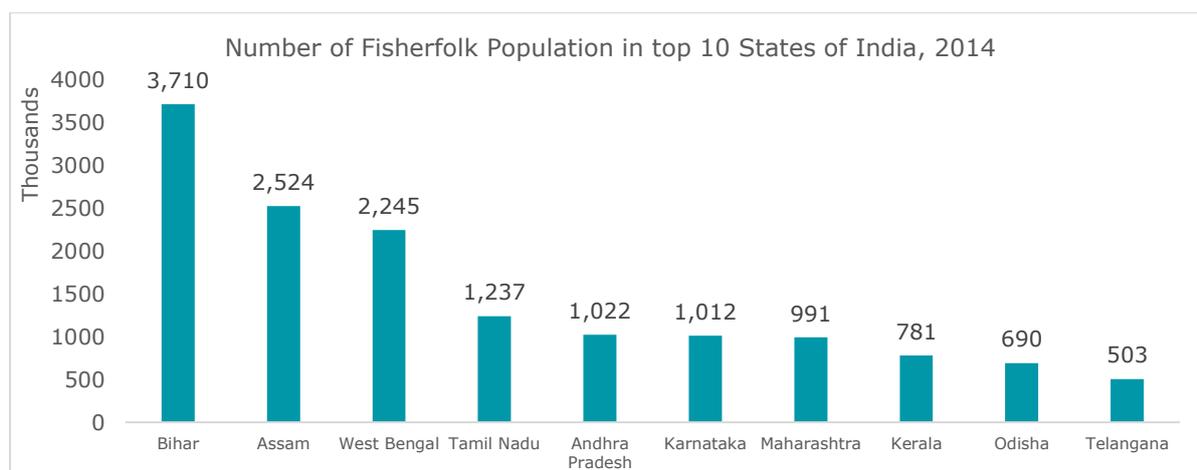
## ii. Direct Indirect Employment

The fisheries sector has been recognised as a powerful income and employment generator by providing opportunities in a number of subsidiary industries and is also an instrument of

<sup>280</sup> NSS 70<sup>th</sup> Round: Livestock Ownership of India report. Retrieved from <https://mospi.nic.in>

livelihood for a large section of economically backward population of the country. The direct and indirect employment provided by the fisheries sector in India covers 16 million fisher-folks across all states at the primary level and almost twice the number along the value chain.<sup>281</sup> The employment statistics include full time fisher-folks (those engaged for at least 90% of the fishable duration in a calendar year), part-time fisher-folks (those engaged for less than 90% of the fishable duration in a calendar year) as well as occasional fisher-folks (those engaged under 30% of their working time in fishing). The top 10 states of India in terms of employment share in fisheries covers more than 90% of total employment in this sector. The graph below depicts the share of the top 10 states.

Figure 160: Number of Total Fisherfolks in top 10 States of India



Source: Handbook of Fisheries 2018

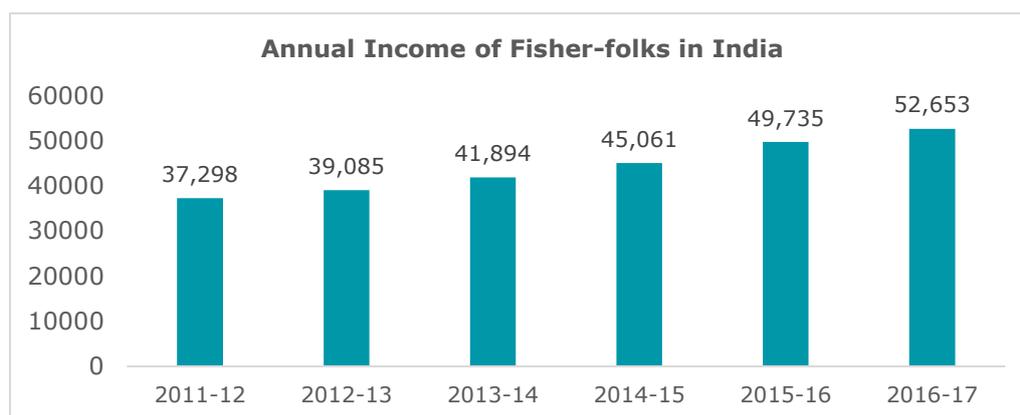
The above graph depicts the number of fisherfolk engaged in this livelihoods in the top states in India. The number of fisherfolks include full time fishers, part-time fishers and occasional fisherfolks.

Among the fisherfolks, adult male members are usually engaged in fishing activities on full time or part time while a significant section of female members of the fishing households are engaged in fishing associated activities including marketing of fish, making/ repairing net, labourer etc. According to the latest Marine Census 2010, there were 864,550 marine fisher-folk households in the country with a total marine fisher-folk population in the country was around 4 million. Tamil Nadu, Kerala and Odisha accounted for 20.1%, 15.3% and 15.1% of total marine fisher-folks in the country respectively. In the household survey it was found that nearly 61% of the marine fishermen families in the country (523,691) were Below Poverty Line (BPL).

As per the estimate of Department of Fisheries, the sector is believed to have immense potential to double the fishers and fish farmers' incomes by 2022. As per the income increase estimated by the department, the annual income has increased by 34% between 2012-13 and 2016-17. The annual income of fisher-folks in India over the period 2011-12 and 2016-17 has been given in the graph below.

<sup>281</sup> Department of Fisheries. 2018. Handbook of Fisheries 2018

Figure 161: Annual Income of Fisher-folks in India



Source: Handbook of Fisheries 2018

Among the people employed in this sector, a large percentage of the fish farmers practice aquaculture on a part-time basis with their involvement in the activity ranging from 17 man-days per annum in Karnataka to the highest of 75 man-days in West Bengal<sup>282</sup>. An FAO study conducted in 6 major aquaculture producing Indian States (Andhra Pradesh, Haryana, Karnataka, Orissa, Uttar Pradesh and West Bengal) have found that fish farming, though a part-time activity, contributes a major share of the income of these fish farmers, ranging from 14.98 percent in Orissa to 95.26 percent in Andhra Pradesh, with an average of 79.66 percent.<sup>283</sup> Shrimp farming has emerged as major employment generating livelihood opportunity with average labour requirement being 600 labour days/crop/ha as against 180 labour days/crop/ha in the case of paddy field cultivation<sup>284</sup>. In the brackish water sector, hatcheries and feed mills are also providing excellent employment opportunities and it has been estimated that over 300 000 jobs have been generated in the main and supporting sectors of the shrimp aquaculture sector in rural areas<sup>285</sup>. In order to protect the livelihoods of the traditional fisher-folk community, a national-level action plan for the sustainable development of marine fisheries attempted to solve the problem of overcapacity of fishing vehicles being used. The national workshop organised by Central Marine Fisheries Research Institute (CMFRI), WWF-India and NITI Aayog had proposed for restricting the fishing rights in the sea exclusively for the fishing community dwelling in the coastal villages. Creation of employment opportunities and income generating avenues such as crab fattening, bivalve farming and ecotourism in mangrove belts for the successful execution of the conservation programme had been recommended as a part of the proposal<sup>286</sup>. As observed from HH surveys, there has been a 24% increase in income between 2015-16 and 2018-19 among fisherfolks.

### iii. Gender Mainstreaming

<sup>282</sup> CMFRI. 2014. Freshwater Aquaculture- Livelihoods Status of Fishers in India. Retrieved from <http://eprints.cmfri.org.in/10325/1/6.pdf>

<sup>283</sup> [http://www.fao.org/fishery/countrysector/naso\\_india/en#tcN7005B](http://www.fao.org/fishery/countrysector/naso_india/en#tcN7005B)

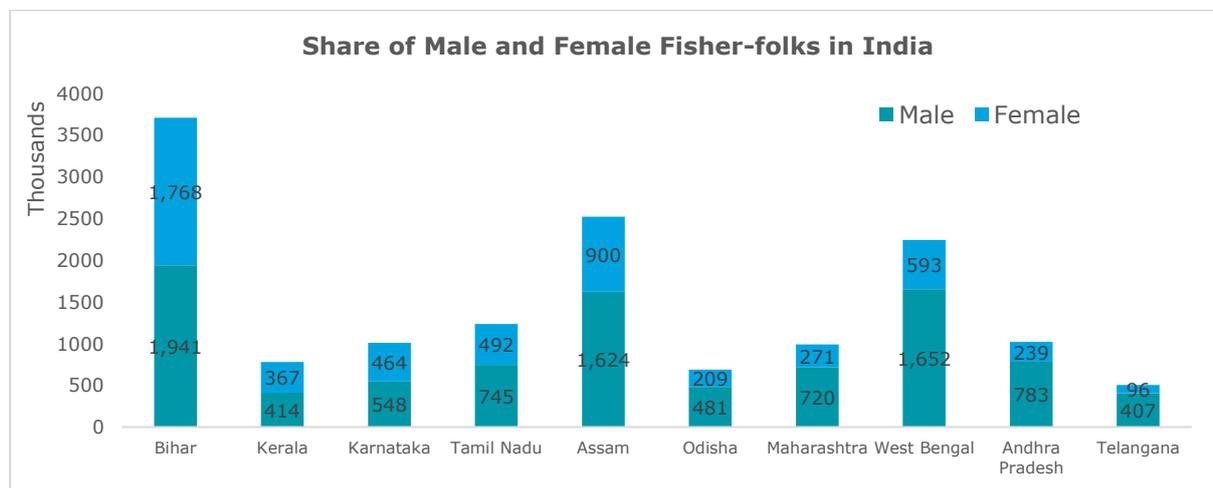
<sup>284</sup> Kiran.2014. Fisheries Development in India – An Overview. International Journal of Emerging Trends in Engineering and Development

