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Azadi Ka Amrit Mahotsav

JOURNEY OF INDIAN AGRICULTURE SINCE INDEPENDENCE

Vision for Amrit Kal

K J S Satyasai, Abhishek Tiwari and Deblina Patra

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT, MUMBAI

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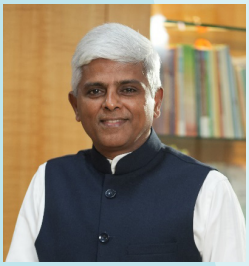
Foreword



India has celebrated Azadi Ka Amrit Mahotsav (AKAM) having completed 75 years of Independence. Indian agriculture has structurally transformed over the years through the efforts of institutions, investment, technology, and crossed several milestones during these 75 years. The journey of Indian agriculture has multiple phases starting from self-sufficiency in food grain production to emphasising farmers' income and welfare.

In this publication, the authors have highlighted the journey of Indian agriculture as it passed through four distinct phases - Production, Nutrition, Income, and Farmers' Welfare. The publication in hand gives a holistic view of the journey of Indian agriculture.

The paper also discusses on how to move ahead during the Amrit Kal, i.e., the next 25 years till 2047 when India would be celebrating one hundred years of Independence.

I congratulate my colleagues in the Department of Economic Analysis and Research for bringing out this timely publication.

P. V. S. Suryakumar
Deputy Managing Director
22 November 2022

Preface

Indian agriculture is unique in many ways compared to other countries. It has a very long history of evolution and has seen various spans of best and worst phases during different regimes. Each regime has brought with it certain legal and institutional reforms. As a result, the country now has a variety of land tenurial systems with Ryotwari system in southern states to Mahalwari system in Punjab, Odisha, and Madhya Pradesh and Zamindari/feudal systems in the eastern states. Accordingly, the production relations/systems that incentivise innovation and initiative of farmers naturally vary across the country.

Another uniqueness is the availability of varied growing conditions from tropical to semi- temperate allowing us to grow virtually any crop grown in any other country. No wonder several new crops and enterprises have been introduced over the years in different regions of the country offering myriad opportunities to farmers. India became a top producer of major agricultural commodities. There are achievements over the last 75 years.

Indian farmers have been at the forefront of technology adoption including the latest digital technology. Agriculture has attracted a considerable number of start-ups and other technology-based solution providers making it future-ready even as smallholders with low literacy levels and poor access to resources are predominant.

Despite such advantages, Indian agriculture is still struggling to match its productivity with other major producers in the world. There are vexing issues, a few listed in this booklet, which we need to address soon.

This booklet is an attempt to chart the agricultural development during the last 75 years and what we shall focus on during the next 25 years, i.e., Amrit Kal. Hope this will be useful to researchers and policymakers and would raise debate on the action for the future.

The encouragement and support we received from our Chairman and DMDs kept us hooked to the analytical research, our mandate. Shri Suryakumar, DMD needs special mention as the source of inspiration to us behind this publication. We acknowledge and thank our officers of the department, DDMs and other NABARD officials for their efforts and contributions to bring out this publication on time.

K J S Satyasai
Abhishek Tiwari
Deblina Patra

Contents

1

Introduction

India has celebrated Azadi Ka Amrit Mahotsav (AKAM) as it turned 75 since Independence. In these 75 years, India has crossed several milestones, transforming it from a very traditional to a vibrant modern economy. Several transformational changes have happened such as achieving food security, the Economic Reforms of 1991, acquiring nuclear capability, positioning its own satellites, and developing as the software hub of the world, among others.

Agriculture has been behind all these developments as the driving force by freeing the economy to focus on the development of other segments as the successive Governments after 1970s never had to worry about food shortages. Indian agriculture has shown its position of importance once again during the recent Covid 19 pandemic by registering impressive growth even as all other sectors of the economy declined. During the Pandemic governments never had to worry about food stocks to feed people and could focus on handling the pandemic.

Starting from Grow More Food Campaign of 1950s to the Green Revolution of mid-1960s and biotechnology developments today agriculture as practised in the country has seen a total transformation. Now with the application of AI, drones, etc., farming is not the same as it had been during the first few decades after Independence. The policy environment has also changed with the signing of WTO in 1995, opening international trade in several agricultural commodities, allowing FDI in organised retail and so on.

During these decades, farmers started growing new varieties of crops; added many new and exotic crops such as kiwi, dragon fruit, avocado, etc. to their cropping pattern; learnt to grow seasonal vegetables in off-seasons and off-locations, and, in essence, viewing agriculture as a business than a mere way of life. Farmers' profiles also have been changing over time. Of course, the farm size of several farmers declined over time, sources of irrigation dried up, and farming became a burden for many due to increasing costs and declining output prices. Any dynamic economy will undergo all such changes over the decades.

During the last 7 ½ decades, we have identified four paradigms in the discourse on Indian Agricultural development: i. Production -the thinking is around increasing production and food security for teeming millions; ii. Income – where the focus is on farmers' income; iii. Nutrition- the focus is to provide nutrition and not just quantity; and lastly, iv. Farmers' Welfare. These are discussed in the following four sections. The last section is on how to move ahead during the Amrit Kal i.e., the next 25 years till 2047 when India would be celebrating 100 years of Independence.

2

Agricultural Production – Quantity Mattered

During the last 75 years, the major focus has been on increasing the quantity of agricultural production, especially, food grains. As a result, agricultural production increased manifold and also diversified. The journey of agricultural production has several trends of which major ones are highlighted here.

Gross Value Added (GVA) in agriculture

i. Share of agriculture in Gross Value Added (GVA)

Gross value added (GVA) by agriculture and allied activities such as livestock, fisheries, forestry, and logging has increased around 7 times, in real terms, from ₹2.96 trillion in 1950-51 to ₹20.48 trillion in 2020-21 (Table 1 and Figure 1). During the same period, overall GVA from all sectors multiplied over 26 times. Thus, the share of agriculture and allied sectors has declined from 61.72% in 1950-51 to 16.27% in 2020-21. Agriculture, as a primary activity, lost its share in GVA to other sectors, especially services. However, due to its interlinkages with other sectors of the economy through its product, factor, market, and foreign trade contributions as Kuznets (1964) postulated, agriculture remains an important sector for India's transformation. More so because even today half of the workers depend directly on agriculture for their livelihoods (Table 1 & Figure 2). Many more are indirectly supported by the farm sector.

Table 1. GVA in agriculture, forestry, and fishing

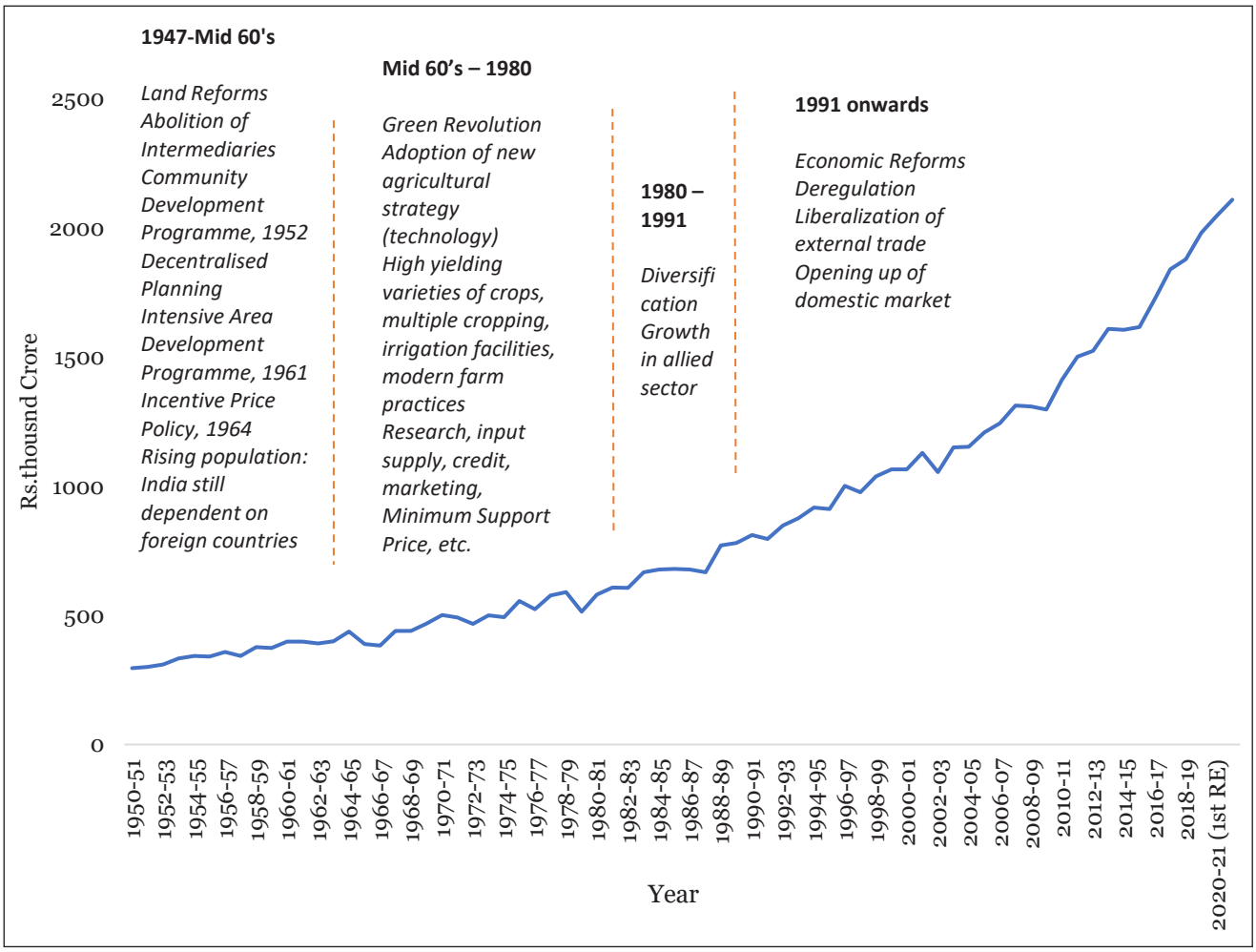
(₹ Crore in 2011-12 prices)

Year	*GVA*	*Agriculture, Livestock, forestry, and fishing*	*% Agricultural GVA in total*	*% Agricultural workers to total*	*% Cultivators in total workers*	*% Agri labour in total workers*
1950-51	4,79,210	2,95,745	61.72	69.70	50.12	19.58
1960-61	7,03,138	3,98,566	56.68	69.50	52.80	16.70
1970-71	10,10,777	5,00,953	49.56	69.70	43.36	26.34
1980-81	13,68,481	5,81,113	42.46	60.50	37.81	22.69
1990-91	23,10,015	8,11,417	35.13	59.00	35.25	23.75
2000-01	40,24,830	10,65,837	26.48	58.20	31.65	26.55
2010-11	77,04,514	14,11,634	18.32	54.60	24.65	29.95
2020-21	1,25,85,074	20,48,032	16.27	51.80 (F)	21.26	30.54

F=Forecast

Source: Various issues of National Accounts Statistics & Economic and Political Weekly Research Foundation India Time Series (EPWRFITS) database

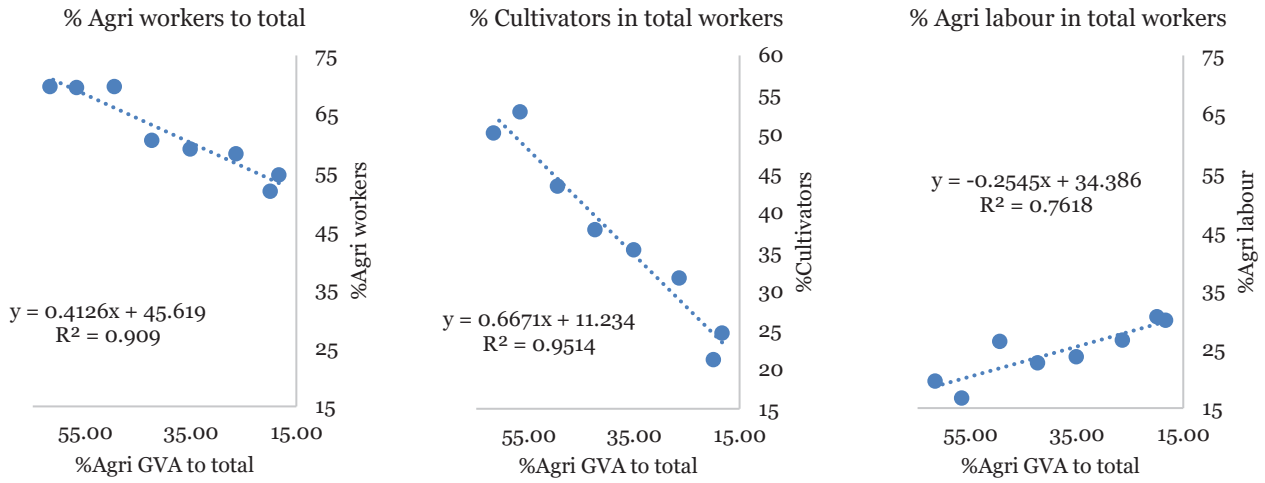
Figure 1. Trend in gross value added by agriculture (Basic prices, 2011-12 prices)



Source: Various issues of National Accounts Statistics

As per the theory of economic development, as a country treads the development path, the relative share of agriculture in national income and employment declines as observed in several countries including our East and Southeast Asian neighbours. In India, the situation has been different. While agriculture's contribution to income declined from 61.72% to 16.27% over the last seven decades, the share of workers employed in agriculture to total remained around close to 70% for the first three decades only to drop by around 9 percentage points (pps) by 1980-81. By that time, agriculture's share in GVA declined by almost 20 pps. During the next four decades, the share of workers in agriculture declined by another 8.70 pps while the share in GVA reached 16.27% falling by 26.19 pps. Thus, the fall in income share is much faster than the fall in share of workers in agriculture. As a result, too many workers have been depending on agriculture. The proportion of cultivators in agricultural workers has declined sharply over the decades while the proportion of labourers increased over time. Each 10 pps decline in the share of agriculture in GVA led to 4.13 pps in share of the workforce and 6.67 pps in share of cultivators in workforce. This commensurate decline, it should be noted, did not happen at all during the first three decades in contrast to the contemporary development experience elsewhere during that period. The falling share in income without a commensurate decline in employment share seems to have resulted in disguised unemployment leading to continued lower incomes and poor living standards for people depending on agriculture.

Figure 2. Disparate falling shares of agriculture in GVA and total workers



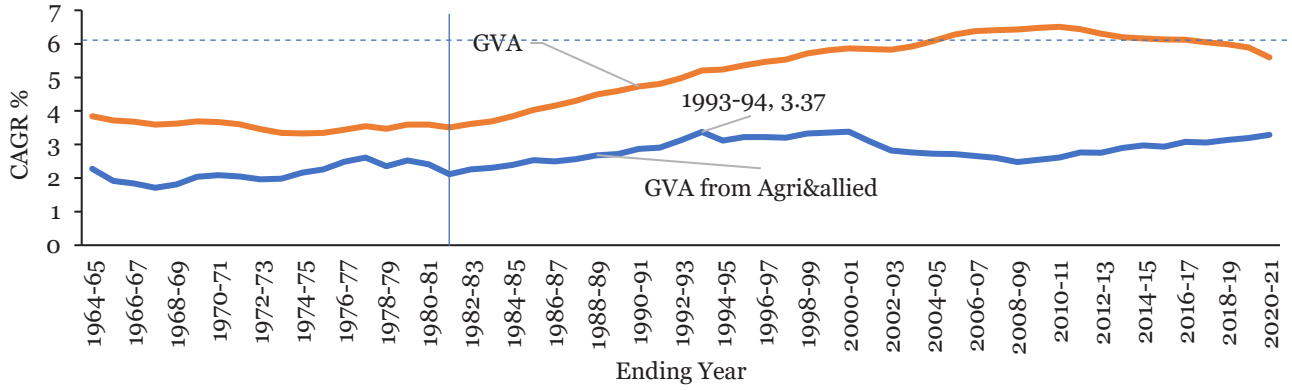
Source: Ministry of Agriculture and Family Welfare (MoAFW), GoI: Agricultural Statistics in brief, various issues.

ii. Growth in GVA and its components

We have seen that GVA in agriculture and overall GVA has grown several times over the last decades. The growth has been differential across various periods. We worked out 15-year moving period growth rates *a la* method suggested by Ray in Rao *et al* (1988) and presented in Annexure Table 1.

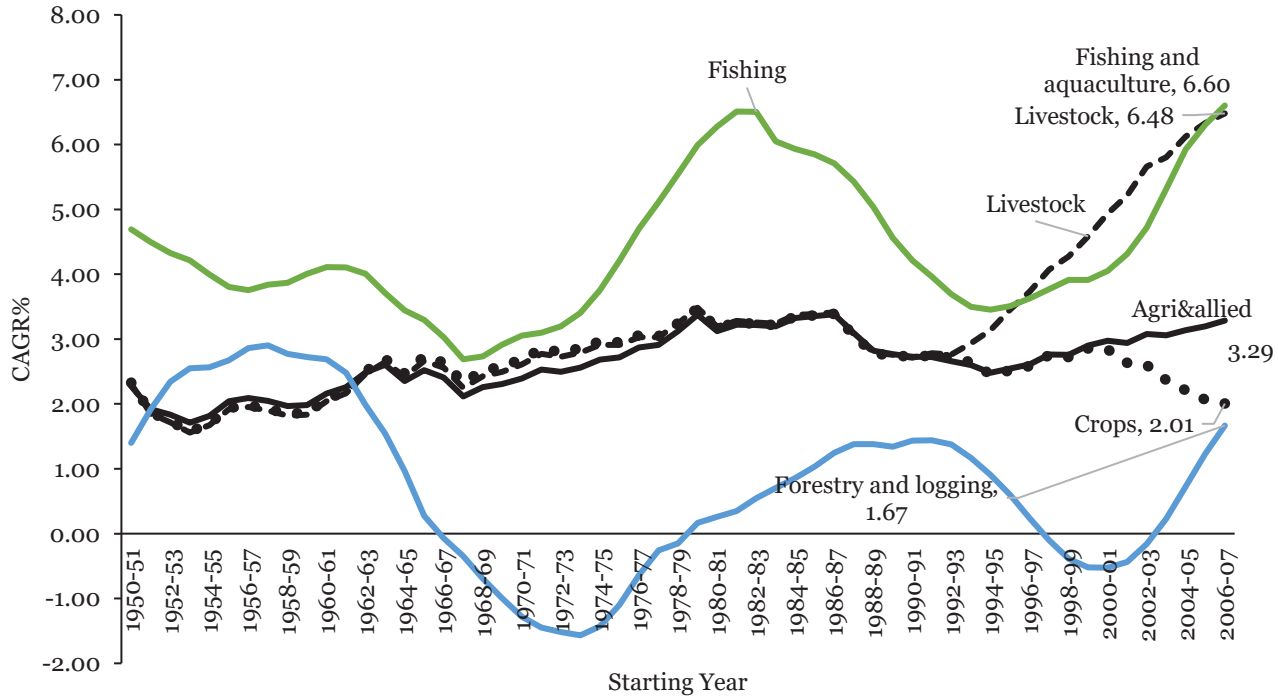
Agriculture grew at above 3% in 18 periods out of 57 (one in 3 periods) in two phases. First phase was over 10 periods from the period spanning 1978-79 to 1992-93 to the period spanning 1987-88 to 2001-02. Again the ≥3% growth was experienced during 8 periods starting from the year 1999-2000 till the period starting from 2006-07. Within agriculture, livestock and fisheries sub-sectors performed well. Livestock sub-sector grew at over 4% since 1998-99 while the fisheries sector showed several high growth rate phases interspersed with poor growth phases peaking at 7.27% during the last one-and-a-half-decade period. In contrast, overall GVA has increased faster than agriculture throughout. The growth rates moved from 3% to 4% during the first 21 periods, 4% to 6% over the next 19 periods before reaching beyond 6% during the remaining 17 periods starting from 1991, the year when economic reforms started. The growth story above perhaps vindicates the claim that the agriculture sector missed the reforms of the 1990s. Figure 3 and 4 portray the above trends clearly.