<sup>285</sup> Ujwala Jadhav. Aquaculture Technology And Environment. Retrieved from [https://books.google.co.in/books?id=OILeKNHx\\_vcC&pg=PA26&dq=the+brackish+water+sector,+hatcheries+and+feed+mills+are+also+providing+excellent+employment+opportunities&hl=en&sa=X&ved=0ahUKEwj14rX39f7oAhVNWysKHVQnDc8Q6AEIKDAA#v=onepage&q=the%20brackish%20water%20sector%2C%20hatcheries%20and%20feed%20mills%20are%20also%20providing%20excellent%20employment%20opportunities&f=false](https://books.google.co.in/books?id=OILeKNHx_vcC&pg=PA26&dq=the+brackish+water+sector,+hatcheries+and+feed+mills+are+also+providing+excellent+employment+opportunities&hl=en&sa=X&ved=0ahUKEwj14rX39f7oAhVNWysKHVQnDc8Q6AEIKDAA#v=onepage&q=the%20brackish%20water%20sector%2C%20hatcheries%20and%20feed%20mills%20are%20also%20providing%20excellent%20employment%20opportunities&f=false)

<sup>286</sup> Times of India. 2017. Stop registration of new fishing vessels. Retrieved from <http://eprints.cmfri.org.in/12012/> as accessed on 14<sup>th</sup> January 2020

In the Fisheries sector, around 5.5 million women are engaged as of 2018 constituting 34% of the total workforce. Most of the women fisher-folks are engaged in fisheries associated activities. According to Marine Census 2010, nearly 81.8% of the fisher-folks engaged in marketing of fish, 88.1% of those engaged in curing and processing and 89.6% of those engaged in peeling are found to be women. As per the Handbook of Fisheries 2018, Bihar has the highest share of women engaged in the sector (47.7%), followed by Kerala (46.9%) and Karnataka (45.8%).

Figure 162: Share of Male and Female Fisher-folks in India



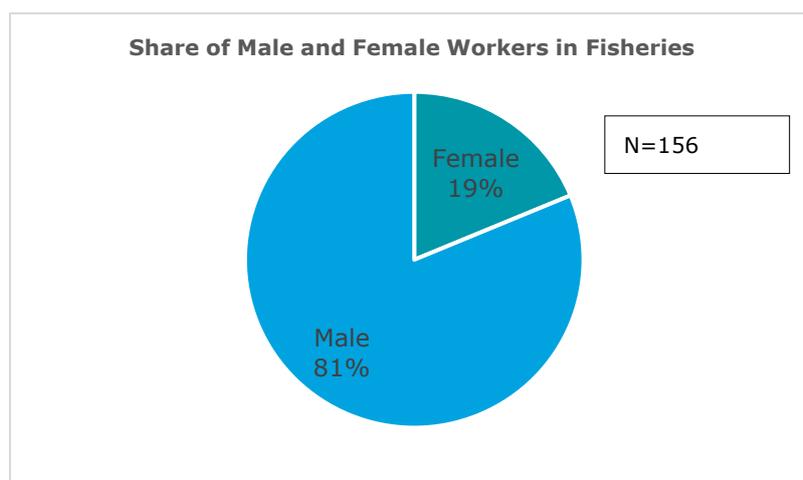
Source: Handbook of Fisheries, 2018

Engagement of women in the fisheries sector is being strengthened through mobilizing the fisher-women in Self Help Groups and fishery based micro enterprises. The women led SHGs in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Odisha have taken up various activities related to fisheries and have been observed to have performed well. Enterprises around clam processing, Chinese dip net, Fish Aggregating Devices, fish drying, cage farming, ornamental fish culture, crab processing are some of the fisheries enterprises these women –led micro enterprises have been handling successfully.<sup>287</sup>

The HH Survey analysed the share of male and female workers in fisheries households. The same has been depicted in the graph below.

<sup>287</sup> CMFRI Annual Report 2016-17

Figure 163: Share of Male and Female Workers in Fisheries HHs



Source: HH Survey, Deloitte Analysis

As observed from the graph above, there are 19% of female workers as against 81% of male workers in fisheries households as per the HH survey.

Box 22: Mobilizing Fisheries SHG in Kerala

#### Case Study on Mobilizing Fisheries SHG in Kerala

Society for Assistance to Fisherwomen (SAF) in Kerala under the Department of Fisheries, Kerala have been working on empowering the fisher-women of the State by promoting livelihoods opportunity by forming SHG groups of fisher women and is one of the notable programs with major role in the formation of SHGs in fisheries sector. Skill development and capacity building of the under-employed and unemployed fisher-women was initiated to induct them into remunerative fishery activities. Insights into fisheries enterprises and alternate livelihood options were included as part of their training programme. Continuous monitoring and evaluation of the SHG groups with a road –map strategized along with regular performance appraisal helped in the women fisher folk to find new livelihood avenues and strengthened economic efficiency. The 'Theeramaithry' programme of SAF helped the economic and gender empowerment of women fisher folk. One of the key enterprises that is formed under SAF facilitation is Theeramythri sea food kitchen SHGs in various locations of Kerala.

Source: CMFRI. 2017. Gender Mainstreaming and Impact of Self Help Groups in Marine Fisheries Sector. Retrieved from <http://eprints.cmfri.org.in/12434/> as accessed on 13<sup>th</sup> January 2020

#### iv. Climate change & sustainability including adoption of climate-change resilient practices & diversification

The fisheries sector is threatened by degraded habitats, climate change and overfishing. Overfishing poses threat to food production as well as functioning of the ecosystem. It is estimated that the fraction of world marine fish stocks that are within biologically sustainable levels has declined from 90 percent in 1974 to 66.9 percent in 2015 implying over 1/3<sup>rd</sup> of the marine fish stocks are overfished.<sup>288</sup> Sustainable development of fisheries require proper management of fishing through effective harvest strategies.

Illegal, unreported, and unregulated (IUU) fishing is considered as major threat to the diminishing fish stocks of the ocean worldwide. The depletion of fish stocks through IUU fishing threatens

<sup>288</sup> FAO. 2019. Tracking progress on food and agriculture-related SDG indicators. Retrieved from <http://www.fao.org/sdg-progress-report/en/>

global food security, along with the livelihoods of some 40 million people who are employed worldwide in capture fishing alone, plus millions more in associated industries<sup>289</sup>. To address the issue, the IUU Fishing Index<sup>290</sup> has been designed to meet the need for a detailed analysis of fishery countries' vulnerability, exposure and responses to IUU fishing. The index benchmarks 152 countries in terms of vulnerability, prevalence and response to IUU fishing. The parameters considered in the index include prevalence of IUU fishing in each country, and their vulnerability and response to it, drawing on various coastal, flag, port, and other state responsibilities. According to the IUU Fishing Index, China fared worst, with an overall score of 3.93 while Belgium came out with the most favourable score for all indicators combined (1.43). India with the score of 2.68 ranks as the 17<sup>th</sup> worst performing country among 152 countries<sup>291</sup>. India happens to have a score worse than the global score, which is 2.29. One of the first binding international agreement developed to combat IUU fishing is the Port State Measures Agreement which came into force in 2016 and consists of 60 member countries. However, India is not yet part of this agreement.

One of the main reasons of depleting fishing stock of the Indian marine ecosystem is attributed to bottom trawling. Mechanized trawlers practicing bottom trawling of the ocean floor have immense adverse effect on vulnerable marine ecosystems and their associated biodiversity. Bottom trawling exploits the fish stocks due to excess fishing effort or capacity and also destroys non-target species scooped from the ocean floor. The physical impact of the harmful practice causes damage to vulnerable ecosystem of marine biodiversity. According to United Nations<sup>292</sup>, about 95 percent of the damage inflicted on deep water systems associated with seamounts results from bottom trawling.

#### Box 103: Artificial Reefs

##### **Artificial Reefs**

Artificial reefs (AR) are devices installed at the sea bottom to provide habitat for marine organisms. ARs have been found to be effective in aggregating a variety of fish species and in holding them by providing suitable habitats. The artificial reefs provide shelter and breeding grounds for majority of the fish shoals. The structures are effective in attracting moving stocks of high value fishes by the rich benthic fauna, crustaceans, molluscs, echinoderms, etc. The ARs are also effective in preventing bottom trawling by damaging nets in restricted zones. Installation of ARs at selected locations along the coast could be an appropriate method to increase fish production as well as value addition to the catch as it would increase production of targeted, high value fish by using non-destructive fishing gears. ARs are installed in areas where fishing (trawling) ban is in existence as it will not involve any destructive fishing methods and would enhance the livelihood security of the coastal artisanal fishers who are affected by the ban. Such structures are constructed and installed in Lakshadweep and Orissa coastal waters for repletion of fish stocks. Under RKVY Scheme, emplacement of artificial reef is promoted along with integrated fish farming, cage farming.

(Source: <https://biophysics.sbg.ac.at/ar/reef.htm>; RKVY scheme analysis; KIIs)

<sup>289</sup> <https://globalinitiative.net/iuu-fishing-index/>

<sup>290</sup> IUU Fishing Index has been developed Poseidon Aquatic Resource Management Ltd., a fisheries and aquaculture consultancy company working globally, and the Global Initiative Against Transnational Organized Crime. Retrieved from (<http://iuufishingindex.net/about>)

<sup>291</sup> <http://iuufishingindex.net/reports/iuu-fishing-index-country-profile-india.pdf>

<sup>292</sup> [https://www.un.org/Depts/los/general\\_assembly/documents/impact\\_of\\_fishing.pdf](https://www.un.org/Depts/los/general_assembly/documents/impact_of_fishing.pdf)

**v. Role of Tribal Sub-Plan (TSP) and Scheduled Caste Sub-Plan component of the scheme in mainstreaming of Tribal and Scheduled Caste population**

Fishing community in India belongs to various castes. The marine fisher community in the maritime states belong to several castes and the inland fisher community in states like West Bengal, Bihar, Uttar Pradesh, Jharkhand and Madhya Pradesh also come from various social groups distinct social, cultural governance structures and traditional practices.

Some of the important fishing castes state-wise include:

- Tamil Nadu: Pattinavars, Mukkuvars, and Paravas
- Andhra Pradesh: Vadabaliyas, Jalaris, Pattapu, and Palles
- Orissa: Jalaris, Vadabaliyas, Kaibartas, Khandayats, and Rajbhansis
- West Bengal: Kaibartas
- Gujarat: Kharvas, Kolis and Macchiyaras
- Maharashtra: Kolis
- Karnataka: Mogaveeras
- Kerala: Mukkuvar, Anjootty, Dheevera, and Pooislan

Traditionally most of the fishing community in India have been small scale fishers. In several states including Kerala, the fishers belong to different religions: Hindu, Muslim and Christians. However irrespective of their religion, fishers are usually recognized under the social groups of “Other Backward Classes”<sup>293</sup>. The small-scale fishing communities of India often face various challenges owing to their low status, low incomes, poor living conditions and little political influence. The need for socio-economic upliftment of these poor communities has been recognized by the Department of Fisheries. The Department of Fisheries has earmarked Rs 224.05 crores under which Rs 146.72 crores has been concurred under Scheduled Caste Sub Plan component in the year 2016-17<sup>294</sup>. From 2018-19, the Department has allocated 8.6% under Tribal Sub Plan. However, the Department of Fisheries or the State Governments do not maintain the record of people in the different social groups.

**vi. Development, Dissemination & Adoption of Innovative Practices & Know-how and Use of Technology**

Fisheries is a growing sector and with advent of new technology and innovative practices, the productivity of the sector can be enhanced, thus impacting the income of nearly 160 lakh people who are employed directly and indirectly in this domain. Institutes like ICAR - Central Marine Fisheries Research Institute and National Fisheries Development Board focuses on various upcoming technologies. The Department of Fisheries has also taken up several initiatives to harness full potential of the sector. During the last 4 years, the CSS Blue Revolution has resulted in the development of Fisheries sector both in terms of fish production and productivity, post-harvest infrastructure, marketing etc. Department of Fisheries has recognized the impending need for formulating and adopting multi-pronged strategies and focused interventions to provide the requisite impetus to accelerated development of Fisheries and aquaculture sector. The

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<sup>293</sup> Interactive Governance for Small-Scale Fisheries: Global Reflections, <https://books.google.co.in/books?id=5VrACQAAQBAJ&printsec=frontcover#v=onepage&q&f=false>

<sup>294</sup> Department of Fisheries. Annual Report 2017-18

Department of Fisheries is implementing the various scheme component for enhancing fish production in both inland and marine sector in the following areas such as:

- (i) Re-circulatory Aquaculture System (RAS),
- (ii) Cage Culture,
- (iii) Brackish Water (including land locked Saline states),
- (iv) Cold Chain Development,
- (v) Mariculture
- (vi) Development of Ornamental Fisheries,
- (vii) Focus on Enhancement of Fingerling Production
- (viii) Development of Cold water Fisheries etc.
- (ix) Creation of Fisheries Infrastructure Facilities both in Marine and Inland Fisheries Sectors and
- (x) Extension of Kisan Credit Card (KCC) facilities to fishers and fish farmers.

Some of the key innovative practices in fisheries have been discussed below:

**Cage Culture in Fisheries:** Aquaculture has been growing significantly to cater to the increasing demand for fish to enhance the fish production. Two of the major strategies adopted for fish farming are hatchery based aquaculture and capture based aquaculture. Under capture based aquaculture, cage culture has emerged as a popular practice to grow fish production sustainably. Cage culture farming has an important role in meeting the global demand for fish products and is considered as one of the important alternate source to increase the aquaculture production. Current constraints in marine fishing such as decline in wild stock and poor return from other culture systems has led the fisher-folks to resort to this viable method of fish farming utilizing existing water resource. Fisher-folks can also select high value fish species for farming in cage cultures and plan the catch at the suitable time, thus increasing their returns on the investment. In India, fishes like, Indian sand whiting (*Sillago sihama*), pearl spot (*Etroplus suratensis*) and hilsa (*Tenulosa ilisha*) are considered as popular fish varieties in states like Karnataka, Kerala and West Bengal, respectively and are given importance in cage culture<sup>295</sup>. Seed production technology of the commercially favoured fish species can be leveraged in cage farming. Cage culture enables the fisher-folks to maintain an optimum stocking density, manage fish feed, diseases and mortality of fish. Cage culture of marine fish has grown rapidly over the last decade in Asia, Europe and Australia, utilizing inshore or offshore net cages and is of high monetary value<sup>296</sup>. The cage farming industry, particularly in Northern Europe, North America, Chile and Japan, expanded dramatically during the 1980s and 1990s, which attracted the interests of a growing number of large multinational companies seeking to diversify into a new and growing market with resources to carry out research and development. The practice has spread to South East Asian countries in the recent years and it is currently estimated that out of one million tonnes of marine fish cultured, around 80-90% of the catch is from cage culture.<sup>297</sup> Cage culture has

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<sup>295</sup>Xavier. ICAR-CMFRI. 2016. Selection of Candidate Species for Cage Culture in India ( Part of Training Manual on Cage Culture of Marine Fisheries)

<sup>296</sup> Ghosh. ICAR-CMFRI. 2016. Overview of Cage Culture- Indian Perspective India ( Part of Training Manual on Cage Culture of Marine Fisheries)

<sup>297</sup> Ghosh. ICAR-CMFRI. 2016. Overview of Cage Culture- Indian Perspective India ( Part of Training Manual on Cage Culture of Marine Fisheries)

demonstrated that fish production is higher than fish cultured in wild by providing scope for the growth enhancement for the fishes cultured through feed manipulation. This finding has been assessed by the Central Marine Fisheries Research Institute on the growth potential of Asian seabass confirming the prospects of cage culture. Cage culture is recommended for most of the states practicing fishery given the constraint of land.

**mKRISHI in Fisheries:** Fish catching is a risky livelihood option given the unpredictable sea conditions, and is full of uncertainties along with high cost of navigation. In an endeavour to make fishing less hazardous for the fisherfolks, latest developments in technology is leveraged to mitigate their risk and address much of their safety concerns. mKRISHI® Fisheries Service incorporates concepts such as Human Computer Interaction (HCI) and present the fisher-folks with information such as Wind Speed Directions, Wave Heights, Potential Fishing Zone Map, Port Weather Forecast, Rain, Cyclone/Tsunami warnings etc. Mobile applications can be used by the fisher-folks' local language which can work on almost all the existing GPRS enabled mobile devices and can function in during no/ low mobile network as well. mKRISHI® Fisheries with application of existing technologies thus became successful involving design thinking, simplification, Human Computer Interaction Service Design, GPS, data connection and content personalization. For the mobile signal extension in deep sea, it required antenna design, tower configuration and device side amplification. This selective fishing option enables the fisher-folks to plan their fishing trips or navigation beforehand and have brought a disciplined approach, which not only led to less expenditure but also less diesel consumption and carbon emissions. According to information collected in Maharashtra (Raigad district), this technology adoption has led to a 30-40% increase in catch and 30% reduction in diesel consumption. Based on the survey conducted in Raigad by Mumbai Research Center of ICAR-CMFRI during 2013-14, it was observed that at 15% adoption level, fishermen can save up to 900,000 of litres (@30% less consumption).

**Fishing Using Lights:** One of the innovative methods of fishing is by using lights under water. In some of the most productive methods of fishing such as purse-seines, stick-held dipnets, and squid jigging uses artificial light. In purse-seine fisheries surface and underwater lamps are used, while only surface lamps are used for stick-held dipnet targeting Pacific saury and squid jigging fisheries. The underwater light attracts fish, driven by certain behavioural/ physiological factors. The principles for light aggregation of fish are:

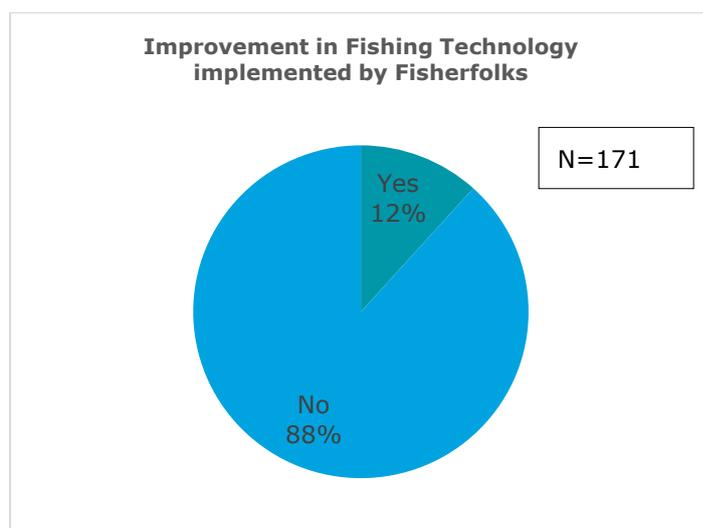
- Schooling for feeding
- Conditioned response to light intensity gradients
- Curiosity behaviour and other social behaviour
- Positive photoaxis making them orient to the light source
- Optimum light intensity for feeding and other activities
- Disorientation and immobilization due to high light levels in surrounding dark conditions

It is a popular method of fishing practiced in Japan, Korea, Malaysia, Vietnam, Thailand as well as certain parts of Europe. It helps in getting bigger catches by avoiding light competitions within sectors and conflicts between sectors. The technology has been further improvised with the advent of cheaper LED (Light Emitting Diode) technology replacing much costlier metal halide and halogen lamps. These new energy efficient light sources are continuing to develop and may be used to develop energy efficient and environmentally friendly fishing technologies for existing

light fisheries. The shift to LED lights has resulted in considerable fuel saving for light fishing vessels. This technology has been recently adopted in India (in 2014) and is mainly prevalent in Karnataka and Goa. Several pilot programs have been conducted by CMFRI9 and FSI/CIFNET10 targeting coastal squid resources.<sup>298</sup> Between 2014 and 2016, more than 50 light fishing operations have been carried out and purse-seining and gillnetting were found to be the suitable methods for fishing using lights. Fishing using lights has been classified as low-impact fisheries with the ability to reduce bycatch and may in addition lead to a cleaner catch.