Figure 3. Compounded annual growth rates (CAGR) in GVA in agriculture and total over successive 15-year moving periods



Source: Computed by Author based on data from EPWRFITS database

Figure 4. Compounded annual growth rates (CAGR) in GVA in sub-sectors of agriculture over successive 15-year moving periods



Source: Computed by Author based on data from EPWRFITS database

A comparison with China and the World average (Table 2) reveals that the GVA (constant 2015 US $ Bn) of China grew at 4.05%, faster than in India (2.94%) between 1968 and 2021. On the other hand, China's population grew at 1.08% per annum compared to 1.88% for India. Thus, India's per capita GVA was much lower than that of China and the World average. Prominently, the gap between India and China continued to widen year after year in the early 1980s (Figure 5). The major factor behind this could be the lower productivity across various crops and non-crop enterprises in India compared to other major producers.

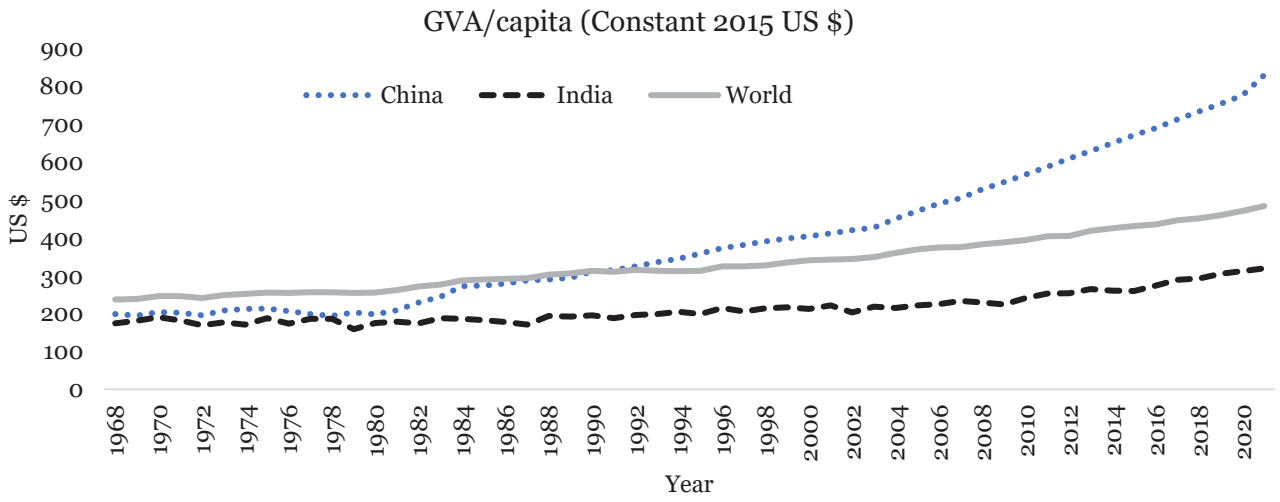
Table 2. GVA per capita in India vs China (1968 to 2021)

(₹ Crore in 2011-12 prices)

Variable	*China*	*India*	*World*
Population growth rate (CAGR %)	1.08	1.88	1.51
GVA (US$ Bn) 2015 prices for 2021	1173	445	3796
GVA growth rate (GAGR %)	4.05	2.94	2.85
GVA/capita ($) for 2021	831	320	484
GVA/capita growth rate (CAGR %)	2.93	1.04	1.32

Source: World Bank Database

Figure 5. Widening gap in GVA per capita between China and India



Source: World Bank Database https://data.worldbank.org/indicator/NV.AGR.TOTL.KD?locations=CN

Value of production in agriculture

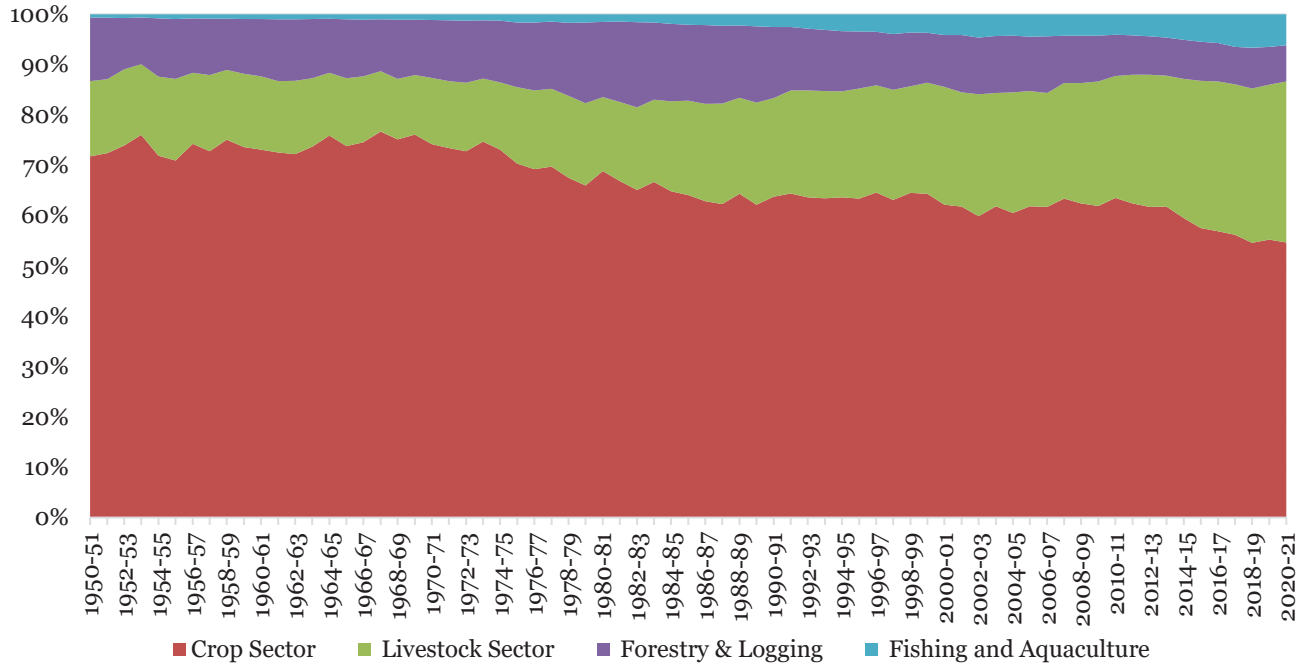
Value of production in agriculture (VOPA) gives us an idea of the level of overall agricultural production over time (Table 3). The VOPA increased 607 times from a mere ₹7278 crore in 1950-51 to ₹44,21,412 crore in 2020-21 in nominal terms. However, in real terms the VOPA grew only 6 times and registered 2.55% of CAGR against 10.46% in nominal terms. Per capita nominal VOPA increased by 160 times during the last 70 years to reach ₹32,039 in 2020-21 while in real terms it reached ₹18,684. Per capita VOPA grew at a very tardy rate of 0.62%.

Table 3. Level of value of production (VOP) from crops, livestock, agriculture, forestry, and fishing

Year	*Nominal*			*Real*		
	VOP (₹ Crore)	*Decade-wise CAGR %*	*Per capita VOP (₹)*	*VOP (₹ Crore)*	*Decade-wise CAGR %*	*Per capita VOP (₹)*
1950-51	7278		202	423749		11735
1960-61	10099	3.37	230	537134	2.31	12230
1970-71	24965	10.79	455	679067	2.23	12387
1980-81	71931	10.24	1053	808907	1.78	11838
1990-91	214443	11.03	2534	1070001	2.55	12642
2000-01	605987	11.51	5891	1377138	2.94	13387
2010-11	1663203	10.42	13735	1808780	2.59	14937
2020-21	4421412	10.03	32039	2578378	3.51	18684
CAGR%	10.46		8.53	2.55		0.62

Source: EPWRFITS database

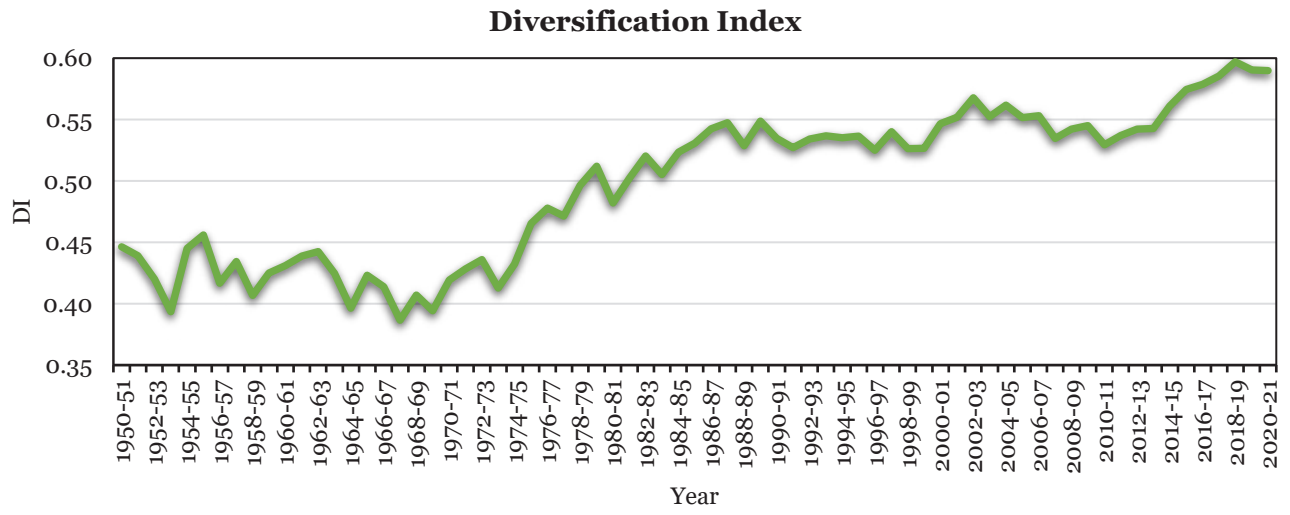
Figure 6. Trend in Composition of Value of Production in Agriculture (current prices)



Source: Based on data from EPWRFITS database

Traditionally, during the early decades after Independence, crop sub-sector dominated the agriculture sector accounting for above 70% of VOPA. The share declined to 55% by 2019-20. With the share of forestry and logging fluctuating over the years, livestock and fisheries sub-sectors have been contributing substantially higher shares to the VOPA in recent years (Figure 6). Thus, the VOPA has been more diversified during recent decades as reflected by the increase in the diversification index[1] from 0.40 to 0.45 during the early 1950s to 0.59 during 2020-21 (Figure 7).

Figure 7. Diversification index for value of production in Indian agriculture



Source: Computed by the Author

[1] Diversification index is measured using formula: $1-\Sigma p_i^2$ where p_i is the share of i^{th} crop/enterprise.

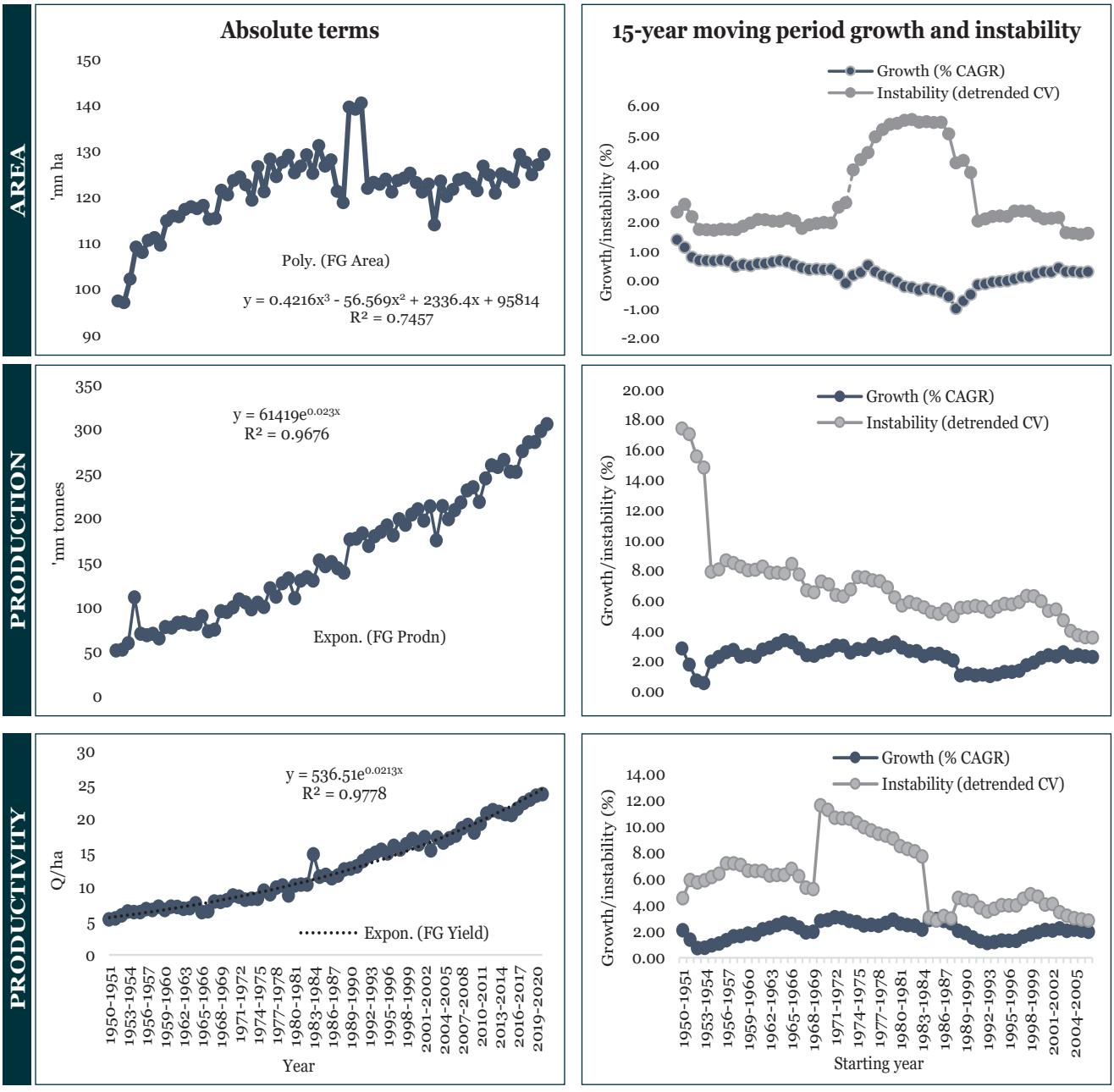
Foodgrains production

i. Achieved self-sufficiency

India has travelled far from a stage when the 'Triage' principle was to be applied for it as there was no hope of meeting our food challenges (Dantwala, 1991). From a mere production of 50 million tonnes of foodgrains in 1950-51, we now produce 314 million tonnes in 2021-22.

Figure 8 gives the time series of area, production, and productivity of foodgrains from 1950-51 till 2020-21. The chart also presents growth (CAGR) and instability (detrended CV) of foodgrains area, production and productivity for the successive 15-year moving period starting from 1950-51[2].

Figure 8. Trend in Foodgrains Area, Production and Productivity 1950-51 to 2020-21



Source: Computed by the Author based on data from EPWRFITS data base and MoAFW.

[2] The methodology for measuring growth and instability for moving periods was adopted based on Ray (1983a) and Mahendradev (1987). Here, instability is measured in terms of de-trended Coefficient of Variation (C.V.). For discussion on instability in agriculture and measures see Ray (1983b), Rao et al (1988), Chand and Raju (2008).

The trend in production and productivity of foodgrains is more or less secular and upward, year-to-year fluctuations, notwithstanding. For the entire period of seven decades, foodgrains production and productivity grew at an exponential rate of 2.30% and 2.13%, respectively. The foodgrains area with an initial level of 97.32 m ha in 1950-51, however, increased at decreasing rate till a severe dip in 1987-88 followed by a spike in 1990-91 and a further deep dive below normal in 2002-03 when the area increased again gradually to reach 129.21 m ha by 2020-21. As we know, there are limits to the growth of area under foodgrains in future. Hence, further production of foodgrains need to be from productivity gains. Bridging the yield gap between the potential yield and the actual can contribute positively. However, this route too has limited scope due to the plateau we seem to have reached for yields with the existing technology.

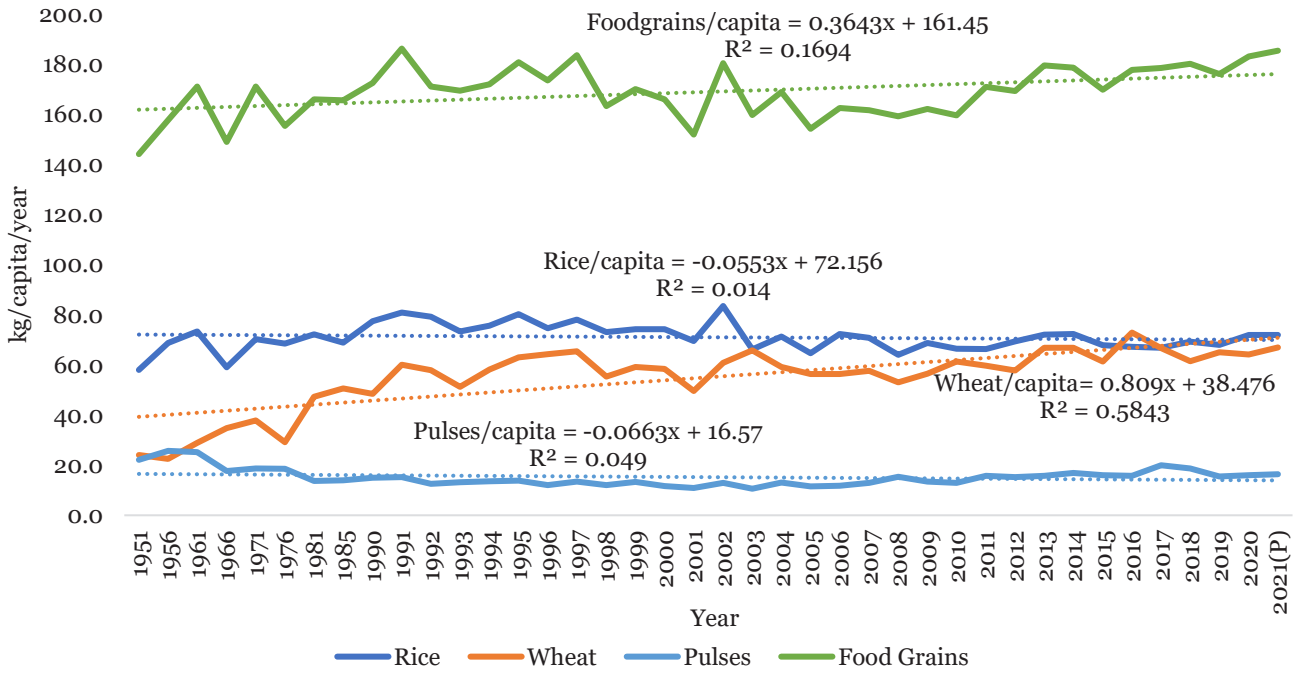
While the production growth rate peaked in the 15-year period starting from 1964-65 and hovered around 3% till the period starting in 1987-88 before falling and rising. For the latest 15-year period the growth rate was 2.25%. Instability, on the other hand, declined substantially after recording higher variations in the initial periods. Growth in area was less than one except for the first 2 to 3 periods and followed U-shape pattern with the lowest growth in the 15-year period starting from 1988-89. Area instability has followed parabola between the periods starting from 1971-72 and 1991-92 peaking at 5.53. This is reflected more or less in the instability metric for productivity also which is much higher for the periods starting from 1971-72 and 1983-84. Growth rates of productivity, on the other hand, remained at 2% for the initial and final periods while peaking at 3.08% for the period starting from 1971-72.