The HH Survey reveals the improvement in fishing technology being implemented by the fisherfolks. The graph below displays the findings.

Figure 164: Improvement in Fishing Technology implemented by Fisherfolks

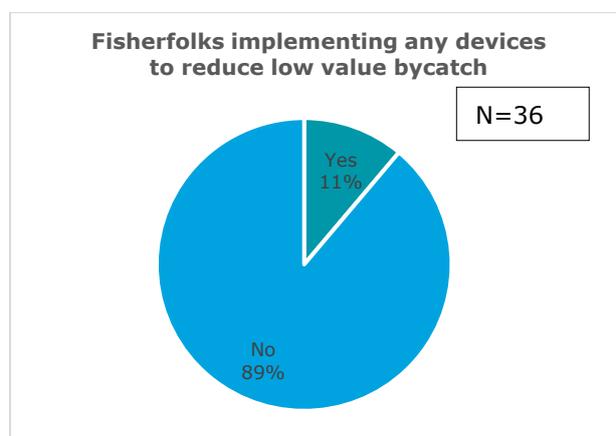


Source: HH Survey, Deloitte Analysis

As it can be observed from the graph, only 12% of fisherfolks have been able to implement improvements in fishing technology.

Observations from the HH Survey brings out the usage of devices by fisherfolks to reduce bycatch. The graph below shows the findings.

Figure 165: Fisherfolks implementing any devices to reduce low value bycatch

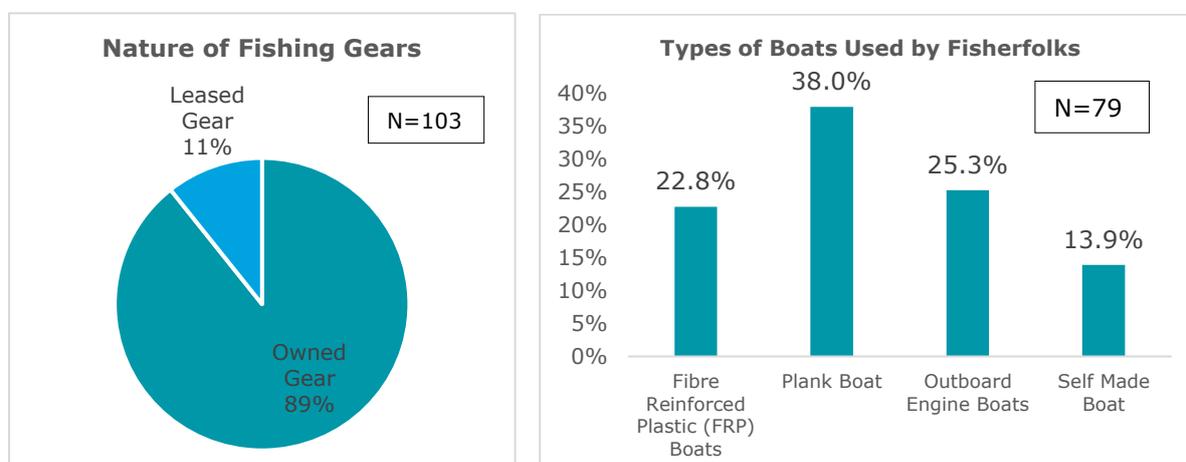


<sup>298</sup> Sunil Mohamed. 2016. Fishing Using Lights: How should India handle this new development. Marine Fisheries Policy Brief - 4. ICAR-CMFRI

Source: HH Survey, Deloitte Analysis

Only 11% of fisherfolks have used devices to reduce low value bycatch. Further analysis of the HH Survey also reveals the nature of fishing gears and the kinds of boats being used by fisherfolks. The graphs below depicts the findings.

Figure 166: Nature of Fishing Gears and Types of Boats used by Fisherfolks



Source: HH Survey, Deloitte Analysis

#### vii. Stakeholder and beneficiary behavioural change

Lack of responsible fishing with unregulated penetration of advanced, yet not necessarily eco-friendly, harvesting technologies have been leading to continuous depletion of natural resources of marine as well as inland water bodies. In order to stem the problem of overfishing, a sustainable fishing system is being brought in and inducted with all stakeholders of fisheries including the fisherfolks and all others involved in the fishing, post-harvest processing and marketing of fish. India's agreement with the FAO Code of Conduct for Responsible Fisheries (CCRF) requires the sector to implement approaches to prevent serious and irreversible environmental degradation. It is required to sensitize them on issues such as severe decline or absence of native fish species, decline in the size range of major species, excessive catch of juveniles, increase in fishing time and distance, and changes in species composition. The behavioural changes among stakeholder engaged in fisheries can be brought in through awareness building on concepts like maintenance of maximum sustainable yield, stock assessment parameters, need for licensing of fleets, adherence to practices like monsoon trawling ban, maintaining mesh size regulations etc. The long term socio-economic impact of overfishing and competitive fishing on the livelihoods of the fisher community is being transferred to the fisher communities by CMFRI through various communication tools and strategies. One of the first steps taken by the CMFRI has been to launch a state-wide campaign on Responsible Fisheries in Kerala. CMFRI developed training modules and animation films targeted towards the fisher community, covering topics on ecological impacts of continued over-fishing.

The ornamental fish business is considered and being promoted by the Department of Fisheries as an excellent source of livelihoods for fish farmers. The department has been aiming to encourage captive breeding of ornamental fish for sustainable growth, livelihood improvement and to enhance foreign exchange through exports. During 2017-18, setting up of 308 ornamental fish units was initiated along with conducting capacity building programmes in the states of Assam, Bihar, Karnataka, Kerala, Maharashtra and Tamil Nadu.

Focus on wetland fishing in the floodplains of Uttar Pradesh, Bihar, West Bengal, Assam, Manipur, Tripura, Arunachal Pradesh and Meghalaya is being done to empower the local fisher communities. Pen/cage culture of fish along with effective management of aquatic weeds and rational stocking of selected fast growing fish species in the floodplains have enhanced livelihoods of fisherfolks in the interior landscapes. Significant effort and financial assistance have been given by ICAR-Central Inland Fisheries Research Institute to promote wetland fishing across several wetlands in Bihar in the year 2017-18.

In order to optimally use the water resources, cage culture is promoted among fisherfolks. Cage aquaculture assists harvest of fish in existing water resources while being enclosed in a net cage which allows free flow of water. Various technologies of cage culture have been standardised and popularised by CMFRI and CIFRI to be used by fisherfolks in open sea, brackish water, reservoirs, rivers and lakes<sup>299</sup>. This low impact farming practice have been demonstrated by the resource organizations, CMFRI and CIFRI in various states including Andhra Pradesh, Karnataka, Tamil Nadu, and Manipur. Fisherfolks of Jharkhand and Kerala have taken up the practice commercially.

### **viii. Research & Development**

In fisheries and aquaculture sector, continuous research and emerging technologies are being attempted to ensure fishing as a safer livelihoods option with precise and predictable outcome. Disruptive technologies are providing ways to gather and store information, adhere to compliances regarding regulations and traceability to ensure sustainable management of resources. Globally in the fisheries sector, disruptive technologies such as mobile internet, advanced robotics, and the “Internet of Things”, or interconnectedness among systems have found solutions in this domain.

India, being one of the largest fish producing nations in the world has been focusing on research and development in this sector to increase productivity while creating work opportunities in fishing, post-harvesting and other affiliated operations. ICAR, the nodal agency for agricultural research in India, has eight fisheries research institutes of which four are mainly responsible for research into aquaculture:

- Central Institute of Freshwater Aquaculture, Bhubaneswar
- Central Institute of Brackishwater Aquaculture, Chennai
- Central Marine Fisheries Research Institute, Kochi
- Central Inland Fisheries Research Institute, Barrackpore

In addition to the above institutes, the National Research Centre for Coldwater Fisheries in Bhimtal contributes to research on cold water fisheries and aquaculture. Critical technologies developed in these institutes have been implemented across the country. Over the years, ICAR has launched several other programmes to develop greater research-farmer interaction including the Lab-to-Land Programme, the International Development Research Centre (IDRC) Rural Aquaculture Projects, the Institutions-Village-Linkage Programme, etc.

In 2018, several critical developments have been made in the fisheries sector spearheaded by ICAR. Large-scale stocking of carp seeds in Ganga river has been done to rejuvenate the dwindling population affected by various anthropogenic activities. Cage culture in inland open water bodies

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<sup>299</sup> NFDB Annual Report 2017-18

is being pursued to assess its socio-economic impact and improvement in yield. Several endeavours to improve the health of fish stocks are being done. Detection of parasitic diseases in prawns, development of tilapia lake virus detection kit and vaccine against viral infection of brackish and freshwater fish have been done. Cadalmin, a nutraceutical product has been produced from extractions of seaweeds. CIFTtest, a consumer friendly test kit was developed to detect formaldehyde levels in water. The frontline practitioners to the fishers demonstrated the innovative solutions intended to be disseminated among the fisherfolks. Around 2329 fish farmers have been benefited in 2018 through the frontline dissemination.

In the future research focus, ICAR intends to explore emerging technologies in ecosystem-based approach to coastal as well as riverine aquaculture to arrest the accelerating loss of fish stock. The focus areas of research in fisheries would include species diversification, aquaculture based on biofloc technology, food value chain, large-scale precision farming green fishing vessels, effective phytosanitary regimes, and epidemiological information.