Research shows that in states where instability declined with high growth, the incidence of poverty was lower. On the other hand, the states which recorded increasing instability with low growth showed a very high incidence of poverty (Mahendradev, 1987).

ii. Foodgrains availability per capita

Due to the consistent increase in foodgrains production, thanks to various government programmes over the decades, per capita foodgrains availability has improved from 144.1 kg/capita/year in 1950-51 to 185.4 kg/capita/year in 2020-21 despite the population growth of 1.93% per annum (CAGR). The main contribution towards higher availability of foodgrains is from wheat which is available at 66.9 kg/capita/year in 2020-21 compared to a mere 24 kg/capita/year in 1950-51 (Figure 9).

Figure 9. Per capita foodgrains availability

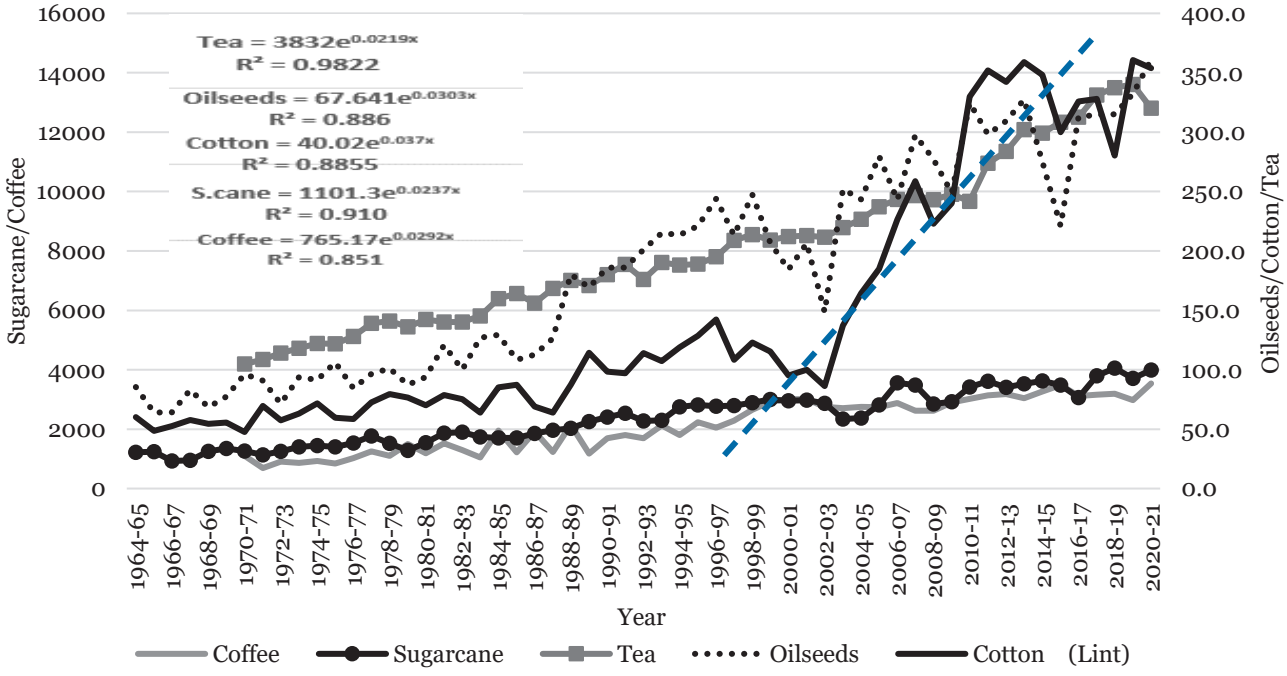


Source: MoAFW

Production of commercial crops

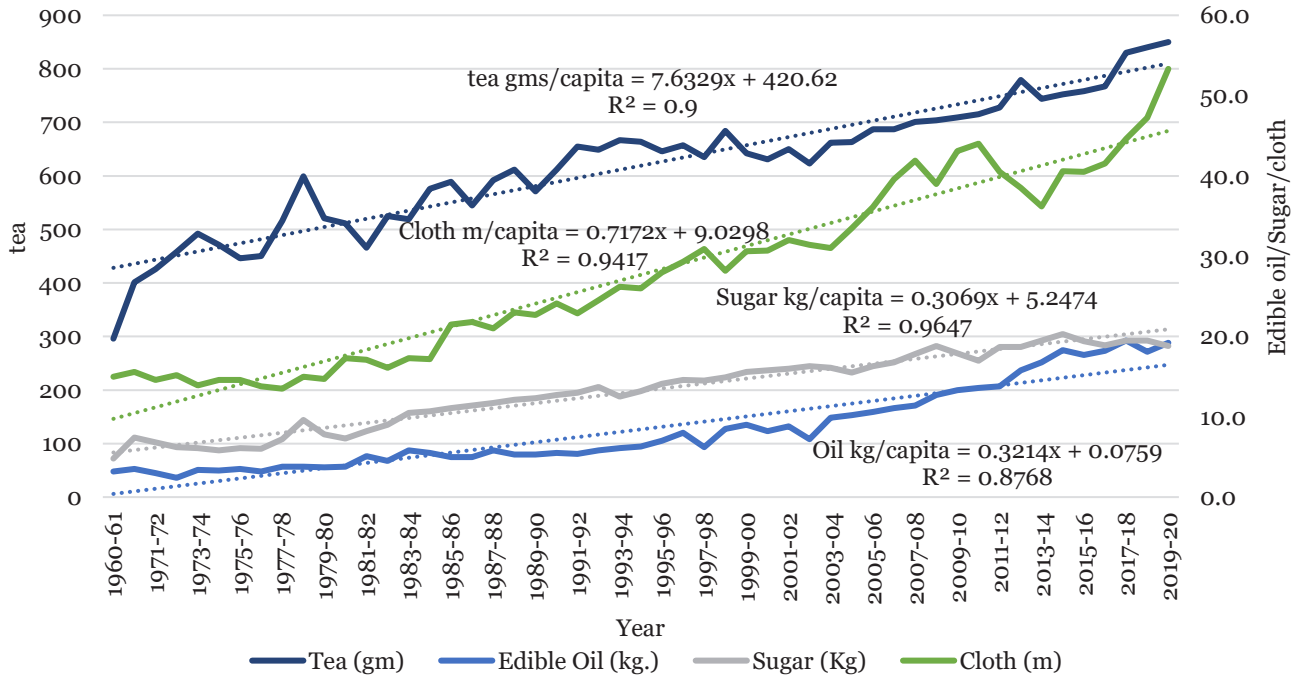
While foodgrain production remained a dominant priority for the farmers and policymakers, commercial crops like oilseeds, sugarcane, and cotton also received attention and especially after 1980s the area allocation towards commercial crops as a share in the gross cropped area increased.

Figure 10. Trend in production of major commercial crops (lakh tonne)



Source: MoAFW

Figure 11. Per capita availability of non-foodgrain agri-commodities

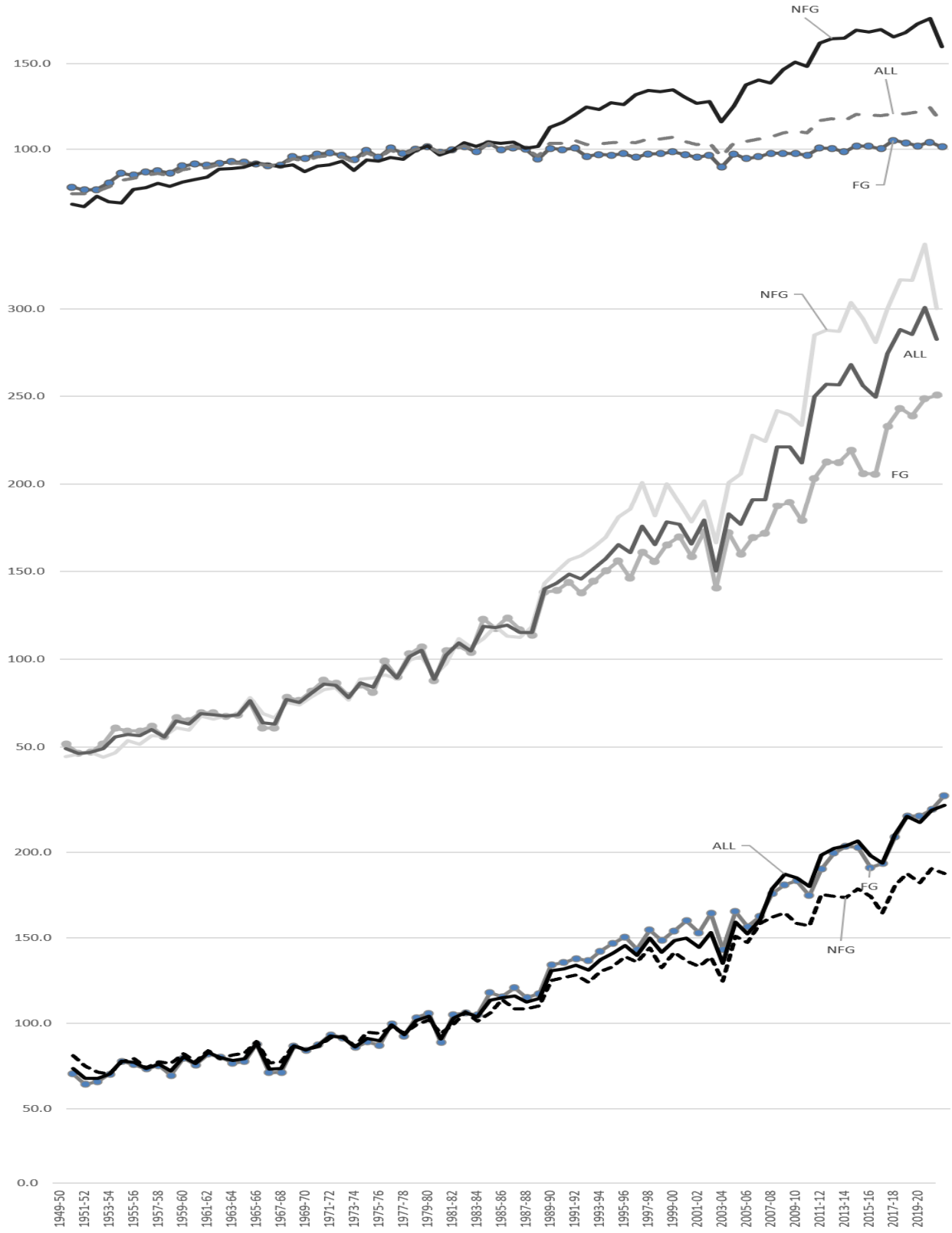


Source: MoAFW

Production trend in a few such crops is given in Figure 10. Cotton has shown the highest exponential growth of 3.70% during the last seven decades followed by oilseeds with 3.03%. Coffee, sugarcane, and tea production grew at 2.92%, 2.37%, and 2.19%, respectively. The success story of cotton comes from significant yield improvement with the adoption of Bt cotton varieties in 2002-03. The kink in production with an apparent structural break can be observed around 2002-03 which is marked with two dotted straight lines in Figure 10. While doubts have been expressed as to the attributability of yield increase to Bt cotton alone (Byravan, 2020), several studies established the positive impact of Bt cotton especially in terms of lower expenditure on pesticides due to reduced pest infestation (Rao and Dev, 2009, 2009a; Ashok *et al*, 2012; Rao, 2013). There has been a significant increase in per capita availability of most of these non-foodgrain commodities during the last 70 years with edible oil availability increasing 6 times per person while cloth, tea, and sugar recorded 3 to 4 times increase in their availability (Figure 11).

Figure 12 gives trend in index of area, production, and productivity of foodgrains, non-foodgrains and all crops since 1949-50 till date. The area under non-foodgrains crossed over that of foodgrains around 1980-81 and from 1987-88 onwards diverged away from the trend in the foodgrains area. The area index has grown till 1965-66 after which remained stagnant. The index of non-foodgrains production has shown faster growth than that of foodgrains after 1988-90 though with larger fluctuations. The index of yield has grown faster for foodgrains and is at a higher level than that of non-foodgrains.

Figure 12. Trend in Index numbers of area, production, and productivity in Agriculture



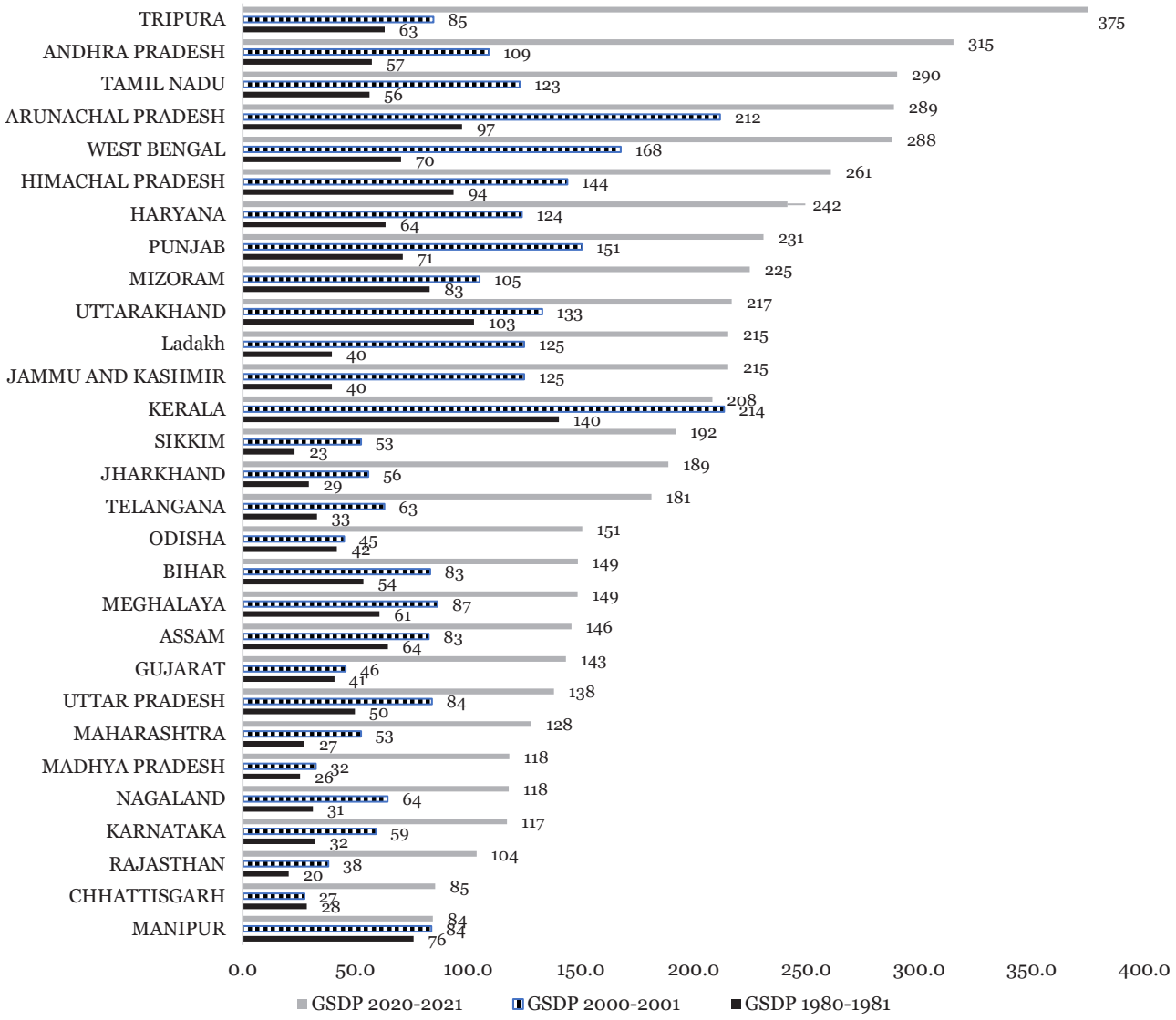
Source: FG- Foodgrain, NFG- Non foodgrain, Source: MoAFW

Regional pattern in production and productivity

How different regions of India have performed has been a hot topic and lot many comparative development studies have been done for understanding why certain regions progressed well and why others lagged despite better resources. Usually, BIMARU states have often been the focus of these studies. The most popular comparison was between Bihar and Punjab/Haryana. Then came the Dr.S.R.Sen Report on Eastern India to pay special attention to the development of a well-endowed Eastern Region as well as inter-regional level studies (Bhalla and Tyagi, 1989; Birthal et al, 2011; Chand et al, 2011; Satyasai, 1992; Satyasai and Premi, 2015, and so on). While these studies pointed to widespread inter-regional disparities, there is evidence of convergence where the regions lagging are catching up with the developed states. Again, as the inter-regional disparities have widened especially after 1990s, the interest in studying them and finding solutions has gained renewed momentum.

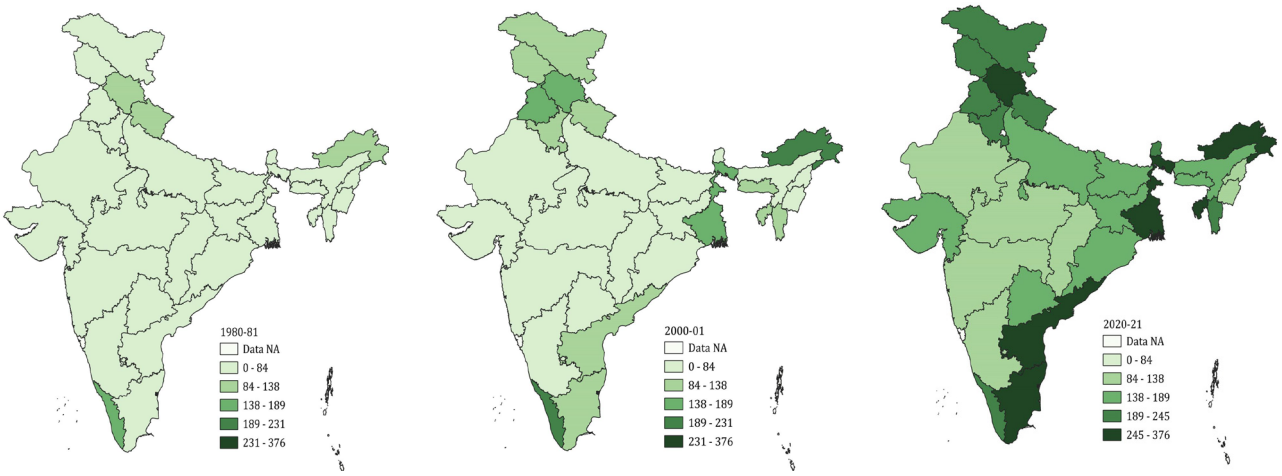
We have displayed GSDP per net sown ha for three points in time (Figure 13) and in a heatmap (Figure 14). Kerala was the topper during 1980-81 and 2000-01 while Tripura topped in 2020-21

Figure 13. GSDP (2011-12 prices) per Net Sown Area (₹ '000/ha NSA)



Source: Based on EPWRFITS database

Figure 14. Spatial spread of SGSDP (₹ '000/ha NSA) across states, constant price 2011-12 series



Source: based on EPWRFITS database - drawn using QGIS

followed by Andhra Pradesh and Tamil Nadu. The heatmap clearly shows the narrowing of regional spread over the decades with a greater number of states (barring western and central regions) improving their per ha GSDP.

Further, we have taken foodgrains yield to understand inter-state disparities at three points in time, 20 years apart (Table 4). The average yield of foodgrains at All India level rose from 872 kg/ha in 1970-

Table 4. Inter-state pattern in foodgrains yield

S. no	States	1970-71			1990-91			2019-20		
		Yield	w.r.t Punjab	Rank	Yield	w.r.t Punjab	Rank	Yield	w.r.t Punjab	Rank
		kg/ha	%	No.	kg/ha	%	No.	kg/ha	%	No.
1	Punjab	1861	100	1	3390	100	1	4527	100	1
2	Kerala	1426	77	2	1872	55	4	3025	67	5
3	Tamil Nadu	1342	72	3	1907	56	3	3052	67	4
4	Haryana	1235	66	4	2348	69	2	3891	86	2
5	West Bengal	1224	66	5	1735	51	9	2904	64	7
6	Jammu & Kashmir	1220	66	6	1512	45	13	2000	44	18
7	Ladakh	1220	66	6	1512	45	13	2000	44	18
8	Himachal Pradesh	1156	62	8	1639	48	10	2180	48	14
9	Manipur	1154	62	9	1763	52	6	2030	45	17
10	Meghalaya	1023	55	10	1160	34	20	2562	57	10
11	Uttar Pradesh	998	54	11	1739	51	7	2816	62	8
12	Uttarakhand	998	54	11	1739	51	7	2343	52	11
13	Assam	975	52	13	1266	37	18	2105	46	16
14	Mizoram	969	52	14	1317	39	15	1676	37	22
15	Tripura	948	51	15	1773	52	5	2770	61	9
16	Nagaland	893	48	16	1109	33	21	1660	37	23
17	Odisha	883	47	17	1003	30	23	1870	41	20

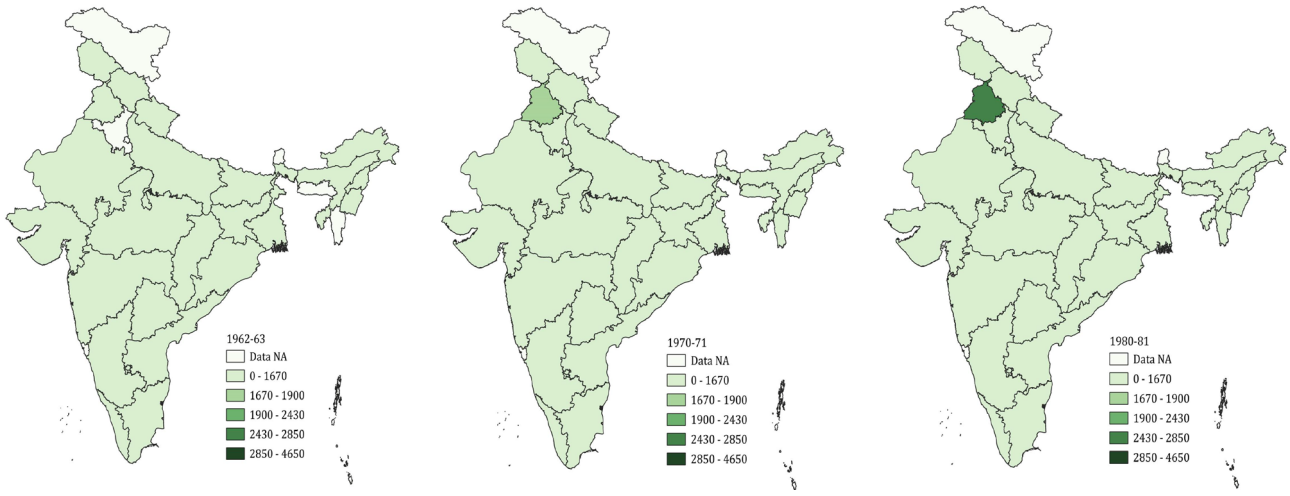
S. no	States	1970-71			1990-91			2019-20		
		Yield	w.r.t Punjab	Rank	Yield	w.r.t Punjab	Rank	Yield	w.r.t Punjab	Rank
		kg/ha	%	No.	kg/ha	%	No.	kg/ha	%	No.
18	Gujarat	864	46	18	1048	31	22	2169	48	15
19	Arunachal Pradesh	847	46	19	1161	34	19	1631	36	25
20	Karnataka	830	45	20	910	27	26	1658	37	24
21	Bihar	795	43	21	1300	38	16	2302	51	12
22	Jharkhand	795	43	21	1300	38	16	1817	40	21
23	Andhra Pradesh	781	42	23	1588	47	11	3022	67	6
24	Telangana	781	42	23	1588	47	11	3483	77	3
25	Rajasthan	686	37	25	864	25	27	1469	32	27
26	Chhattisgarh	648	35	26	1001	30	24	1584	35	26
27	Madhya Pradesh	648	35	26	1001	30	24	2199	49	13
28	Maharashtra	433	23	28	846	25	28	1163	26	28
29	Sikkim				1328	39		1669	37	
30	All India	872	47		1380	41		2343	52	11

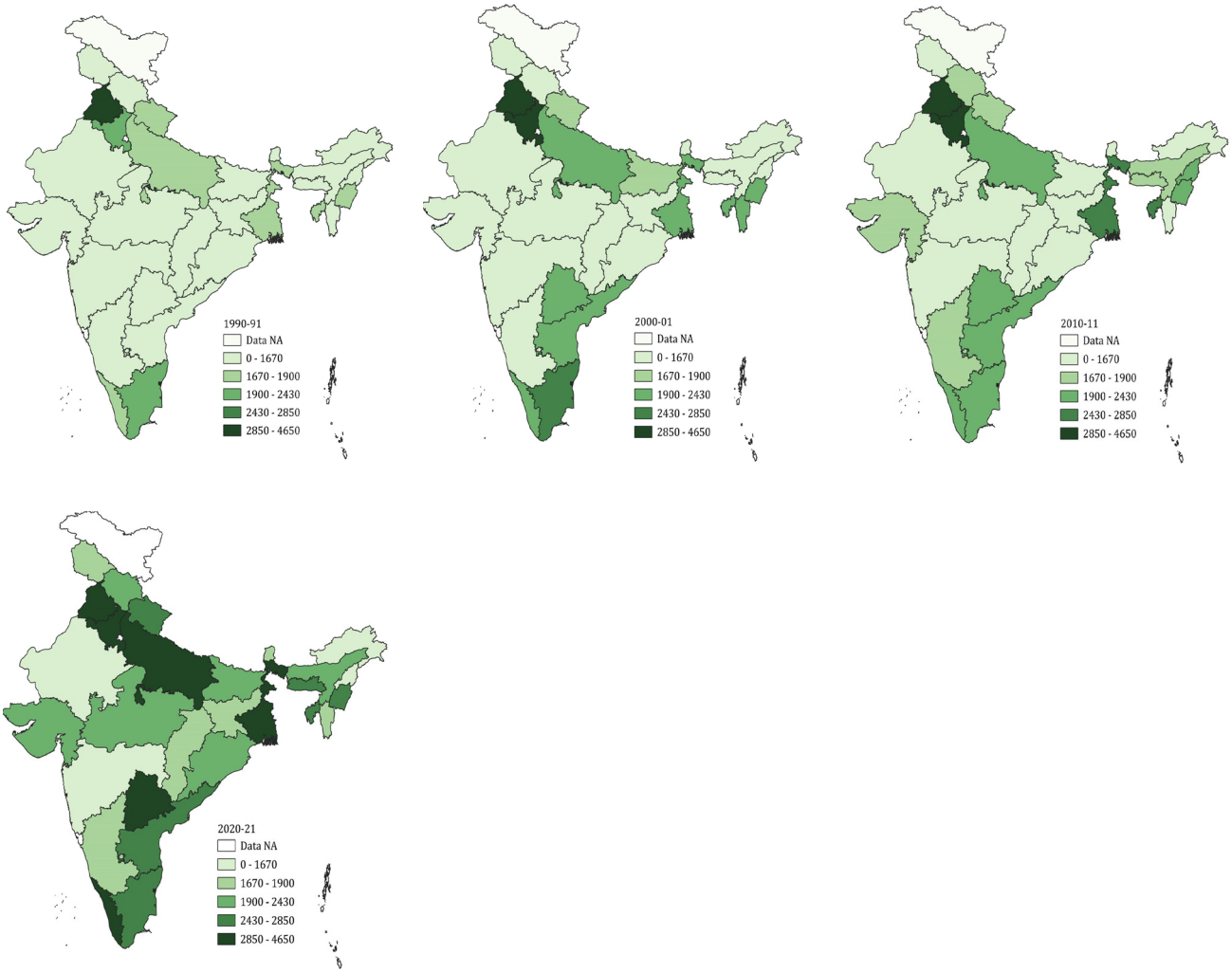
Source: MoAFW

71 to 1380 kg/ha in 1990-91 and further to 2342 kg/ha in 2019-20. Punjab took lead since 1970s by being a topper till date while the distance from yield in Punjab and other states declined. The trend is prominently visible in the heatmaps (Figure 15). Over the years the greater number of states have been moving to higher yield classes.

Regional variation in the SGDP or foodgrain yields are largely determined by the differential resource endowments, i.e., water, land, infrastructure, skilled manpower, etc., across states. Rainfed areas need special mention as they account for large share of people and lower share in water. Frequented by droughts, these areas have concentration of poor people and are underdeveloped. They need to be brought to the mainstream (Deshpande 2022).

Figure 15. Foodgrains yield gap between Punjab and other states





Source: Based on data from MoAFW

3

Nutrition is the New Urgency

After the initial urgency to provide food, i.e., ensuring food security to all is met, the focus shifted to nutrition security. Pervasive anaemia especially among women, child stunting and wasting pushes nutrition into focus. India's faster economic growth after the 1990s has raised per capita income (expenditure) and has significantly affected its food consumption patterns by causing a change in the structure of the food basket. There has been a steady increase in the per capita consumption of edible oils and food products of animal origin over the years. Thus, there has been an increase in diversification in calorie intake (from 0.557 to 0.630) and protein intake (from 0.574 to 0.634) during the period of 1991-92 to 2014-15 (Satyasai and Shukla, 2016).

In tune with consumption pattern changes, the production basket too has changed. New crops, especially fruits and vegetables, and animal-based enterprises entered the production basket to improve the nutritional content of the production. Due to relative non-profitability, crop groups like pulses and nutri-cereals (millets) have been substituted with other lucrative crops. Pulses being the major source of protein in the Indian diet, concerns have been expressed. However, due to the introduction of soybean, rise in the production of peas, and diversification towards animal-based enterprises, overall protein production in the country has increased. Similarly, total calorie production too has increased over the years. Gross protein production (GPP) and gross calorie content (GCC) of food produced in the country have been assessed using the protein and calorie content of various food items as the weights (Satyasai and Viswanathan, 1996, Satyasai and Shukla, 2016).

Gross protein production

Between TE1993-94 and TE2020-21, the relative contribution of the crop sector to protein production declined from 85.39% to 74.08%. The decline is offset by animal sources which contributed one-fourth share by TE2020-21 (Table 5 and Figure 16). Protein production per capita per day reached 106 gram

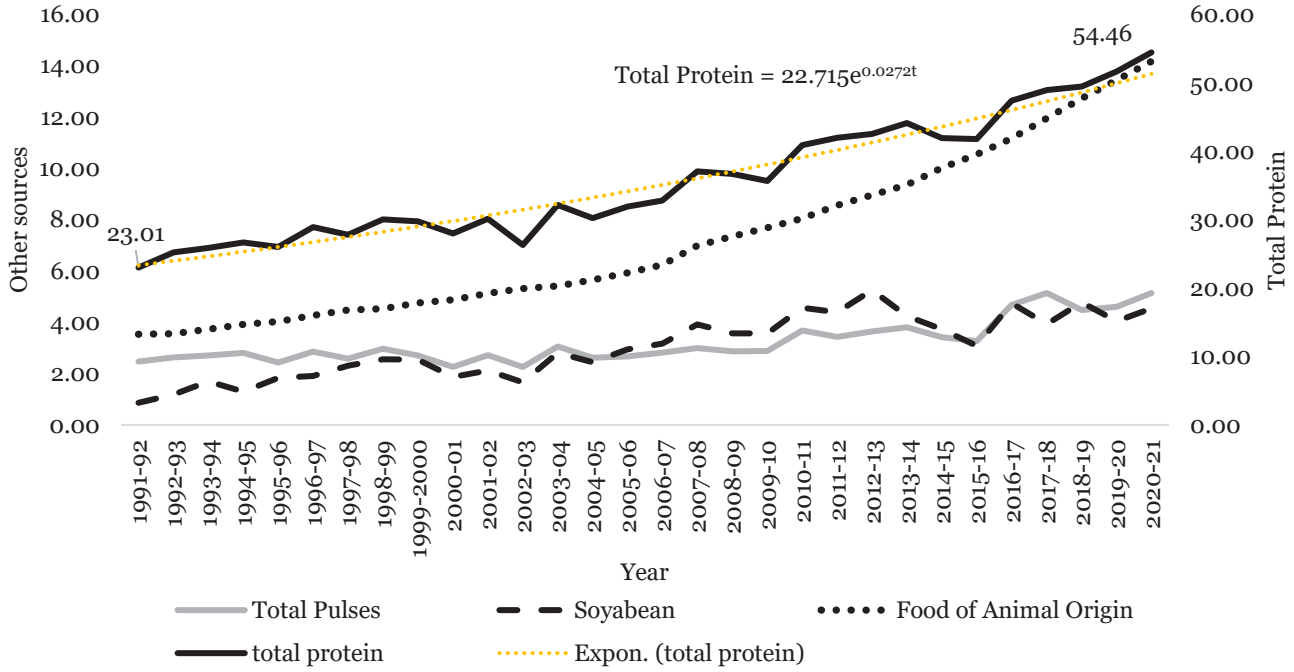
Table 5. Trend in Protein Production in India (MT)

Crop/Crop Group	*Triennial Average for Triennium ended*							
	1993-94	*%*	*2003-04*	*%*	*2013-14*	*%*	*2020-21*	*%*
CROP ORIGIN	**21.09**	**85.39**	**24.24**	**82.09**	**33.41**	**77.95**	**38.43**	**74.08**
Food Grains	16.56	67.03	18.80	63.67	24.42	56.99	28.64	55.22
Cereals	13.95	56.48	16.12	54.60	20.80	48.53	23.90	46.08
Fine Cereals	10.69	43.26	12.82	43.40	16.65	38.85	19.29	37.19
Coarse Cereals	3.26	13.21	3.31	11.19	4.15	9.68	4.61	8.89
Pulses	2.61	10.55	2.68	9.07	3.63	8.46	4.74	9.14
Oilseeds	3.71	15.02	4.18	14.14	6.55	15.28	6.97	13.43
Vegetables	0.62	2.51	0.93	3.14	1.78	4.16	2.05	3.96
Fruits	0.21	0.83	0.34	1.14	0.65	1.52	0.76	1.47

Crop/Crop Group	*Triennial Average for Triennium ended*							
	1993-94	*%*	*2003-04*	*%*	*2013-14*	*%*	*2020-21*	*%*
ANIMAL ORIGIN	3.61	**14.61**	5.29	**17.91**	9.45	**22.05**	13.45	**25.92**
Dairy Group	2.06	8.33	3.13	10.61	5.14	12.00	7.26	14.00
Non-dairy group	1.55	6.28	2.16	7.31	4.31	10.05	6.18	11.92
Total	24.70	100.00	29.53	100.00	42.86	100.00	51.87	100.00
Index of Diversification	*0.75*		*0.75*		*0.78*		*0.79*	
Per capita production (kg/year)	28.29		27.97		34.69		38.68	
Daily production (gm/ per capita)	**77.5**		76.6		**95.1**		106.0	

Source: Computed by Author

Figure 16. Trend in protein production (Million Tonne)



Source: MoAFW

in TE2020-21, a 37% hike from the TE1993-94 level. Given the protein requirement of 100 gram per day, the current level of protein production is just adequate, provided distribution aspects are taken care of.