#### **ix. Reforms and Regulations**

The fisheries resources are maintained through various regulatory tools and measures directed towards limiting rate of extraction and ensuring a sustainable stock in its reserves. The regulatory measures are built around the concept of maximum sustainable yield which is the maximum level at which a resource can be routinely exploited without long-term depletion. A new concept has been introduced in fisheries called maximum economic yield that defined the level of harvest or effort that maximizes the sustainable net returns from fishing, which has become a guiding principle behind fishing regulations followed globally<sup>300</sup>. Approaches of fishing regulation can be classified as:

- Access-control based
- Output/catch based
- Input/effort based
- Temporal (mainly seasonal bans)
- Spatial (locational restrictions to minimize destruction to sensitive stocks)

Marine capture fisheries regulations in India are in place from the pre-independence era, followed by several new regulations. Demarcation of maritime zones for fishing and ocean administration is ensured through the following two laws:

- The Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976
- Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981.

Some of the more recent regulations and laws include The Coastal Regulation Zone (CRZ) notification, 1991; New Deep Sea Fishing Policy, 1991; Biological Diversity Act, 2002; Comprehensive Marine Fisheries Policy, 2004 and National Policy on Marine Fisheries, 2017. The most recent policy, National Policy on Marine Fisheries, 2017 aims to ensure the healthy and ecological integrity of the marine fisheries resources of India's Exclusive Economic Zone (EEZ)

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<sup>300</sup> <http://eprints.cmfri.org.in/13338/>

through sustainable harvests, socio-economic upliftment of fishers, principle of subsidiarity, partnership, inter-generational equity, gender justice and precautionary approach<sup>301</sup>.

As per the Seventh Schedule of the Constitution of India, the states have the jurisdiction to govern fishing and fisheries in the territorial waters, whereas the union government reserves its jurisdiction beyond territorial waters, i.e., between 12 nm and 200 nm. The marine activities are governed by the Marine Fisheries Regulatory Acts (MFRAs) of the respective maritime states. MFRAs are effective in regulating fishing within the territorial waters and they include required legislations to make use of a variety of regulatory approaches such as access control, input/ effort-based restrictions, spatial as well as temporal restrictions.<sup>302</sup>

Alongside the formal and institutional regulatory mechanisms, a number of sui generis regulatory and co-management systems are instrumental in various parts of coastal India. These traditional community-based governance models are highly dynamic and adaptive to the technological improvements of the recent times, yet they are not officially recognized and have little legal sanctity.<sup>303</sup>

Table 55: Community based Governance Models

<b>Community-based governance models</b>	<b>Access rights regulated by the community institutions</b>
Padu System followed in parts of Kerala and Tamil Nadu	Regulates access to designated fishing grounds is limited to members of a specific caste group in the locality based on a lottery system for harvest site allocation
Kadakodi system in northern Kerala	Acts as a regulator of resources, protector of livelihoods and a mediator of social conflict
Panchayat system along the Coromandel Coast of Tamil Nadu	Regulates access and usage of fishing resources, besides discharging conflict resolution among community members
Alternate-day fishing systems in Gulf of Mannar and Palk Bay areas	Ensured limited extraction through alternate days fishing access

Recently, Pradhan Mantri Matsya Sampada Yojana (PMMSY) - a scheme to bring about Blue Revolution through sustainable and responsible development of fisheries sector in India, has been launched in May 2020. The scheme aims to enhance fish production to 220 lakh metric tons by 2024-25 from 137.58 lakh metric tons in 2018-19 at an average annual growth rate of about 9%. Moreover, the scheme is expected to result in doubling export earnings to Rs. 1,00,000 crore and generate about 55 lakhs direct and indirect employment opportunities in fisheries sector over a period of next five years. A brief analysis of components of old scheme (IDMF) continued as a part of new scheme in the department (PMMSY and FIDF) is provided below<sup>304</sup>.

- Components of old scheme (IDMF) have been adequately covered in the PMMSY, however, detailed cost norms for each component are missing. Preparation of detailed cost norms for each activity will help in better planning and effective implementation of the new scheme.

<sup>301</sup> Handbook on Fisheries Statistics 2018. Retrieved from <http://dof.gov.in/> on 9 June 2020

<sup>302</sup> <http://eprints.cmfri.org.in/13338/>

<sup>303</sup> <http://eprints.cmfri.org.in/13338/>

<sup>304</sup> [http://dof.gov.in/sites/default/files/Book\\_PMMSY\\_Framework%2826.05.20%29\\_0.pdf](http://dof.gov.in/sites/default/files/Book_PMMSY_Framework%2826.05.20%29_0.pdf)  
[http://dof.gov.in/sites/default/files/Annexure%20to%20statesUT%20%282%29\\_0.pdf](http://dof.gov.in/sites/default/files/Annexure%20to%20statesUT%20%282%29_0.pdf)

- The implementation structure of the scheme needs to be clearly defined including the structure, roles and responsibilities of central apex committee, PMU, state and district level units.
  - Provision for technical experts and project management staff needs to be suitably introduced in the scheme.
  - Affordable brood and seed, fish feed, stocking of fish fingerlings and sea cultivation appears to be important areas and form key part of recommendations to meet sectoral challenges. A minimum percentage of funds may be fixed for these interventions under PMMSY with clearly defined targets.
  - The post-harvest losses and issues vary across the across regions and there is need to promote region specific strategy. The PMMSY scheme consists of a wide range of activities, these activities can be prioritized across different regions based on immediate requirements.
  - During proposal submission stage by states, the states can be asked to align proposed interventions with the major challenges that are being faced in their region and submit a plan for addressing these challenges.
  - The annual support for fisherfolks may be increased to at least Rs. 6000 per year in-line with support that is provided to farmers in PM-KISAN scheme. This component is suggested to be separated from the scheme. All fisherfolks can be made part of the existing central sector scheme and 100% support may be provided to the fisherfolks.
  - Considering that overexploitation is a major issue, the envisaged targets of enhanced production from 13.75 million metric tons to 22 million metric tonnes need to consider its environmental impacts. Reassessment of targets may be made on a periodic basis and these targets can be aligned to output/ outcome indicators to assess the overall impact of the scheme.
  - Some of the activities under the scheme can be complemented with existing mangrove restoration activities in states, regions where mangrove restoration interventions are going on may be prioritized for interventions.
  - Scheme monitoring framework needs to be defined. There is need to make provision for baseline, midline and endline assessment to assess effectiveness of scheme at different stages of implementation.
  - Marketing and processing of fish and fish products has improved in recent years, however, it remains an important component for boosting the income of fishing populace and needs to be provided attention during prioritization of interventions.
- x. Impact on and role of private sector, community/ collectives/ cooperatives (e.g. Farmer cooperatives, FPOs, Water User Associations, etc.) and civil society in the scheme**

Fisherfolks in India are mostly small scale fish farmers with limited capacity to expand their operations and little access to market. The challenges faced by the fisherfolks include lack of physical and livelihood assets such as land which can be used as collateral. They are often not functionally organized and dispersed, thus not capable of economies of scale in production,

marketing, and post-harvest operations.<sup>305</sup> In order to collectivize the small fish farmers, self-help groups, producer organizations and cooperatives are being formed in each state. As per the Marine Census 2010, nearly 32% of adult fisherfolks have memberships in co-operatives, in which 22.1% had memberships in fisheries co-operatives and 9.9% had memberships in other co-operatives. The state-wise details of marine co-operatives among the 9 maritime states and 2 union territories is given below:

Table 56: State-wise Details of Fisheries Cooperatives

States	Fishing Villages	Fisheries Coops	Other Coops	Member Fisheries Coop	Member Other Coop
West Bengal	188	100	118	11974	4411
Odisha	813	230	427	27395	22734
Andhra Pradesh	555	358	2819	37875	82622
Tamil Nadu	573	580	1108	254378	70822
Puducherry	40	25	36	23620	1801
Kerala	222	276	255	124971	59536
Karnataka	144	58	175	30287	13909
Goa	39	11	42	1415	46
Mahashtra	456	236	160	56896	3173
Gujarat	247	79	65	8903	1054
Daman & Diu	11	16	9	1303	239
<b>Total</b>	<b>3288</b>	<b>1969</b>	<b>5214</b>	<b>579017</b>	<b>260347</b>

Source: Marine Census 2010

Promotion and development of fishery cooperative movement in India is pursued by the National Federation of Fishers Cooperatives Ltd. (FISHCOPFED) which is the apex institution of Indian Fisheries Cooperative Movement. FISHCOPFED is well promoted through schemes and funds of the Department of Fisheries, Govt. of India, National Cooperative Development Cooperation and National Fisheries Development Board.<sup>306</sup> Under FISHCOPFED, there are over 18 thousand primary fisheries cooperative societies under which around 3 lakh fisherfolks are organized. FISHCOPFED is instrumental in providing insurance to fisherfolks, conduct regular training program for fishers, and also enabling post-harvest operations in fishery such as providing market linkage for several states. FISHCOPFED aims to expand its reach to the fishers by providing better fish marketing solutions through establishing wholesale fish market, start mobile fish retail marketing, and establish cold chain solutions.

Some of the state's fisheries cooperative federations have also helped in organizing and strengthening the small scale fish farmers. Some of the notable state fisheries cooperative federations are Matsyafed, the Kerala State Co-operative Federation for Fisheries Development Ltd, TAFCOFED or Tamil Nadu State Apex Fisheries Co-operative Federation Limited and AFCOF or Andhra Pradesh State Fishermen Cooperative Societies Federation Limited.

Matsyafed provides various socio-economic services to the fisher community and has formed more than 15000 SHGs in the state of Kerala. TAFCOFED has 483 Primary Fishermen Co-operative Societies, 171 Fisherwomen co-operative societies, 151 Inland Co-operative societies and 9 district Fisherwomen Co-operative Federations. The institution has been actively promoting production, procurement, processing and marketing of fish and fish products as well

<sup>305</sup> NABARD Sector Report. 2018. Fisheries and Aquaculture

<sup>306</sup> <http://www.fishcopfed.in/AboutUs>

as implement welfare programme for the economic and social development of fisher community. AFCOF also functions on the same lines, undertaking procurement of fish, and establishing cold storage plants and net making plants.