Gross calorie production

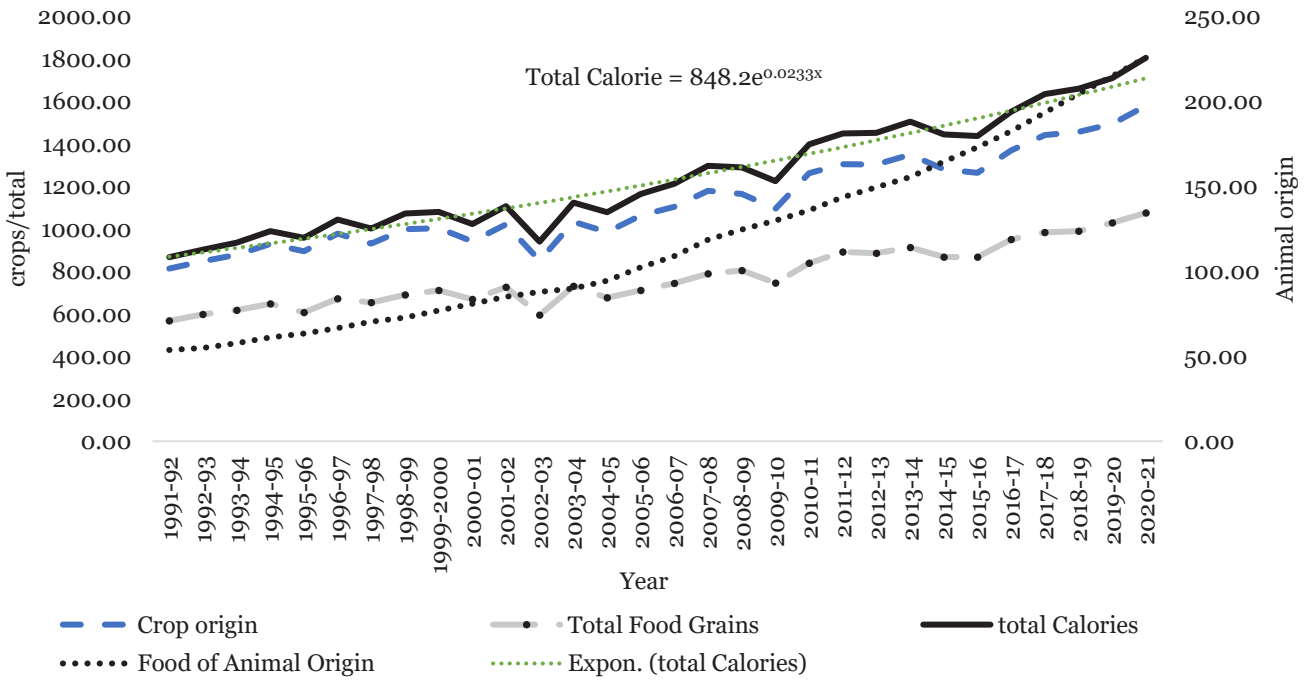
Gross calorie content (GCC) in food produced has almost doubled between TE1993-94 and TE2020-21 and so did the share of animal sources. Per capita per day production increased from 2827 to 3524 calories (25% growth) during the same period (Table 6 and Figure 17).

Table 6. Trend in Calorie Production in India (Bn. Cal)

Crop/Crop Group	*Triennial Average for Triennium ended*							
	1993-94	*%*	*2003-04*	*%*	*1993-94*	*%*	*2003-04*	*%*
CROP ORIGIN	845.59	83.79	968.43	81.46	1310.65	79.82	1509.98	78.48
Food Grains	593.60	65.88	683.08	64.68	888.52	60.56	1030.53	59.74
Cereals	551.84	61.25	639.78	60.58	828.36	56.46	952.04	55.19
Fine Cereals	466.33	51.76	539.97	51.13	689.42	46.99	790.85	45.85
Coarse Cereals	85.52	9.49	99.81	9.45	138.94	9.47	161.18	9.34
Pulses	41.76	4.63	43.30	4.10	60.15	4.10	78.49	4.55
Oilseeds	126.50	14.04	123.14	11.66	178.94	12.20	204.01	11.83
Vegetables	19.63	2.18	29.01	2.75	55.54	3.79	64.38	3.73
Fruits	15.19	1.69	24.98	2.37	48.07	3.28	54.86	3.18
Others	90.67	10.06	108.22	10.25	139.59	9.51	156.20	9.06
ANIMAL ORIGIN	55.43	6.15	87.59	8.29	156.43	10.66	215.03	12.47
Dairy Group	43.76	4.86	71.30	6.75	122.56	8.35	166.52	9.65
Non-dairy group	11.67	1.30	16.29	1.54	33.87	2.31	48.51	2.81
Total	901.02	89.94	1056.02	89.75	1467.08	90.49	1725.01	100.00
Index of Diversification		0.69		0.70		0.73		0.74
Per capita calorie production		1031.70		1000.02		1187.60		1286.23
Daily calorie production		2826.57		2739.79		3253.69		3523.92

Source: Computed by Author

Figure 17. Trend in calorie production in Indian (Billion)



4

Farmers' Income, to be Enhanced

The announcement of the goal by the Hon'ble Prime Minister of India in the year 2015-16 to double farmers' income helped shift the paradigm from production to income. There was a divided opinion for and against the proposal and lot has been said and written in academic and popular press (Desai, 2016, Gulati and Saini, 2016, Satyasai and Bharti, 2016, Satyasai, 2016, Satyasai and Mehrotra, 2016, Nair and Kulkarni, 2016). We hardly have income estimates for farmers. Chand et al (2016) have estimated using National Account Statistics data for the period 1983-84 to 2011-12. While NSO has made a few attempts earlier, income estimation at the farm household level was not done due to certain methodological challenges (Bakshi, 2010,2012; Satyasai, 2019; Surjit, 2017; Swaminathan, 2017). Situation Assessment Surveys of Agricultural Households done by NSO in their 59th, 70th and 77th rounds and the NAFIS survey of NABARD are among the major sources of data on farmers' incomes in the country (NSSO 2005, 2016, 2021; NABARD 2018). Shukla (2010) and SPICE (2014&2016) are other efforts to measure farmers' incomes. When the announcement for doubling of incomes was made, we were clueless as to which benchmark to take. Hence, we estimated income trends using NSSO 59th and 70th rounds fully knowing that the two rounds are not comparable strictly. Now 77th round results came which are comparable with the 70th round. We present a few income patterns below from these two rounds.

Average income

Table 7 shows that the average monthly income of agricultural household was ₹10,084 which rose by 7.80% when compounded annually from 2012-13 level of ₹6426. In real terms, the compounded growth rate is 2.5% per annum. This is too slow a growth to support the doubling dream.

Table 7. Average monthly income of agricultural households and CAGR (Nominal & Real) for the period between 2012-13 and 2018-19 (CPI-AL: Base 2012-13)

Size class of land possessed (ha)	*Total income (2012-13) ₹*	*Total income (2018-19) ₹*	*CAGR % (Nominal)*	*CAGR % (Real)*
<0.01	4,561	10,950	15.72	10.1
0.01- 0.40	4,152	7,333	9.94	4.6
0.41-1.00	5,247	8,495	8.36	3.1
1.01-2.00	7,348	11,375	7.55	2.3
2.01-4.00	10,730	16,289	7.21	2.0
4.01-10.00	19,637	27,841	5.99	0.8
10.00+	41,388	60,177	6.44	1.2
all sizes	6,426	10,084	7.80	2.5

Source: Satyasai and Jadhav (2022).

Composition of income

Farmers earned ₹25,380 per household in 2002-03 which increased to ₹1,22,616 in 2018-19 which comes from multiple sources (Table 8). Wages and salaries account for 40% in 2018-19, higher compared to 2012-13 but lower than what NAFIS estimated, i.e., 50% (Table 8). The share of crop cultivation is around 38% in the 77th round compared to the 70th round and livestock has continued to contribute a higher share reaching 16% by 2018-19. Non-farm business as a source of income to farm households has declined from earlier rounds. The lower share of the crop sector in 2018-19 and state-wise variation in farm incomes are of concern and these Situation Assessment Surveys of NSO have very valuable information on the state of agriculture in the country. For instance, the report reveals the monthly income of farmers to be the highest in agriculturally advanced states – Punjab and Haryana – and the lowest in relatively poorer states – Jharkhand, Bihar, Odisha, Madhya Pradesh and West Bengal (Hussain and Bathla, 2021).

Data would make it clear that when land size increases, the share of net receipts from agricultural operations (crop production and animal farming) per agricultural household increases. The share of income from agricultural operations for large farmers (10 ha and more) is 91 % while for small and marginal farmers (0.01-0.04) it is just 28%. The income disparity between agricultural households with 0.40 to 1.00 hectares and agricultural households with 10 hectares & more is significant, with the latter's average monthly income being eight times that of the former compared to 10 times during 2012-13, the income gap seems to have narrowed. The growth in average monthly income has not been uniform across the states in the period between AY 2012-13 to AY 2018-19 (Satyasai and Jadhav, 2022).

Table 8. Source-wise share in income for time period 2002-03, 2012-13, 2015-16 and 2018-19 (%)

Particulars	*AY 2002-03 (NSSO 59)*	*AY 2012-13 (NSSO 70)*	*AY 2015-16 (NAFIS)*	*AY 2018-19 (NSSO 77)*
Income from wages &salaries	39	32	50	40
Net receipt from Crop production	46	48	35	38
Net receipt from Farming of Animals	4	12	8	16
Net Receipt from Non-Farm Business	11	8	6	6
Total Income/annum ₹	100	100	100	100
	25,380	77,112	1,07,172	1,22,616

Source: Author's calculation on 70th and 77th rounds of SAS

Income of various social groups

Socially deprived categories may have a disadvantage in terms of access to resources like credit and levels of income earned (Satyasai et al, 2017). The level of income of SC and ST households is lower compared to OBC and 'Others'. SC, ST and OBC category households earned lower than average income (Table 9). These households are more dependent on income from wages than households belonging to the category 'Others' (Table 10). Households belonging to category 'Others' earn 42% of their income from crop cultivation which is significantly higher than other categories – OBC(37.6%), SC(25.2%),

Table 9. Income (₹) by social group across different size class of land for 2012-13 and 2018-19

Farm-size, ha	*ST*		*SC*		*OBC*		*Others*		*Overall*	
	2012-13	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*
Landless (< 0.01)	6467	9451	4177	7840	4582	10611	3786	15865	4561	11204
Lower marginal (0.01 - 0.40)	4815	7487	3649	7177	4170	7127	4339	8675	4152	7522
Upper marginal (0.41 - 1.00)	4957	8030	4390	7559	5249	8573	6028	9704	5247	8571
Small (1.01 - 2.00)	6375	9336	6138	10182	7211	11338	8761	13706	7348	11449
Semi-medium (2.01 - 4.00)	8153	12214	7874	13307	10654	16733	12677	18573	10730	16435
Medium (4.01-10.00)	14270	23451	13074	23768	18904	22426	22384	38675	19637	28292
Large (>10.00)	100792	145517	24961	17763	35214	56205	46030	57700	41388	60758
All sizes	5864	8979	4539	8142	6378	9977	8059	12806	6426	10218
CAGR (%)	7.35		10.22		7.74		8.02		8.03	

Source: NSO's 70th and 77th round of SAS

Table 10. Income composition of social groups for 2012-13 and 2018-19 (%)

Social Category	*Wages/salaries*		*Crop cultivation*		*Livestock*		*Non-farm*		*Total*	
	2012-13	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*	*2012-13*	*2018-19*
ST	38.98	50.6	43.72	34.4	14.34	11.7	2.97	3.0	100	100
SC	50.89	53.0	32.52	25.2	10.13	14.0	6.43	7.1	100	100
OBC	29.54	36.9	48.82	37.7	12.78	17.8	8.86	6.7	100	100
Others	26.52	33.8	54.05	42.6	10.24	14.2	9.19	6.6	100	100
All	32.23	39.8	47.95	37.2	11.87	15.5	7.97	6.3	100	100

Source: NSO's 70th and 77th round of SAS

ST(34.4%). In terms of the growth rate of income between the period 2012-13 to 2018-19, SC (10.22%) household growth rate was the highest followed by 'Others' (8.02%), OBC (7.74%) and ST (7.36%). Livestock as an income source doesn't show much variation across social groups. Its share in total income for OBC households is more than the category 'Others' (Satyasai and Jadhav, 2022).

5

Farmers' Welfare, Towards a New Paradigm

In recent years, there is a major change in policy stance from production to income augmentation when the goal of doubling the farmers' income was set. We propose that the paradigm should shift to farmers' welfare as income is only one of the indicators of farmers' welfare. There are several other indicators of farmers' welfare such as: i. both absolute and relative average income; ii. availability and accessibility to the social security system – education, health, etc.; and iii. facilitating the farmer in moving up Maslow's need hierarchy beyond social security (Dalwai, 2019). Taking a cue from there, Satyasai et al (2021a&b and 2022) proposed farmers' welfare framework by constructing a composite Farmers' Welfare Index (FaWI) across states. The index captures six dimensions viz.: (i) production (5 indicators) (ii) post-production (7 indicators) (iii) infrastructure (7 indicators) (iv) social development (11 indicators) (v) ecological aspects (2 indicators), and (vi) policy & fiscal environment (3 indicators). The composite index, NAFINDEX (Satyasai and Kumar, 2020 a&b) encompassed 17 indicators, is one of the indicators used and thus, a total of 52 indicators used for FaWI. The results are given in Table 11 and Figures 18 a&b.

Table 11. Farmers' Welfare Index and its Dimensions

State	*Production*	*Post-Production*	*Infrastructure*	*Social Development*	*Ecological Dimension*	*Fiscal Dimension*	*FaWI*
Andhra Pradesh	0.44	0.32	0.26	0.53	0.27	0.31	0.36
Arunachal Pradesh	0.10	0.14	0.15	0.46	0.87	0.65	0.39
Assam	0.06	0.34	0.21	0.60	0.63	0.18	0.34
Bihar	0.39	0.23	0.18	0.47	0.42	0.16	0.31
Chhattisgarh	0.23	0.26	0.09	0.48	0.49	0.22	0.29
Goa	0.09	0.33	0.67	0.89	0.79	0.65	0.57
Gujarat	0.27	0.40	0.19	0.64	0.25	0.41	0.36
Haryana	0.52	0.56	0.28	0.67	0.44	0.23	0.45
Himachal Pradesh	0.27	0.30	0.26	0.63	0.43	0.26	0.36
Jharkhand	0.14	0.44	0.10	0.38	0.52	0.24	0.30
Karnataka	0.32	0.39	0.26	0.59	0.35	0.32	0.37
Kerala	0.42	0.35	0.56	0.71	0.78	0.14	0.49
Madhya Pradesh	0.27	0.26	0.10	0.46	0.47	0.24	0.30
Maharashtra	0.41	0.32	0.20	0.62	0.25	0.37	0.36
Manipur	0.15	0.18	0.09	0.57	0.58	0.45	0.34
Meghalaya	0.22	0.14	0.10	0.53	0.69	0.26	0.33
Mizoram	0.26	0.14	0.13	0.70	0.68	0.45	0.39
Nagaland	0.13	0.20	0.10	0.56	0.49	0.27	0.29
Odisha	0.16	0.33	0.18	0.29	0.32	0.28	0.26

State	Production	Post-Production	Infrastructure	Social Development	Ecological Dimension	Fiscal Dimension	FaWI
Punjab	0.41	0.68	0.37	0.74	0.50	0.41	0.52
Rajasthan	0.35	0.25	0.13	0.53	0.00	0.18	0.24
Sikkim	0.10	0.09	0.14	0.75	0.67	0.52	0.38
Tamil Nadu	0.59	0.32	0.42	0.58	0.45	0.24	0.43
Telangana	0.59	0.34	0.34	0.59	0.32	0.23	0.40
Tripura	0.15	0.30	0.24	0.56	0.86	0.18	0.38
Uttar Pradesh	0.44	0.34	0.17	0.54	0.44	0.21	0.36
Uttarakhand	0.37	0.44	0.19	0.63	0.60	0.23	0.41
West Bengal	0.29	0.39	0.23	0.46	0.56	0.21	0.36

Source: Satyasai et al, 2022 b.

Figure 18a. Spatial Pattern of Farmers' Welfare Index (FaWI)

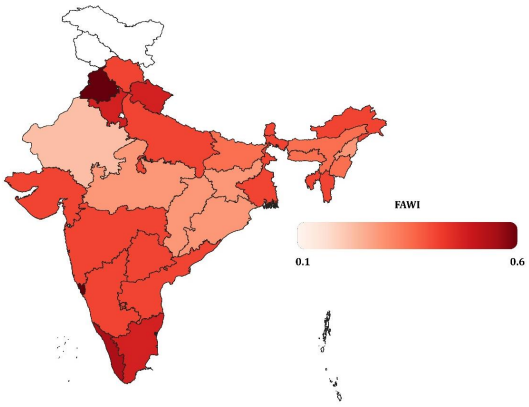
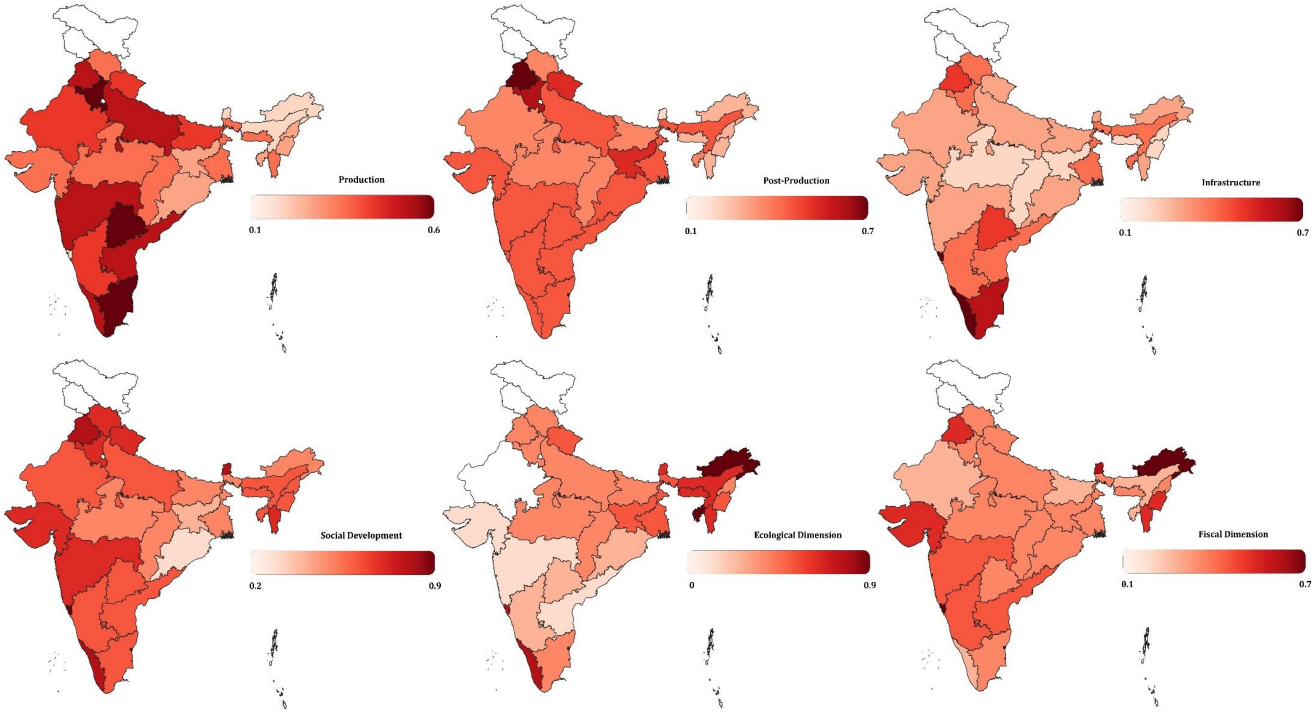


Figure 18b. Spatial Pattern of six dimensions Farmers' Welfare Index (FaWI)



6

Perceptions of Farmers about the Last 75 Years of Agricultural Progress

In addition to the analysis of secondary data, we collected data through a small survey to understand the perceptions of farmers on the journey of Indian agriculture after independence. In the quest to understand the ground reality of agriculture since independence, we canvassed a short questionnaire of farmers over 60 years of age, to capture their experience of various developments in farming during their lifetime. We obtained views from 242 veteran farmers across the country. This survey enlightens us with the insights of those farmers who are responsible for the agricultural growth which we witness today. The survey also shares the views of the farmers who have been through all the agricultural revolutions since Independence[3]. The following are the major findings of the primary survey:

Table 12. Average size of holding (ha)

Year	1970-71	1980-81	1990-91	2000-01	2005-06	2010-11	2015-16 (Prov.)	Trend
Marginal (Less than 1 hectare)	0.41	0.39	0.39	0.40	0.38	0.39	0.38	
Small (1.0 to 2.0 hectares)	1.44	1.44	1.43	1.42	1.38	1.42	1.4	
Semi-Medium (2.0 to 4.0 hectares)	2.81	2.78	2.76	2.72	2.68	2.71	2.69	
Medium (4.0 to 10.0 hectares)	6.08	6.02	5.9	5.81	5.74	5.76	5.72	
Large (10.0 hectares and above)	18.1	17.41	17.33	17.12	17.08	17.38	17.07	
Overall	2.28	1.84	1.55	1.33	1.23	1.15	1.08	

i. Persistent land fragmentation reduced average holding size to uneconomical levels

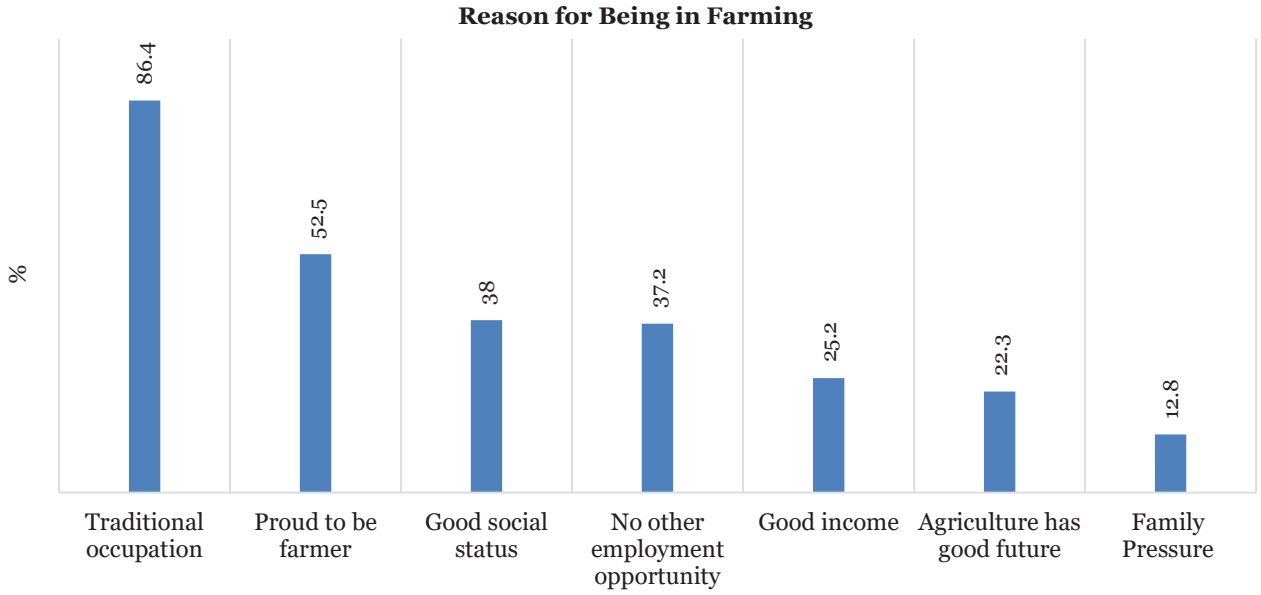
India, being an agrarian economy, the land is the fundamental means of production. Small and marginal farmers form the core of the Indian rural and agricultural economy constituting 86% of the total farming community but possessing only 46% of the total operational land. From the data of the primary survey, it is observed that land fragmentation still exists before 1970s.

[3] Detail findings of the primary survey is published under: Insight Report II - Agriculture in India @75, National Bank for Agriculture and Rural Development, Mumbai.

The declining trend of per capita availability poses a serious challenge to the sustainability and profitability of farming. Since shrinking land resources reduces the scope of horizontal expansion of land for increasing food production, vertical expansion along with multi-cropping, inter-cropping, and integrated farming can come out as a solution.

ii. Family farms cannot survive in isolation

From the 242 farmers surveyed, it is observed that agriculture remains the main occupation for the farmers (37.2% feel there are no other employment opportunities). The majority of them have taken up agriculture as a traditional occupation (86.4%), while quite a good number still feel that agriculture gives a good social status (38%). Various surveys like NABARD All India Rural Financial Inclusion Survey and Situational Assessment Survey have already shown that in rural areas non-farm incomes are more than farm income.



iii. Future Generations not inclined towards farming

One of the major findings of the primary survey is that 63% of the total respondents do not want their future generation to be in agriculture. The major reason cited by the respondents for being unwilling to continue agriculture are the following:

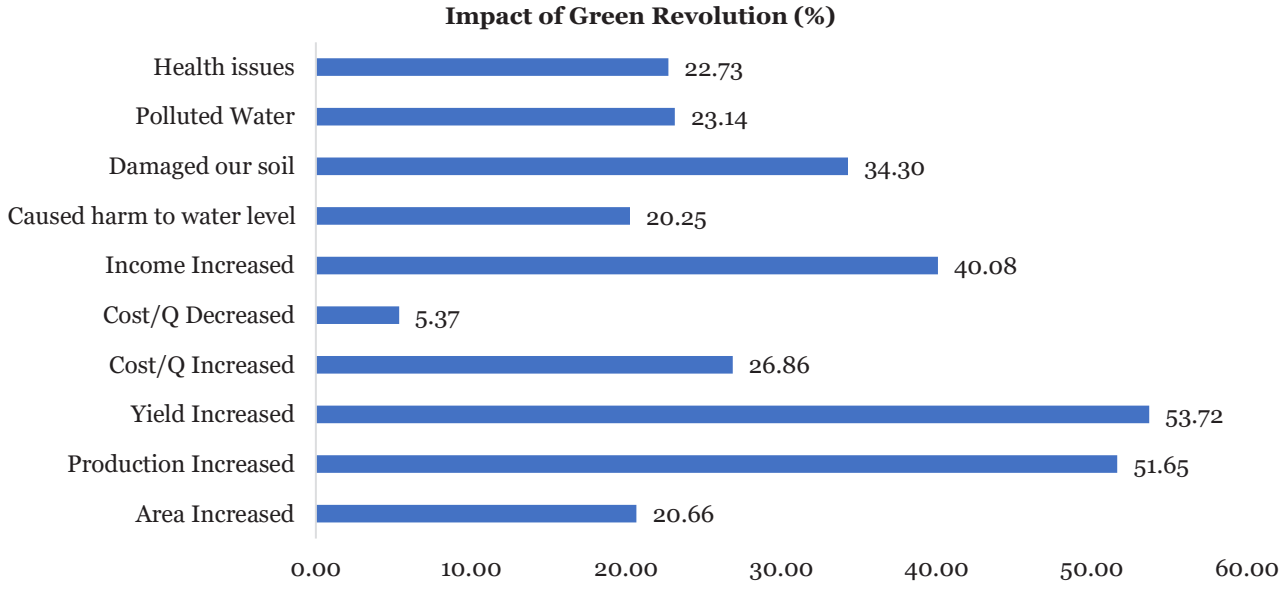
- Farming is not a lucrative occupation. The new generation is not keen to take up farming
- Farming is a risky venture
- Decrease in farm size and increase in input cost
- Shortage of labour
- Remunerative prices not met
- Market uncertainty
- Migration from rural areas to urban areas for a better future
- Future generation youth have no guarantee of income/ Low income/ no regular income
- Not profitable

- Highly Dependent on monsoon
- Climate Change causing the reduction in yield
- Highly risk prone to natural disasters
- No respect/ social status
- Irrigation
- Absence of proper price mechanism
- Absence of a robust procurement system including marketing, MSP inadequate
- Lack of awareness of Govt schemes, even if aware of not getting benefits as an individual farmer

Among all the above points 40% of respondents gave a reason that agriculture is a risky venture.

iv. Green Revolution was hugely successful in terms of improving agricultural productivity but its broader impact at social and environmental level was limited

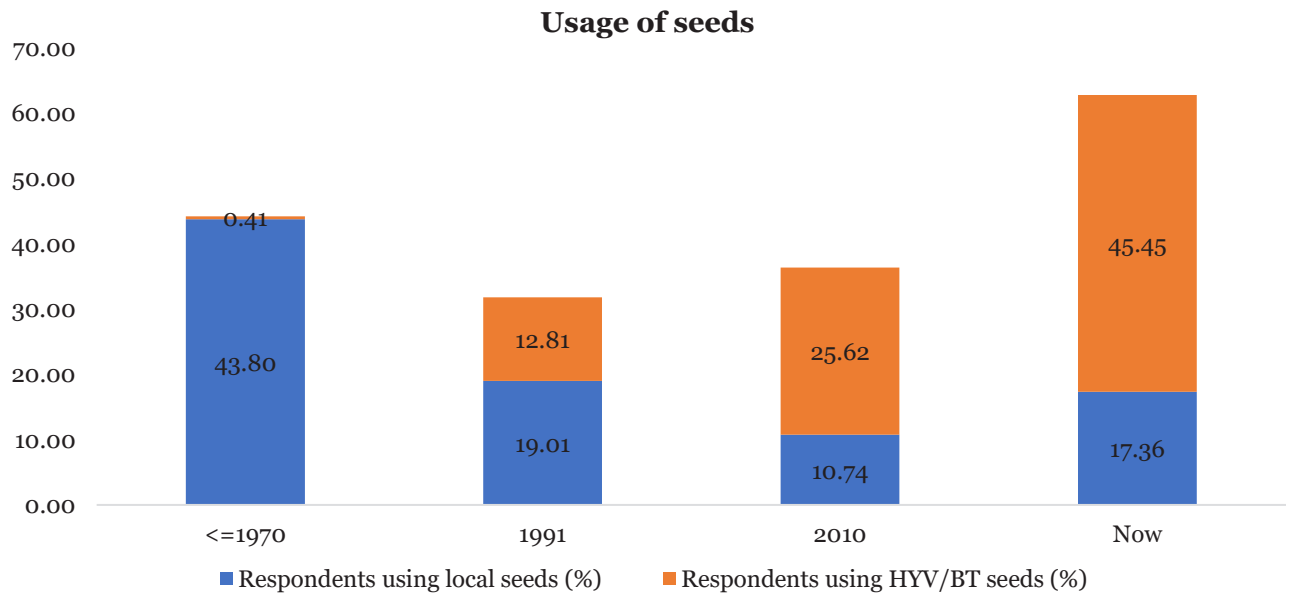
It was observed that 66% of the respondents were aware of Green Revolution. Though production and yield increased by more than 50%, the revolution harmed the environment.



v. 62% of the farmers still prefer traditional/local seeds for low cost

Green Revolution gave the country a new high-yielding variety of seeds which were stocky, disease-resistant, fast-growing and highly responsive to fertilizers. Results from the primary survey show that 46% of the respondents' use HYV/BT seeds at present whereas 62% of the farmers still prefer traditional/ local seeds for their low cost.

During the survey, 62 per cent of the respondent said that due to lower cost, they are using local seeds instead of HYV or BT seeds. This shows that timely credit and penetration of KCC can be useful in providing the loan at the need.



vi. Post-liberalization period showed a decline in the area, production & productivity of cereals (mainly rice, and wheat) whereas the growth rate of pulses increased

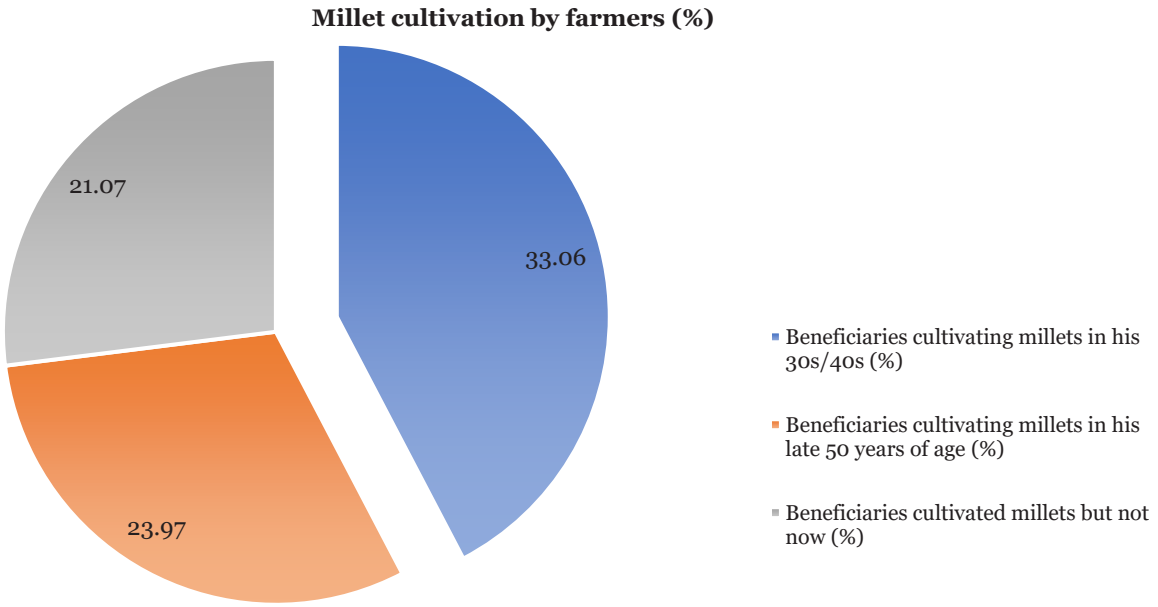
Given its wide range of agroecological regions, Indian agriculture is faced with a great diversity of needs, opportunities and challenges. The improvement in the agricultural sector in recent decades is attributed to a series of steps that led to the availability of infrastructure, new farm technologies which have influenced cultivation practices and cropping patterns. However, at the farmers' level', potential productivity and quick income-generating activities act as guiding principles while opting for a particular crop/ cropping pattern/ cropping system.

The primary survey highlights a lack of diversity in cropping patterns as 65% of the respondents are involved in paddy cultivation in their early years of farming (30s/40s) and 70% of the farmers in their late 50s continue paddy cultivation irrespective of kharif/rabi season. In the case of wheat (44%) and pulse (40%) respondents are involved in the cultivation during their late 50s.

vii. Millet cultivation was taken up by 33% of farmers in the initial years and reduced to 21% of farmers in the later years

Millets are a staple food for the population living in the dry land regions of India thus helping in sustaining agriculture and food security. In India, millets are grown on about 17 million ha with an annual production of 18 million tonnes and contribute 10% to the country's food grain basket (source: Nutritional and Health Benefits of Nutri-Cereals, ICAR-IIMR).

However, their cultivation and consumption have declined over the past three decades mainly because of an overwhelming shift in food habits from traditional to modern foods with a great shift among the elite sections living in urban areas.



viii. Income generation (increase) from vegetable and fruit cultivation was low in the last 30 years

Golden Revolution not only stuck to the self-sufficiency of horticulture produce but also emphasized developing cold chains along with value chains through proper market access to improve farmers' income and generate new employment opportunities, especially in the wake of population explosion and rapid urbanization. While India has diversified significantly from producing grains to a variety of high-value commodities, the commodity value chains have remained relatively underdeveloped..

Operation Greens' Scheme was announced in the Union Budget for 2018-19 to promote Farmer Producer Organisations (FPOs), agri-logistics, processing facilities and professional management for Tomato, Onion and Potato (TOP) crops. In pursuance of the Budget announcement 2021-22, the scope of this scheme has been expanded from TOP to Twenty-Two Perishable products.

Primary survey data shows that 36% of the beneficiaries took up vegetable and fruit cultivation post-50 years of age. However, 12% of the beneficiaries responded that their income has increased from vegetable and fruit cultivation during the last 10 years.

ix. Access to Bank Credit has improved in the last 10 years

Indian agriculture though dominated by small landholders produces sufficient food and feed for India's large population. This would not have been possible without the infusion of massive credit (both institutional and non-institutional) which acts as a catalytic agent for farmers to buy inputs like seeds, fertilizers, pesticides, farm machinery, etc.

In the first 20 years of their lives in farming (till 1970), 24% of farmers did not have access to formal loans and 15% thought that formal loans are inadequate.

However, the situation improved in the last 10 years wherein the survey showed that 37% of the farmers are having bank accounts and 57% are having KCC.

Table 13. Access to Informal Credit (%)

	SHG/JLG/MFIs	*Ahratiya/crop trader*	*Private money lender*	*Other*
Last 30 Years	9.5	9.09	8.68	6.2
Last 10 Years	28.1	7.44	5.37	5.79

7

How to move to Amrit Kal?

The previous sections have described the paradigms prevalent over the last 75 years. Now the question is what to do during the Amrit Kal, i.e., next 25 years till 2047 when we will celebrate 100 years of Independence. Before we list out a few items of the Agenda Amrit Kal, we will highlight major drivers behind the past agricultural performance and also some of the persistent issues in agriculture that need attention and solution.

Drivers behind growth in agriculture

There are several drivers behind the growth of agriculture over the decades. A few major ones are mentioned here.

i. Government programmes for agricultural development

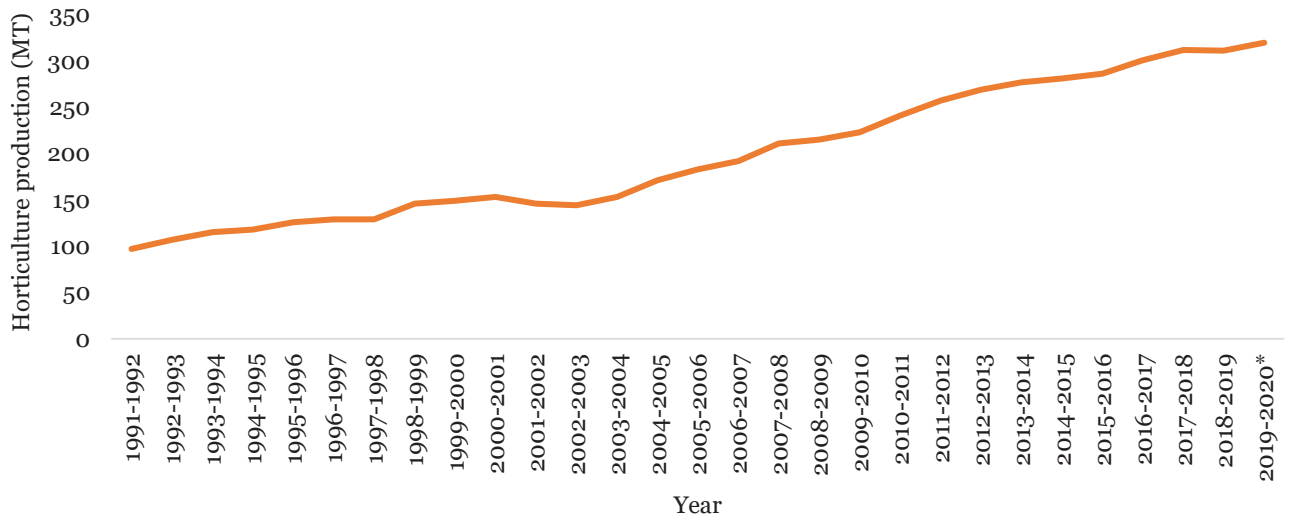
Both central and state governments have rolled out various programmes/schemes like Grow More Food of 1950s, Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP), Green Revolution of 1960s, Special Foodgrains Production Programme for Eastern India in the late 1980s and early 1990s, National Food Security Mission (NFSM) of 2007, Rashtriya Krishi Vikas Yojana of 2007-08 of which Bringing Green Revolution to Eastern India (2010-11) and Rainfed Area Development Programme (2011-12) were sub-components, and special programmes for North Eastern states towards increasing food production. Major running programmes are National Mission on Sustainable Agriculture (NMSA) with Rainfed Area Development (RAD) as a component, and Pradhan Mantri Krishi Sinchai Yojana (PMKSY) with micro-irrigation as a component, among others. There have been several other programmes for various plantation crops and commercial crops such as Technology Mission on Oilseeds. The contribution of all such programmes has been impressive, differential impact notwithstanding[4] (NITI Aayog, 2018).

ii. Commercialisation and diversification

Commercialisation and diversification of the agricultural sector in recent decades transformed the traditional, subsistent, hand-to-mouth existence of the farming community (Nadkarni, 1996; Satyasai and Viswanathan, 1996, 1997). There have been cropping pattern changes over the decades towards high-value commercial crops. In several states, even wheat and rice crops attained commercial status due to their profitability. There has been diversification towards horticultural crops. Horticulture has recorded tremendous growth over the decades as can be seen in the gain in their area shares (Figure 19). It surpassed foodgrains production too during 2012-13 (Kumar et al, 2021). The efforts

[4] For latest achievements under various schemes: (https://agricoop.nic.in/sites/default/files/All-India-Comparative-Statement_0.pdf)

Figure 19. Trend in horticulture production



to promote horticulture have received a major shot in the arm with the establishment of the National Horticulture Board and several programmes and schemes implemented thereof to bring high-tech cultivation.