### 1.3 Issues and Challenges

Some of the key issues and challenges that impact the development of the sector including improved productivity and restrict income of fish farmers have been elaborated below.

**Problem of Marine Debris Accumulation:** Influx of marine debris in coastal waters of India is a major impediment for the fisher-folks operating their fishing gears. Lack of proper solid waste management protocols in the coastal areas of the country has been affecting the quantity of solid waste entering the coastal waters through rivers, and interlinked canals of major estuarine systems along the Indian coast. The current practice of fisher-folks of throwing back litters to the water aggravate the problem. The debris collection in the water has been affecting the entire marine food web including plankton, mussels, clams, oysters and all kinds of fish ingesting the contaminated marine organisms. According to researchers conducted by CMFRI, micro and macro plastics are often found in the guts of fish catch and the plastics ingestion is increasing over the years<sup>307</sup>. Littering in the coastal areas is also affecting the coral reefs which support the livelihoods of several thousand of fishers. Abandoned and lost fishing gears add to the woes of debris being collated affecting the benthic habitat and the marine biota. Lack of practices to manage, retrieve and recycle the derelict fishing gears lost during calamities or discarded along the coast is the primary reason behind the accumulation of debris owing to fishing. To address this issue, awareness on retrieving the nets and gears is required to be generated among fisher-folks to bring back the damaged gear and dispose them on land. Along with awareness of fisher-folks, awareness of tourists in the coastal tourism areas is also critically important since debris tend to accumulate in tourism spots and during festival times. Protection of the marine ecosystem is critical by managing the debris collection.

**Lack of Social Protection of Fishers:** Traceability on Aquaculture and Vessel Monitoring System: Vessel Monitoring System (VMS) is a real-time tracker of marine vessels and is a cost-effective tool for the successful monitoring, control and surveillance (MCS) of fisheries activities. VMS provides a fishery management agency with accurate and timely information about the location and activity of regulated fishing vessels. The VMS consists of continuous monitoring equipment installed on fishing vessels, which records and transmits satellite information on the vessel's geographic position, course and speed to a Fisheries Control and Monitoring Center (FCMC) in real-time every 2 h<sup>308</sup>. The Vessel Monitoring System can regulate Illegal, Unreported, or Unregulated (IUU) fishing activities, one of the high risk areas in fisheries. Information collected by the Vessel Monitoring system can be used for inspection, monitoring, traceability and control of fishing activities. A VMS is essential for the country like India having over 2 million km<sup>2</sup> of the sea space. In India, although implementation of Vessel Monitoring System had been initiated, it is yet to be implemented across the country. In light of this issue of incomplete implementation of VMS by all the coastal states, registration of new vessels were stopped to resolve the issue of unmonitored vessel movement and growing overcapacity in the sector. In a recent enquiry constituted by the Government of India into the loss suffered due to discrepancies in the policy of issuing LOP (Letter of Permit) Scheme for the fisheries sector, implementation of

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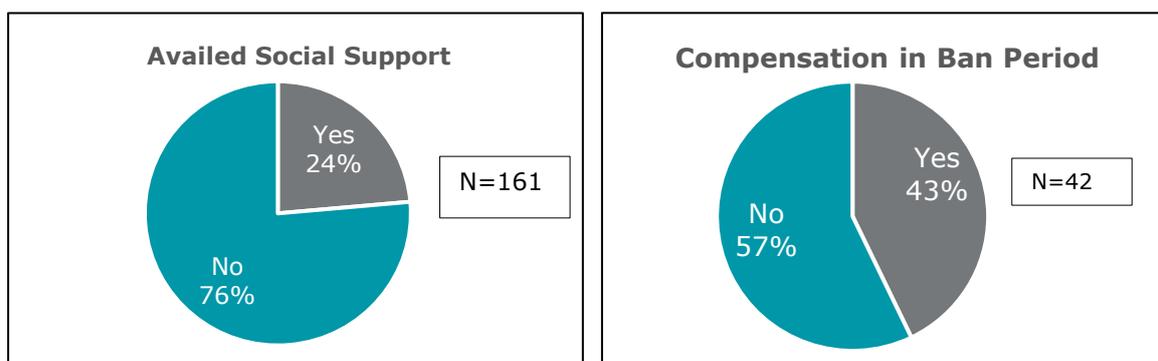
<sup>307</sup> Shylaja, Kripa. 2018. Assessment of marine debris in the stake net fisheries of Vembanad Lake, Kerala, India. ICAR-CMFRI. <http://eprints.cmfri.org.in/13253/>

<sup>308</sup> Ferreira. 2019. Edge Computing Approach for Vessel Monitoring System.

VMS in India was reiterated. It was recommended that mid-sea trans-shipments of catch should not be allowed, until a system of at-sea monitoring through Vessel Monitoring System (VMS) and posting an independent on-board observer is ensured.

Social protection to fisherfolks has been analysed from the HH Survey. The analysis reveals the social support availed by fisherfolks and compensation received by fisherfolks during fishing ban periods. The graphs below depicts the findings.

Figure 167: Social Support and Compensation Received by Fisherfolks



Source: HH Survey, Deloitte Analysis

**Slow Development of Recirculating aquaculture systems (RAS):** Recirculating aquaculture systems (RAS) are tank-based systems in which fish can be grown at high density under controlled environmental conditions and ensuring water quality management. RAS is considered to be one of the most efficient systems being environmentally sustainable, using 90-99 percent less water than other aquaculture systems<sup>309</sup>. RAS can also reduce the discharge of waste, the need for antibiotics or chemicals used to combat disease, and fish and parasite escapes. Hatcheries with RAS facility are often fully closed and entirely controlled, making them mostly biosecure - diseases and parasites cannot often get in. Although RAS is commonly used for freshwater environment, it can also be used for marine environment. However, this system is expensive and requires constant monitoring to avoid catastrophic losses. Energy efficiency of the system is a critical aspect requiring considerable investment along with checks on water levels, disruption of electric power, fire, smoke and intrusion of vandals. In order to make RAS biosecure, it is important to disinfect the RAS water to avoid any contamination through chemicals, drugs or antibiotics. Another key issue in RAS is related to the solid removal in recirculating systems. The presence and accumulation of particulate wastes in RAS (faeces, uneaten feed, and bacterial flocs) will negatively impact the water quality by affecting the performance efficiency of the water treatment units. Hence, it is required to filter the water using drum filters, bead filters, screen filters and rapid sand filters. In India, this technology is the need of the hour but yet to be taken up at a large scale. Lack of stricter water pollution regulations in India has been one of the impediments to bring this technology to use. This system also requires high investment cost on technology and is dependent on constant source of power which are some of the main causes from slower implementation of RAS technology in India<sup>310</sup>. Establishment of RAS requires good knowledge base among fish farmers about emerging and future technologies in aquaculture which is currently lacking.

<sup>309</sup> ICAR-CMFRI. Nazari A. 2018. Recirculating Aquaculture Systems. CMFRI Training Manual Series 14/2018.

<sup>310</sup> NFDB. 'Recirculatory Aquaculture Systems (RAS)' Presentation by Shri Anil B. Ghanekar, <http://nfdb.gov.in/nfdb-videos.htm>

**Overfishing and Resource Exploitation:** Deep sea fishing, motorized fishing and trawling has been some of the key reasons of overfishing and resource exploitation in the Indian fisheries. Deep sea fishing has led to fast depletion of fish in the marine waters. The concern had been expressed by an Expert Committee of Indian Council of Agricultural Research in 2014 while examining the existing Marine Fishing Policy. The findings of the committee reported that fish production in India from the near-shore waters has plateaued and that there is very little scope for increasing production in waters up to a depth of 200 metres. The reports found that exploitation of resources in waters between 200 m and 500 m was at initial stage owing to small fishing boats [mainly measuring between 15 m and 20 m] targeting the resources in this area. Inadequate capacities of implementing a stringent Monitoring, Control and Surveillance (MCS) regime leads to inefficient management of deep sea resources. Information on scientific and technical information on the commercial fisheries resources can ensure sustainable fishing. Depletion of fish resources is also attributed highly to factors like mechanization in fishing. Trawling, purse seining and gillnetting are the most commercial and destructive fishing methods in the country and have resulted in overfishing and resource depletion. Trawling has been the most energy intensive fishing method and the exploitation of resources is directly related to the size of the trawlers preferred as well as the number of hours of operations. Bull trawling is considered as one of the most intensive trawling mechanism that causes huge damage to seabed. Pelagic trawling, although banned in 1980s, is still practiced in the country total damage to fish species and other marine organisms<sup>311</sup>. Destructive fishing practices like the use of small mesh or mini trawl which has mesh sizes as small as 16 mm and is operated in the shallow coastal waters ends up catching mainly the juvenile prawns and fish. Lack of regulations on fishing gears (recommended mesh size and dimension) and boatyards have aggravated the issue. In order to end resource exploitation, it is critically important to educate fisher-folks about all the destructive fishing practices and bring about behaviour change.

### **Inadequate Marketing Infrastructure**

The fish market system is a traditional and informal setup and does not have adequate infrastructural support across the country. This lacuna has been one of the strong observations in the Doubling Farmers' Income report of Niti Aayog published in 2017. Domestic fish market is driven by fisherfolks and private traders only with hinterland demand remaining untested due to insufficient cold-chain connectivity. The perishable nature of fish and the time lag to transport the fresh catch from the fish landing centres to the interior markets is one of the key challenges in the current fish markets in the country. The harvested fish is not evenly distributed to interior areas due to lack of refrigerated transportation. Due to lack of monitoring in the entire value chain, there are considerable compromises on the quantity and type of ice used in the refrigerated transport modes (reefer containers or trucks), putting the hygiene and food safety at risk. The handling facilities are also poor. Availability of potable water, good quality ice, electricity, waste disposal system, etc. is inadequate, affecting consumer acceptance and demand for fish from hinterland population<sup>312</sup>.