There was also diversification towards secondary and tertiary sectors in rural areas besides strengthening agri-industry linkages (Satyasai and Viswanathan, 1997,1999). New field crops such as soybean in the 1970s and new horticulture crops like kiwi and strawberry have been cultivated by Indian farmers even in remote geographies. In the livestock sector too there are many examples of rearing exotic breeds such as Angora rabbit. The intent is to maximise incomes through market orientation. Overall, there is newfound enthusiasm for agriculture (NABARD, 2022).

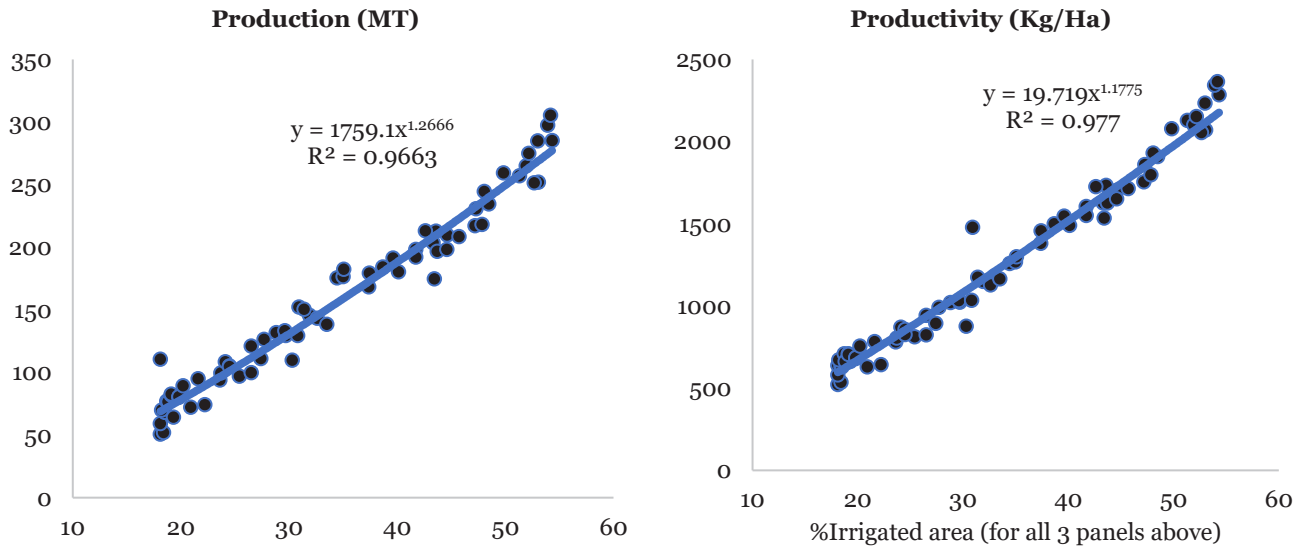
iii. Irrigation expansion

Irrigation is the lifeline for agriculture and the expansion of irrigation led to changes in cropping pattern towards remunerative and high-yielding crops, improvement in yields, enhancing production and employment absorption in agriculture. The impact of irrigation has been well established in the literature (Dhawan, 1986, 1988, 1989, 1990 a&b, Dhawan and Satyasai, 1988, 1989, Satyasai, 1995). Production of foodgrains has an elasticity of 1.267 with reference to the proportion of foodgrains area irrigated which moved from 18.10% in 1950-51 to 54.2% in 2020-21. Foodgrain yield has moved from 522 kg/ha to 2343 kg/ha during the period, implying an elasticity of 1.18 with respect to the foodgrain area under irrigation (Figure 20). Irrigation helped increase the cropping intensity which measures the number of times a given piece of land is cultivated. One percentage point increase in irrigation facility (GIA/NSA) can lead to increase of cropping intensity (GCA/NSA) by 0.57 per cent points.[5]

Recent PM Krishi Sinchai Yojana (PMKSY) with the twin aims to provide irrigation to all (Har Khet Ko Pani) and improve water use efficiency (Per Drop More Crop) is a fresh attempt to improve irrigation facility. PMKSY includes watershed and water harvesting initiatives also. Through the Rural

[5] Cropping intensity (GCA/NSA) = 102.42 + 0.5713 GIA/NSA ; R^2 = 0.9878, for period 1950 to 2020.

Figure 20. Co-variation between % foodgrains area irrigated, production and productivity



Infrastructure Development Fund (RIDF), since 1995, Long Term Irrigation Fund (LTIF) since 2016 and Micro Irrigation Fund (MIF) since 2020 operated by NABARD, GoI has given a further boost to irrigation development. RIDF has so far completed 25 years and created 36.4 m ha from 3.5 lakh projects. LTIF has prioritised 101 irrigation projects pending completion and added 2.27 m ha of irrigation potential created between 2016 to 2021 besides command area development of 1.5 m ha. MIF sanctions envisage coverage of 1.28 m ha in seven states.

iv. Adopting new technologies

Seed-fertiliser-water technology of the mid-1960s, popularly known as the Green Revolution has saved India from severe food crises through higher yields. Credit goes to farmers for adopting high-yielding varieties and hybrids that improved yields and production. All along the history, farmers showed their progressiveness by adopting various technologies including Bt cotton and contributing to agricultural progress. Scientists, on the other hand, have toiled to usher in new seed varieties, standardise the package of practices, reduce drudgery for farm families, manage soil and water, control pests and diseases, ensure sustainable agriculture, help launch new technologies for processing, storing, etc. Now several farmers are adopting ICT, drones, and AI-based solutions for many farm issues. A lot of young professionals are taking up agriculture as a passion and/or providing solutions through start-ups leveraging their IT expertise. About 10% of the 69000 start-ups in India as on 2 May 2022 are in the agriculture and food and beverage sectors. Several innovative technological and marketing strategies leveraging cutting-edge information technologies by start-ups helped overcome supply disruptions that emerged during COVID-19 to strengthen the resilience of food supply chains and at the same time accelerated their growth (Rao 2022). Technology incubators such as those in ICRISAT, ICAR-NAARM, ICAR-IIMR in Hyderabad; rural business incubation centres (RBICs) supported by NABARD in TNAU in Madurai and Coimbatore; and CCS-HAU, Hissar among others have been helping budding innovators and entrepreneurs to transform their ideas into start-ups (NABARD, 2022). Biotechnology has ushered in new possibilities at a time we started facing yield fatigue, which could not be capitalised

in time.

v. Input use: fertilisers and pesticides

High-yielding varieties of crops introduced in the mid-1960s needed intensive cultivation using higher doses of fertilisers and chemicals for expressing their genetic potential. With subsidies for use of fertilisers, the consumption of fertilisers per hectare increased from 93 kg to 138 kg during the last two decades. Fertiliser use along with irrigation water was necessary for the genetic potential of HYVs to be expressed. The use of pesticides increased from 250 gram to 308 gram per ha during the last two decades. Certified seeds use has multiplied by 4 times from 4.88 kg/ha to 20.72 kg/ha during these two decades. Linear growth rates of fertiliser, pesticide and certified seeds per ha have been 2.30 kg, 4.98 gram and 0.82 kg/ha per annually[6], respectively.

vi. Giant role of institutions

We can trace most vexed issues in agriculture to the institutional structure within which it operates. Major institutions in agriculture are rural credit and financial institutions and non-credit institutions such as land tenure and tenancy, organizational modes of farm production, processing, and marketing, agriculture research and extension system, agricultural market institutions, and resource management institutions, especially water institutions. We discuss here a couple of aspects. For a comprehensive discussion, see Saleth (2022).

Credit institutions

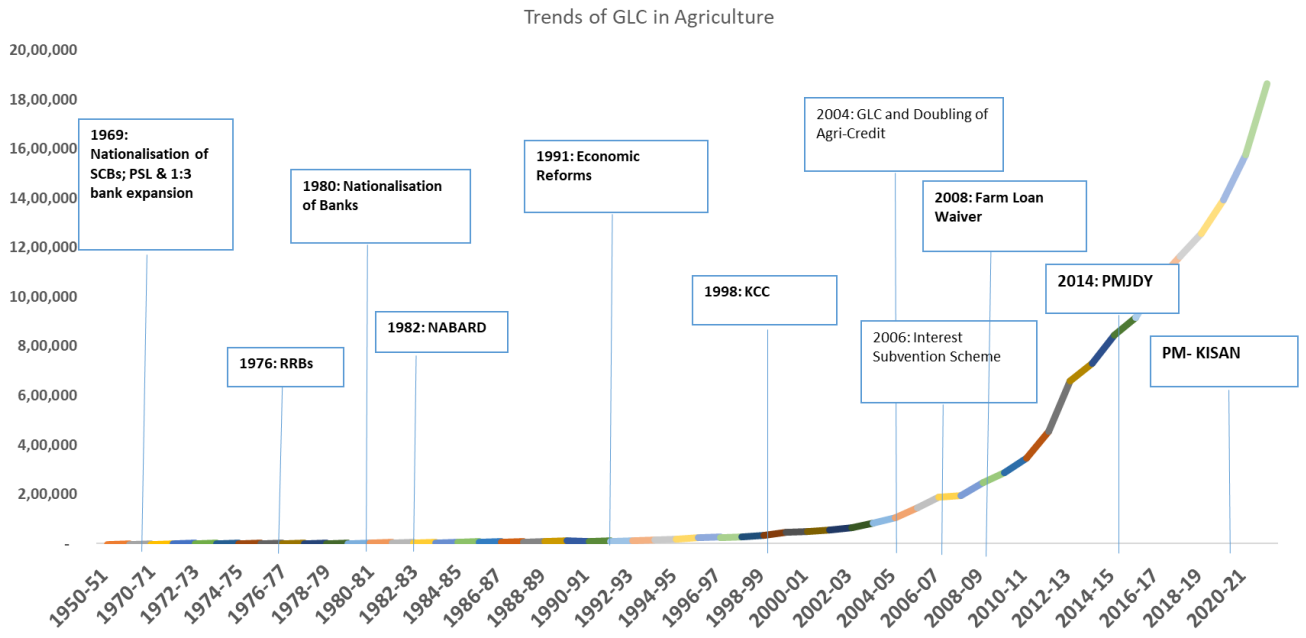
Major credit policy interventions have been multi-agency approaches and expanding penetration of institutional credit at lower rates of interest since the availability of adequate and timely credit at a cheaper rate of interest is very crucial for running a profitable farm business. Successive governments have taken several initiatives towards this which helped farmers in getting working capital for crop growing and investible funds for capital formation.

Bank nationalisation, cap on interest rates (till the liberalisation phase after the 1990s), directed credit (priority sector lending), muti-agency approach with co-operatives (short- and long-term structures), commercial banks (through Nationalisation in 1969 and 1980), Regional Rural Banks (created in 1975), formation of NABARD, interest subvention, loan waivers, doubling credit, regulation of microfinance, etc. are a few important measures. As a result, ground-level credit (GLC) flow has increased manifold over the decades (Figure 21) reaching ₹18.63 trillion.

Since a quite good number of people, especially women, did not have access to credit and banking services NABARD has steered the Self-Help Group- Bank linkage programme over the last 3 decades which led to the large-scale formation of SHGs, especially of women. Similarly, since tenants and landless farmers have the problem of access to credit, Joint Liability Groups (JLG) on the principle of the group of farmers standing guarantee to one another have been promoted since 2007 to purvey

[6] Estimated linear growth equations:
Fertilsers kg/ha = 2.3004x + 97.217; R^2 = 0.5924
Pesticides gram/ha = 4.9758x + 209.32; R^2 = 0.5858
Certified Seed kg/ha = 0.8187x + 4.0464; R^2 = 0.9355

Figure 21. Trend in GLC flow to agriculture



collateral-free institutional credit. As on 31 March 2022, 118 lakh SHGs have been formed with cumulative savings of ₹47,240 crore and 187.9 lakh JLGs have been promoted.

All these institutions under the direction of central/state governments, Reserve Bank of India and NABARD have participated in rural development programmes like SFDA, MFAL, IRDP, SGSY, 20-Point Programme, skill development programmes, Self Help Groups (SHGs)-Bank Linkage, lending to Joint Liability Groups (JLGs) and so on. The contribution of the banking system towards enhanced food production (through short-term crop loans), building the productive capacity of farms (through term credit for capital formation) and employment generation (through loans for MSMEs). All these and many other banking initiatives helped India fight poverty and unemployment. Among others, the banks could inculcate banking habits in people. Literature was replete with success stories of the contribution of our banking system.

Kisan Credit Card has been the major innovation in the agricultural credit space. This is a popular product among bankers and farmers. It has several advantages. Once issued, the KCC limit need not be renewed every year saving a lot of time and transaction costs. While all crop loans are migrated to KCC, for many farmers it is still a limit and very few farmers are able to operate it to their advantage the way we operate our credit cards. Introduced in 1998, the KCC scheme has been modified in 2012 to incorporate many new features over & above the financing of crop production requirement, viz., consumption expenditure, maintenance of farm assets, term loan for agriculture & allied activities, coverage of KCC holders under PAIS and recently the coverage of KCC holders under Atal Pension Yojana, etc. All crop loans are extended through KCC and are cheaper due to interest subvention (2%) and prompt repayment incentive (3%).

Non-credit institutions

Several non-credit institutions such as farmer producers' organisations (FPOs), marketing societies, etc. have been formed over time. Recently, the focus has been to organise farmers into FPO, numbering

around 10,000 in the country, to impart the advantage of size, better bargaining capacity and power of aggregation to the smallholders who are otherwise uneconomical.

Farmer Producers' Organisations (FPOs)

Indian Agriculture sector has progressively become predominantly smallholder driven as 86 per cent of farmers possess less than two hectare of land having a share of only 46 per cent of the area. Small and marginal farmers suffer the problems of access to quality inputs, institutional credit and other resources, organised markets, modern farming technologies, etc. In this context, aggregation of produce by organising small farmers into FPOs to achieve economies of scale can spur farm-level efficiency. India has always emphasised on the potential of cooperation and an inclusive approach to development. The creation of FPOs is an important initiative to involve farmers in marketing, post-harvest management and value chain. Recognising the importance of FPOs, government has announced the formation of 10,000 FPOs. FPOs response during the pandemic and lockdown has been a revelation for farmer members as well as for other stakeholders.

FPO as a novel idea holds immense potential in increasing the share of processed commodities in India's overall production. Currently, about 13-14% of the total share of agricultural output has undergone secondary processing, which is substantial but way below in comparison to China and the United States at 23% and 65%, respectively (Seema Bathla and Siraj Hussain, 2021). The low level of food processing in the country couples with a huge waste of food especially fruits and vegetables (16%). Against this backdrop, FPOs hold a crucial position to undertake processing and value addition, thus earning higher prices for their produce. This requires handholding, imparting business development knowledge and support for branding and packaging to enable FPOs to overcome challenges in successfully undertaking processing activities.

The study conducted by NABARD[7] brought out the positive impact of FPO membership on farmers' welfare. Farmers reported receiving a higher average price for their produce after obtaining membership to FPOs. The farmers also reported a reduction in dependence on informal sources of credit along with added benefits of achieving higher crop yield, saving on input costs and reducing the cost of cultivation. Being associated with the FPOs, farmers also reported an improvement in their social engagement along with increased awareness about issues related to health, sanitation, hygiene, education, etc.

The encouragement of corporates in FPOs may enhance the scope for contract farming and improve backward and forward linkages with industries. In this vision of revamping agriculture value chains, Farmers' Producer Organisations (FPOs) are expected to play a pivotal role.

Collaboration of FPOs, private players and academic institutions will be the key for *Amrit Kal*. Scientific and educational institutions contributed towards agricultural progress over the decades. ICAR-SAU system's contribution to evolving new varieties, standardising package of practices, research contribution to make agriculture sustainable, and more importantly building a pool of scientific manpower has been remarkable. Besides the public sector, private sector companies too have been

[7] Case Studies of FPOs in India 2019-2021 by Prof. Amar KJR Nayak, NABARD Research Study - 25

contributing to agricultural research. For instance, private sector companies have introduced about 122 crop varieties during the last few decades while improving their share in total seed production from 57% in 2017 to 65% in 2021 (Saleth 2022).

vii. Marketing interventions

Establishing regulated markets, formation of the Commission for Agricultural Costs and Prices (CACP) – earlier known as Agricultural Prices Commission, declaration of Minimum Support Prices, market support operations such as procurement, various Central Sector schemes for building storage godowns, establishing Electronic National Agricultural Markets (eNAMS), developing Grameen Rural Agricultural Markets (GRAMs), are some of the major interventions to improve agricultural marketing system in the country. So far the e-NAM platform has covered 1,260 APMCs from 18 states and 3 union territories with a total registered user base of 1.66 crore farmers, 1.31 lakh traders, 73,151 commission agents, and 1012 FPOs and a total commodity coverage of 150. Though nascent, e-NAM is an important institutional innovation with huge potential to promote transparency, competitiveness, and digital integration of auction, payment, and delivery logistics. Empirical evidence suggests that there has been a hike in the prices of commodities traded over eNAM platform (Nookathoti and Behera, 2022, Rao et al 2022).

The Integrated Scheme for Agricultural Marketing (ISAM) has been rolled out covering various items like godowns, grading and standardisation, marketing research and information network, strengthening AGMARK grading facilities, venture capital assistance, and Choudhary Charan Singh National Institute of Agricultural Marketing to improve marketing experience of farmers. All these measures helped farmers experience improved marketing practices, expanded markets, and better price realisation among others.