**Fish Feed and Hatcheries:** Freshwater aquaculture is highly dependent on input availability for breeding stocks. Traditionally breeding of fish stocks were done with fish seeds collected from the natural water bodies. However, this method has not been effective to meet the demand. The collection season has been short and the quantity of the annual collection fluctuated

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<sup>311</sup> [https://www.business-standard.com/article/current-affairs/banned-pelagic-trawling-is-back-in-kerala-114082700284\\_1.html](https://www.business-standard.com/article/current-affairs/banned-pelagic-trawling-is-back-in-kerala-114082700284_1.html)

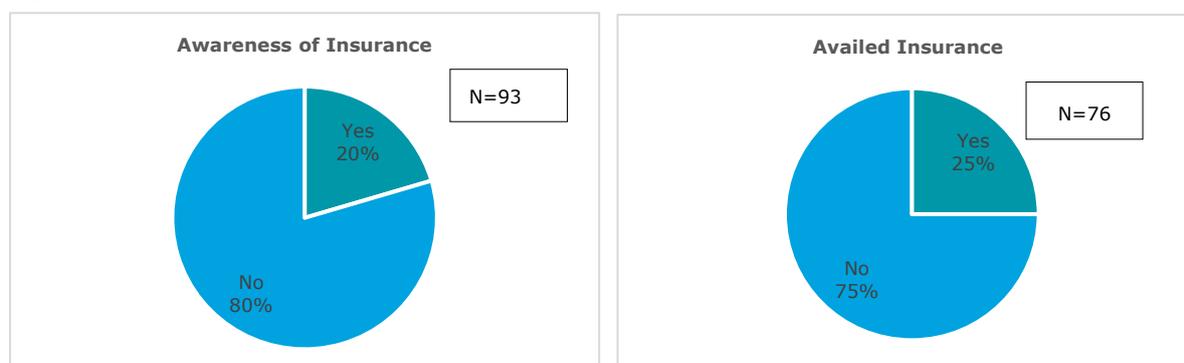
<sup>312</sup> Niti Aayog. 2017. Doubling Farmers' Income – Volume IV, Chapter 11 Livestock and Fisheries Marketing

considerably with the variation of environmental conditions. Deterioration of river environments has resulted in quick decline in both quantity and quality of collection<sup>313</sup>. To address this issue, fish hatcheries have to be established to increase the seed production. However, the hatcheries in India lack proper technology to produce quality fish seeds. There are around 1784 hatcheries of various sizes which are located across different states<sup>314</sup>. Although the hatcheries can provide adequate fish seeds, the quality of fish seeds need to improve. Quality of fish seeds is one of the major bottleneck in vannamei shrimp production. The seed production technologies of some high value fish like murrels, mahseer, pearl spot, koi, pangassius are yet to be standardized/ commercialised. The state run seed farms also need to be strengthened<sup>315</sup>. There is lack of quality brood stock to supply to the hatcheries catering to all types of fish breeds. Modern hatcheries have not developed in-line with the requirement because they are technology and capital intensive.

**Lack of Credit and Insurance Coverage:** The fisheries sector is dependant largely on informal credit. There is lack of credit availability from the formal sector, particularly for marine and aquaculture. Investment in aquaculture is perceived to be risky leading to limits of credit exposure. There is also lack of awareness among the branch level bankers on the aquaculture technologies and their techno-economic feasibilities<sup>316</sup>. There are gaps in the institutional lending, with no incentives like interest subvention being provided for working capital in many states. The sector lacks proper insurance coverage as well. Insurance facility for the marine fisheries assets and aquaculture assets and standing crops are charged very high premium without any subvention by the Government<sup>317</sup>.

It has been observed in the HH Survey that awareness of insurance and adoption of insurance is very low. The graphs below depicts the findings.

Figure 168: Awareness and Adoption of Fisheries Insurance



Source: HH Survey, Deloitte Analysis

As it can be observed from the graphs above that there are only 20% of respondents aware about insurance and around 25% have availed insurance among fisherfolks.

<sup>313</sup> Jayasankara. 2018. Present status of freshwater aquaculture in India

<sup>314</sup> NABARD. 2018. Fisheries and Aquaculture Report. Retrieved from <https://www.nabard.org/auth/writereaddata/tender/0803193019Fisheries%20and%20Aquaculture.pdf>

<sup>315</sup> NABARD. 2018. Fisheries and Aquaculture Report. Retrieved from <https://www.nabard.org/auth/writereaddata/tender/0803193019Fisheries%20and%20Aquaculture.pdf>

<sup>316</sup> NABARD. 2018. Sectoral Paper: Fisheries and Aquaculture. Retrieved from <https://www.nabard.org/auth/writereaddata/file/Fisheries%20and%20Aquaculture.pdf>

<sup>317</sup> NABARD. 2018. Sectoral Paper: Fisheries and Aquaculture. Retrieved from <https://www.nabard.org/auth/writereaddata/file/Fisheries%20and%20Aquaculture.pdf>

## Chapter 2: Sector Level Recommendations: Fisheries

### 2.1. Recommendations at Sectoral Level

Post consultations with the department officials at central, state and district level; sector experts; and our analysis of the issues and challenges faced by the fisheries sector, the recommendations and solutions have been provided below across the Value Chain.

#### Production

- There is a shortage of hatcheries and cost-efficient feed which results in a shortage of quality fingerlings. Therefore, it is suggested to strengthen/ increase the number of hatcheries and feed mills.
- Promoting the use of floating pen and river cage based fish farming in perennial rivers on the lines of similar practices in countries such as Vietnam, Cambodia, etc. Promoting the cultivation of sea weeds and mussels.

Box 24: Tilapia Cage Farming in Vietnam

#### **Tilapia Cage Farming in Vietnam**

**Background:** Cultivation of fish in cages is a dominant type of freshwater aquaculture in the southern provinces of Vietnam and the Mekong Delta. Due to limited land availability, cage culture of fish has expanded by effectively taking full advantage of the available water resources.

**Impact:** Tilapia cage farms are the most popular freshwater cultivation practice which has contributed substantially to livelihoods, food demand and poverty alleviation.

**Effects:** Deterioration in water quality and fish mortalities

#### **Solution:**

- Better management practices such as improvements to the cage designs, checking seed quality at stocking, monitoring water quality and fish health, improving bio-security during production, keeping records and a proactive approach to health management.
- Use of new advanced techniques: high-density polyethylene (HDPE) floating cages and nets with anti-fouling coatings, based on Norwegian technology. The floating cages can endure winds and waves, are easy to move, and can breed a large quantity of fish. They are convenient for checking and harvesting fish.
- Leading to increase in the quality of fish and other aquatic species bred in floating cages.
- The Government has advised fish farmers to pay attention to the quality of fish seed and market demand.
- The department is also building a brand name for the province's fish bred in floating cages so they can be sold directly to wholesale markets and supermarkets. This would add more income for farmers.

#### **Learnings:**

Similarly, customized model can be adopted in India, wherein, the floating cages can be located in sea areas far from shore and have clean water, preventing pollution and disease among fish.

Source: The Fish Site, Better Management Practices, <https://vietnamnews.vn/society/506454/farmers-use-advanced-techniques-to-breed-fish-in-cages.html>

- There is a need for customizing the RAS/ Biofloc technology through R&D efforts in the community ponds and water bodies for enhanced productivity and reduced investments.

Box 25: The Netherlands: Managing Ecosystem Impacts in Aquaculture through RAS

### **The Netherlands: Managing Ecosystem Impacts in Aquaculture through RAS**

**Background:** The Dutch finfish aquaculture sector is unique in the World and based solely on RAS. The sector was developed with the application of RAS in the seventies and eighties, and nearly exclusively applies RAS technology in indoor farming systems for several species, such as African catfish, eel, tilapia, sturgeon, pikeperch, barramundi, turbot, sole, yellowtail kingfish and others.

**Advantages of RAS:** RAS offers a variety of benefits to fish producers in comparison to open pond cultures. Some of them are listed below.

- Maximizes production on a limited supply of water.
- Low land requirements.
- Ability to control water temperature.
- Independence from adverse weather conditions.
- Nearly complete environmental control to maximize fish growth.

**Environment and Ecological Sustainability in The Netherlands:** From an environmental point of view the input into RAS is mainly fish, nutrients water and energy. The nutrient retention by fish inside a RAS is more efficient compared to other husbandry organisms in other animal production systems.

RAS systems are more efficient in terms of water use. The most important output of the operation are fish as end product and the emitted nutrients as a waste product. Compared to ponds, RAS emits waste from the system in higher concentrations and at clearly defined emission points which allows for easier waste management.

The environmental impact of RAS is rather limited as normally end-of-pipe treatments are included in the system setup.

New technologies are focusing on the integration of low trophic species converting the fish sludge into valuable secondary products e.g. other fish species, worms, algae, etc. The generated sludge, bioflocs, are reused then as fish feed.

Comparison of catfish RAS in Netherlands with pangasius culture in Vietnam shows lower CO<sub>2</sub> emissions from Dutch production during production and processing processes, including feed production.

**Learnings:** Government may support and/ or encourage research and pilot projects using RAS/ biofloc technology. This may include partnering with large scale fish farmers through production agreements. Moreover, some of existing facilities used for demonstration may be upgraded into commercial fish farms and leased out to a group of entrepreneurs.

Source: Advancing the Aquaculture Agenda: Workshop Proceedings, OECD, <https://www.slideshare.net/AndrewAyuka/project-report-presentation1-49262229>

- Develop and rollout podcast for capacity building on pond management and hygiene and sanitation practices.
- Aggressive promotion of shrimp and pearl cultivation through reclamation of low-lying areas under saline/ sodic soils, as is happening in Haryana and Punjab.
- Diversification into fast growing species like Tilapia, Cobia, Asian Seabass, etc.
- Focus on capacity building of fishers on fish farm/ fish pond management, hygiene and sanitation aspects of the catch.

- The fish is susceptible to diseases due to contagious nature and mortality in fish is noticed often due to poor management of ponds and hatcheries. Therefore, the ponds need to be limed and fertilized at regular intervals to maintain optimum water quality and load of fish food organisms.

### Processing and Value Addition

- Development of fish filleting and ready to cook fish products manufacturing facilities<sup>319</sup>.
- Promoting the development of inland fish landing/ aggregation centres with ice plants/ ice flaking machinery (regular monitoring and treatment of water quality).
- Creation of fish waste management systems at all major fish markets including facilities for manufacturing by-products like Chitin, Chitosan, Fish meal, Fish oil, etc.
- Strong cold chain network needs to be developed to displace the age-old practice of transportation of fish under ice and covered with saw dust which leads to higher chances of contamination.
- Need to invest and train the fisher folks on quality assurance practices mainly on hygiene and sanitation which have a strong linkage to the quality of the product. This would not only ensure better quality of the product but also increased shelf life and better price realization.

### Marketing

- GI tagging for some of the fish species like rainbow trout, Hilsa, etc. for higher value creation.
- Linking fishermen collectives with e-commerce players in the sector such as Jalongi, Fresh-to-Home, Licious, Fresh Fish Market, etc.

#### **E-commerce players: Key Highlights**

- Cleaned and pan-ready (packed ready to cook, no need to wash).
- Products branded specific to region, providing choice to customers.
- Presence in major Tier-1 cities.
- Delivered at customer's home, no need to visit wet fish markets.

#### **Domestic Consumption per year:**

- Fish & Seafood: INR 65,000 crore, Meat & Poultry: INR 1,50,000 crore

Source: <https://www.newsbarons.com/retail/scaleing-the-fish-business/>

- Conduct periodic fairs and events at global level for promotion of Indian variety of fishes, which will lead to increase in exports.

### Research and Development

- Promoting the development of low-cost quality feed as it comprises around 70% of the cost of production.
- Promoting innovations for adaptation of newer, intensive farming technologies like RAS/ Biofloc in community ponds/ water bodies.

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<sup>319</sup> CIFA (2019)

- Promoting timetable based action led research on development of newer fast growing disease resistant varieties/ species of fish.
- Undertaking R&D for development of processed products from fresh water fish species.
- Development of new varieties/ species for cold water fisheries.
- Promoting innovations to capture the potential of riverine fisheries.

### Policy Level Interventions

- There is a need to develop a uniform policy across the country governing fresh water aquaculture incorporating guidelines and best management practices for the same. These could address areas of management of common water resources, incentivizing fish production at individual level, promoting the development of fishermen collectives (FFDA is one of the initiatives currently being undertaken).
- There is a need for having special package for development of cold water fisheries in specific parts of the country.
- There is a need for exploring the potential of insurance as one of the social safety net tools (widely adopted across the world) for containing and mitigating variety of risks such as asset risks, production and management risks, market risks and personal and health risks<sup>320</sup>, as the risk financing behaviour of Indian fishermen is very low.

Box 26: Key Suggested Reforms for Increasing Adoption of Insurance in Fisheries

#### Key Suggested Reforms for Increasing Adoption of Insurance in Fisheries

Innovative products such as weather-index based insurance schemes are already in force in the agriculture sector, wherein, satellite data and inputs from weather stations are being used to trigger insurance payments in case of occurrence of weather related events. These can be extended to the fisheries sector as well, to increase efficiency and simplify procedures.

The inputs from such platforms could be used for compensating damages to coastal assets of fisher folk, marine cages, and other fishery-related infrastructure.

Similarly, advanced vessel monitoring systems (VMS), could be used to track the fishing vessels and assess incidents such as mid-sea capsizing and collisions. Such data would be valuable for the insurance companies to verify insurance claims by affected beneficiaries.

Further, interactive ICT tools and mobile applications could be leveraged for speedy processing of insurance claims as well as for real-time assessment of damages incurred to fishing vessels and mariculture units in case of calamities.

Source: Asia Pacific Fish Watch (2019)

- The terms of auction/ allocation of community ponds/ water bodies may be revisited to enable small and marginal fishermen gain the rights over fishing in these community ponds/ water bodies.
- It is recommended to explore the potential of expanding the scope of minimum support price to fish catch as well.

<sup>320</sup> AsiaPacFish.org (2019)

- There is a need to develop an on-going real time surveillance mechanism linked to early warning systems for diseases in fishes to take pre-emptive measures. A real-time MIS with open access should be developed which would support the disease control interventions.

#### **Key Recommendations at the Sector Level for Achieving Transformational Improvements Across the Value Chain**

- Exploit untapped potential of brackish water resources to increase production – currently only 14% of the 1.2 mn Ha available under brackish water is being utilized.
- Capacity building of the fish farmers to promote high input – high stocking systems which uses intensive supplementary balanced diet feeding along with increased/ intensive aeration and replenishment of the water bodies. Through implementation of such systems, the production can be increased to 10-15 tonnes/ Ha/ year from 3-5 tonnes/ Ha/ year.
- Higher financial incentives can be considered for aiding capital investment like raceways for trouts, fish pond rejuvenation, etc.
- Development of logistics network for transportation of live fish – which is gaining market traction and attracts premium.
- Lack of dynamic market intelligence is one of the major constraints affecting adequate returns to fishermen. There is a need to set up a dynamic market intelligence on the lines of commodity portals for players to have real time updated information on demand and prices for fish species at major markets in the vicinity.
- Development of low-cost production technologies for production of feed and/ or nutritional products for both humans and animals from sea weed, algae, etc.
- To provide social protection of fishers, explore the potential of universalizing the financial support during lean months under the National Savings-cum-Relief Scheme as being implemented by Tamil Nadu Government with fisher folks in Gulf of Mannar.
- Technical support groups involving multi-disciplinary team needs to be created for project management, planning and implementation at the central and state level. Fixed term contracts/ tenures for scheme level officials for 3-4 years with yearly performance linked appraisal may be introduced for higher accountability.

## Change in Key Indicators for the Sector

As highlighted in sectoral analysis, the increased focus of government on strengthening the fisheries sector has resulted in increase in India's fish production at a CAGR of 7.1% during 2014-15 to 2017-18. The growth in aquaculture and deep-sea fishing owing to changing consumer preferences, use of technology, and government initiatives is likely to spur India towards its aim of doubling farmers' income. However, to achieve this, there has to be concerted efforts towards technology use in the sector, specifically, capture fisheries. Lack of processing facilities, limited value addition in products, and insufficient storage infrastructure are some of the constraints hindering the country to derive full potential from its fishing resources. Moreover, a significant difference has been noticed between allocation of money by the centre and utilization by the states.

In this respect, the Blue Revolution programme is expected to play a significant role as it seeks to improve training and capacity building of fishers and fish-farmers, encourage species diversification and proper fish health management, fortify the country's scientific research and strengthen credit facilities. The key aspects that the scheme focusses on include sustainable fish farming, enhanced output through better coverage, addition of value-added products and species' diversification.

In India, traditional boats/ vessels have been used by fishers, which cannot operate beyond near-shore waters. This results in over-fishing in coastal waters, and under-fishing in deep-sea where high value fishes like tuna are found. Hence, there is a need to achieve a suitable balance. Acknowledging this, the Blue Revolution scheme aims to strengthen infrastructure including motorization of traditional craft, establishment of fishing harbours, establishment of hatcheries, and solar power support for aquaculture. The scheme also gives due importance to sustainability, thus, it steers away from introducing large scale industrial farming and instead focusses on enhancing productivity, better feed quality and diversification of species. The practice of setting up re-circulatory aquaculture system is likely to further boost sustainable fish farming.

The status of some of the important indicators that have been a focus of the Blue Revolution schemes have been analysed below<sup>321</sup>.

Table 57: Change in Key Indicators for the Sector

Particulars	Baseline status	Latest status
Production Marine Fisheries (Lakh Tonnes)	36 (2015-16)	36.88 (2017-18)
Production Inland Fisheries (Lakh Tonnes)	71.62 (2015-16)	89.02 (2017-18)
Marketing fresh fish (000 tonnes)	4930.40 (2015-16)	6494.64 (2017-18)
Frozen fish (000 tonnes)	462.16 (2015-16)	703.62 (2017-18)
Curing (000 tonnes)	258.06 (2015-16)	290.13 (2017-18)
Canning (000 tonnes)	52.25 (2015-16)	36.15 (2017-18)
Reduction (000 tonnes)	321.92 (2015-16)	333.76 (2017-18)
Fish seed production (million fry)	41,824 (2015-16)	52,262 (2017-18)
Exports quantity (tonnes)	945891.90 (2015-16)	1377243.70 (2017-18)
Exports value (Rs crores)	30420.83 (2015-16)	45106.89 (2017-18)

<sup>321</sup> Handbook on Fisheries Statistics, 2018

<b>Particulars</b>	<b>Baseline status</b>	<b>Latest status</b>
No of fishermen provided housing (central scheme)	4809 (2015-16)	950 (2017-18)
No of fishermen provided insurance (central scheme)	5056924 (2015-16)	4214220 (2017-18)
No of fisherman provided relief (Central scheme)	443493 (2015-16)	61740 (2017-18)

As can be seen that the fisheries sector has achieved a consistent growth over last few years. There has been significant boost in production (nearly 25%) of inland fisheries in only two years, which shows the shift in focus from marine to inland fisheries development. In addition, there has been a significant increase in marketing of fresh and frozen fish. The curing of fish also increased significantly during this duration. In addition, numbers on fish seed production also show a tremendous growth of nearly 25% during the period of analysis.

The development of fisheries infrastructure and processing has also boosted the exports which have grown by nearly 50% between 2015-16 and 2017-18. While the numbers show a significant improvement in these areas, the welfare components including the fishermen provided with housing, insurance and relief declined significantly, this marks a shift in orientation of the scheme towards infrastructure development and improvement in production/ productivity.

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