Since mid-1960s we have a price policy, which covers declaration of Minimum Support Prices (MSP) for 23 crops that helped in agricultural progress. However, its objective has been evolving from ensuring cheaper food to consumers, to bringing changes in cropping patterns, to that providing remunerative prices to farmers and helping manage risks (Kumar and Mittal 2002).

Value Chains

Indian agriculture production system has changed significantly over the period. On the one hand, mono-cropping culture or production of wheat and rice has gone up while on the other hand horticulture production has surpassed foodgrain production. Apart from being self-reliant in foodgrain, India is a leading producer of many high-value agricultural products. High production of horticulture and high-value crops generates the opportunity for food processing and integration into the global value chain. However, India is lagging in grabbing this opportunity which is why farmers' income has not increased as much as the production in agriculture.

The major problem which Indian agriculture industry is facing is the lack of robust market linkages which is resulting in poor price realisation for the farmers as well as leading to the huge wastage of fresh produce. Such instances have been witnessed on multiple occasions in the case of horticulture produce which is highly perishable with low shelf life. Agricultural value chains in India are subject to high

fragmentation and intermediation, resulting in substantial losses in quantity and quality of produce, limited processing capacities, and high price volatility. Agricultural policies in India have primarily focussed on augmenting production, without giving due attention towards developing efficient value chains.

The fragmented agriculture value chain is causing huge losses to the producers and making farming unviable and vulnerable. During the pandemic vulnerability of agricultural value chain became more obvious as in the lockdown supply chain dealing with fresh food was severely hit. In the absence of robust direct marketing channels, farmers could not sell their produce and suffered losses in terms of low-price realization and wastage. Despite farmers receiving low prices, retail prices of fresh agricultural produce in many urban pockets did not decline. An efficient value chain will help the producers to get the benefit of global demand as well, e.g., after the Ukraine-Russia war, dependency on Indian wheat has increased manifold in the world market.

With rising incomes, the demand for high-value crops such as fruits and vegetables, dairy products, eggs, chicken and fish in India has increased over the years. Therefore, it is important to develop value chains that can handle the pre and post-harvest requirements of such commodities, which are different from that of cereals and pulses. Hence, during the *Amrit Kal*, the Government of India should give greater emphasis to develop an efficient and inclusive value chain to make agriculture profitable.

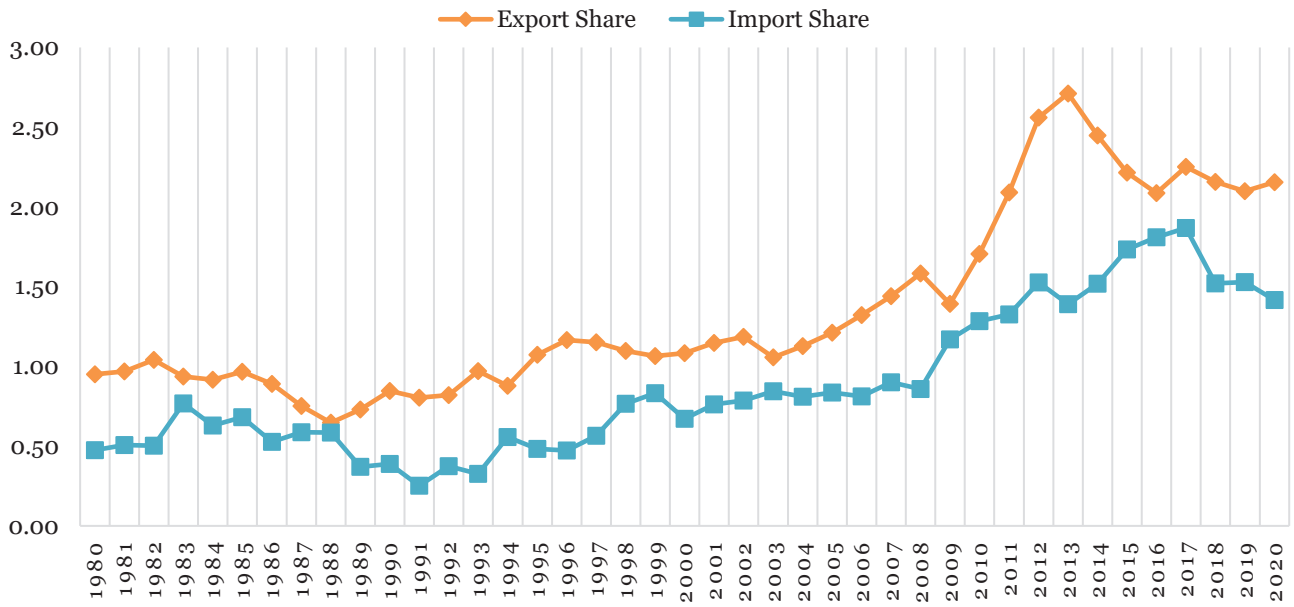
Exports

The government announced a comprehensive Agri Export Policy (AEP) in 2018 which focuses on a farmer-centric approach and envisages the promotion of exports-oriented production by encouraging infrastructure and logistics to facilitate agricultural exports and promoting value-added products. AEP also encourages farmers to grow exportable crops which are in high demand in the international markets through pre/post-harvest management of production in identified clusters in the country, diversifying the exports basket, destinations and boosting production of high-value crops exports including a focus on perishables, promoting novel, indigenous, organic, traditional and non-traditional agricultural products enabling farmers to get benefits of export opportunities in overseas markets. After the launch of AEP, India's export has done quite well even during the pandemic. India's agricultural exports crossed $50 billion during the fiscal year that ended on March 31, 2022. While valued at $50.3 billion, no less interesting imports, too, scaled an all-time high of $32.4 billion.

As per WTO's Trade Statistics 2021, the share of India's agricultural exports and imports in the world agriculture trade in 2020 was 2.16 per cent and 1.42 per cent, respectively. Trends of export and import of agricultural products are indicating upward movement and agri-export of India is all along more than the import since the green revolution (Figure 22).

The Food and Agriculture Organisation's (FAO) Food Price Index suggests a positive relationship between world food prices and India's agri-export, which means the higher the prices, the greater the export of India's agricultural products. Higher food prices are benefitting the Indian farmers' income and improving trade balance (Figure 23).

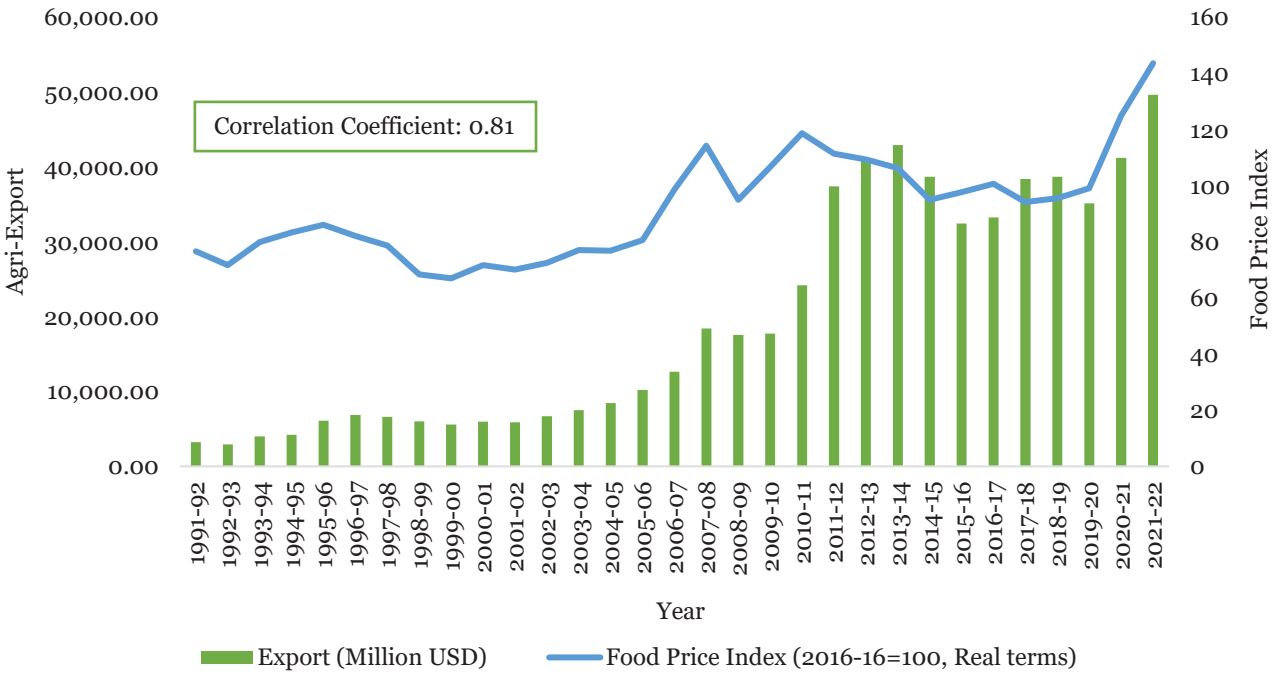
Figure 22: Trends in India's agri-trade share in the world's agri-trade



Source: Share is calculated by using trade data from WTO stats: https://stats.wto.org/

India has thus showcased an impressive growth trajectory from a food-scarce country to food sufficient and a food surplus one now. All revolutions in agricultural production, triggered by innovations, incentives and institutions, have successfully made India a net exporter of agricultural produce.

Figure 23: India's agri-export vis-a-vis Food Price Index



Source: Export data: CMIE and Food Price Index: FAO

Vexing issues in agriculture

i. Poverty, hunger, and deprivation

Successive Hunger Index or Multi-dimensional Poverty Indices show that India is facing a serious problem of hunger and deprivation. India is ranked 107 out of 121 countries in Global Hunger Index for 2022. India could push 41.5 crore people out of MPI poverty between 2005-06 and 2021-22. Still, we have 22.8 crore poor, largest in the world. Unemployment is still a persistent issue in rural areas which is exacerbated by the COVID-19-induced lockdown. Thus, the task at hand appears formidable and the performance of agriculture holds the key to solving these problems. The agriculture sector has proved a saviour in the Covid period by providing food to people and recording impressive growth amidst a decline in all the other sectors of the economy.

ii. Scarce land, dwindling average farm size, increasing demand for food

We have limited land resources with no possibility of expanding the net sown area. The competing needs for land from industry and urbanisation may reduce land availability for agriculture further. From 2.30 hectares per holding in 1970-71, the average farm size dwindled to 1.08 ha in 2015-16. On the other hand, population pressure is likely to mount further, and food demand is bound to increase sharply. Comfortingly enough, the food balance sheet as projected for 2030-31 appears comfortable (Gulati, 2021) under the business-as-usual situation barring a few commodities like oilseeds and pulses where imports are needed. The food supply situation can be critical if we are constrained to put much lesser land under agriculture in future amidst the depletion of natural resources and climate vulnerability. The problems of tenants could not be sorted out so far despite oft-avowed intentions even as lot many tenants have contributed to agricultural development and our food security, unsung and unacknowledged.

iii. Scarce water resources

Water resources are scarce compared to land and excess water use has been the practice as our efforts were towards maximising returns to land and not water. Also, water is not priced to reflect its scarcity value because of which water use efficiency has been very low. Even after developing all our available water resources, we can irrigate hardly half of our cultivated land. Agriculture is the major user of water but has been facing competition from industry and urban development (Gulati et al, 2019).

Tank irrigation, once a major source of irrigation in semi-arid tropics, is no longer a reckonable source and most tanks are out of use. Groundwater accounting for two-thirds of the net irrigated area in the country is depleted to dangerous levels in many states. Cropping patterns are not aligned with local resource levels anymore (Sharma et al, 2018).

iv. Yield fatigue /technology fatigue

The major source of agricultural production growth in the country is productivity (yield) which started growing for a few crops such as rice and wheat especially after ushering in the Green Revolution. Over the years, the yields seem to have reached a plateau and thereby limiting the scope for further production growth. Further, to enhance yields we need to increase the use of inputs such as fertilisers

and water much faster as we operate on a production response curve where diminishing returns eventually set in. As a result, productivity is no more a source of effective production growth.

v. Excessive chemical use risks soil and human health

Soil health has been of serious concern over the decades. First, erosion of topsoil and loss of soil carbon over the decades has been serious concern. Second, there has been abuse of fertilisers and pesticides in farming. As a result, the ratio between Nitrogen, Phosphorous and Potassium has been disturbed. It is nowhere nearer to the ideal 4:2:1. Soils developed micronutrient deficiency which impaired the quality of the produce. However, over the decades' fertiliser use has gone beyond judicious levels leading to unbalanced use of major nutrients i.e., Nitrogen (N), Phosphorous (P) and Potassium (K). Hardly 12% of households were getting their soils tested (GoI, 2021). Further, micro-nutrient deficiency and depletion of organic carbon started manifesting in several locations. Investigations carried out under the All India Coordinated Research Project on 'Long Term Fertilizer Experiments' over five decades at fixed sites have indicated that continuous use of nitrogenous fertilizer alone had a deleterious effect on soil health and crop productivity showing deficiencies of other major and micronutrients (PIB 2021). Thus, soil health must be paid a lot of attention. In 2015-16 Soil Health Cards (SHC) were introduced to help farmers in using the right type and quantity of fertilisers based on soil test results. SHC data on the status of macro & micro-nutrients and organic content of soils shows that a large proportion of samples (2.33 crore, Cycle II, years:2017-18 to 2018-19) have very low and low nutrient levels. Such data are available up to the village level which can be a very important input for nutrient planning[8].

The use of pesticides increased from 250 gram to 308 gram during last two decades. Excessive pesticide use has created pest-predator imbalance and often led to severe pest attacks wrecking the farmers. Pesticide overuse and residues thereof on produce have posed several health risks among humans. Overuse of fertilisers is reported in several locations leading to groundwater contamination affecting human health. Integrated nutrient and pest management as also bio-alternatives have registered limited penetration.

vi. Price realisation and marketing problems

One of the most common issues for farmers is lack of marketing facilities and the non-realisation of remunerative prices for their produce. Market access is important for farmers to realize better returns. Farmers have regularly been demanding higher MSP and expressed dissatisfaction with MSP system in some way or the other. Even recent declaration of MSP of 150% of cost A1 + family labour cost met with criticism. It is often said that merely declaring MSP is not enough to ensure better returns for farmers. Marketing channels available to farmers, market support system that can ensure the realisation of MSP, market forces of supply and demand at the time of harvest – both locally and globally, efficiency of markets, market information, bargaining power of farmers, transport costs, etc. are important factors that count.

We have 7320 Agricultural Produce Market Committees (APMCs), popularly known as *mandis* or regulated markets, across the country to address the marketing needs of farmers. The density of

[8] Soil Health Card (dac.gov.in): https://www.soilhealth.dac.gov.in/NewHomePage/NutriReport

them, however, is much less except in the Punjab-Haryana region. Despite many legal, policy, and procedural regulations, the regulated markets remain archaic, isolated, and localized mainly because of the dominance of vested interest groups and the existence of many trade barriers. The resultant isolation and missing linkages among state-level markets make them inherently inefficient and rigid with limited competition but higher transaction costs.

Farmers, especially smallholders, depend heavily on local traders for selling their produce though, a priori, selling to procurement agencies and traders in mandi is likely to fetch better prices. About 50% of the quantity sold is through local traders on average for all crops. For certain crops, the share of quantity sold by smallholders to local traders is up to 98%. Several considerations such as convenience and ease in selling within the village, saving on transport and hassles in selling in mandi, which may not be always efficient, seem to outweigh the choice of market channel. Surprisingly, a large proportion of households are satisfied with the agency they dealt with, though the level of satisfaction among that selling in mandi is significantly higher compared to those who sold to local traders. Awareness about MSP is very low which reflects in the lower proportion of households who sold through public procurement system and realized MSP.

vii. Low surplus income

As we have seen earlier, average income of a farmer is rather low and netting out the consumption expenditure, the surplus left is so meagre and even negative for lower farm size groups (NSSO, 2016). The household economy can go for a toss if they face any major health episode in the family or have to spend on education. As was observed earlier, agricultural households have been spending a higher proportion on education and health in successive rounds of surveys (Satyasai, 2015, Paliath, 2018).

Giant strides have been made in agri export since independence. In 1950-51, India's agri export was about Rs. 149 crores which have risen to the level of Rs. 2.53 lakh crores in 2019-20. There has been a substantial increase in the export of almost all agricultural items in the last 15 years, but despite being one of the top producers of agricultural products, India does not figure among the top exporters of agricultural produce. For example, India holds the second rank in world wheat production but ranks 34th in export. Similarly, despite being world No. 3 in the production of vegetables, the export ranking of India is only 14th. The same is the case for fruits, where India is the second largest producer in the world, but export ranking is 23rd. To reach the ranks of a top exporting nation in Agriculture, commensurate with the production, there is a clear and categorical need to take proactive interventions.

viii. Low access to finance

Farmers often face a cash crunch to meet their farming expenses or household expenditure. Cash inflows and outflows do not match over the year and hence, borrowing is essential often. However, there are a few sticky issues in credit markets such as the waning of banks' interest in lending, persistence of informal sources of credit (Satyasai and Viswanathan, 1998, Satyasai, 2015), disparate access to formal credit across geographies (Satyasai and Jadhav, 2022), limited access to formal credit to various social groups and tenants, diversification (dilution) of priority sector lending, weakening of cooperatives, structural problems (Satyasai, 2012), market distortions through loan waivers and interest rate subvention that made long-term loans unattractive, higher propensity to borrow vs income growth (Satyasai and Jadhav, 2022), operational issues in implementing KCC (Mani 2016), and so on.

ix. Social capital/organisation and linkages

As a tiny producer, an average smallholder has limited marketable volumes and hence, impaired negotiating power and remains a price taker. Hence, there has been a drive to organise the farmers into cooperatives or Farmer Producer Organisations (FPOs). Over the decades, the cooperatives have largely been defunct/less effective barring a few that too among milk cooperatives. FPOs have been promoted with a renewed hope that registering the farmers' organisations especially as companies would help them perform better. While the FPOs are promising they cannot be effective automatically without building the much-needed social capital. Mere bringing people physically together cannot ensure success for an FPO. Also forming an FPO is not a panacea for the problems of farmers. Right local champion/agent and inculcating collective action principles are important for these organisations to flourish (Satyasai, 2015).

x. Inequalities

Even as the increased agricultural production at the national level is impressive, certain geographies lag behind others. Within a given region, interpersonal disparities in gains from development galore with marginal and small farmers receiving lower incomes due to their lower access to the resources such as land and water. Disparities exist in access to credit and other resources, and production or income levels. Successive governments have tried to bridge these disparities which declined and increased again, especially post-1990s reforms. Inequalities in non-income parameters are much sharper than income inequalities (Mahendradev, 2016).

Agenda for Amrit Kal

As we entered Amrit Kal, we need to focus on addressing the above issues. We need to think no-holds-barred to arrive at dispassionate solutions and rethink productivity and populism through alternative approaches. Kumar et al (2020) present many thought-provoking alternative perspectives. They argue, among others, for a new set of metrics keeping the focus on ecological aspects. Importantly, we should think about farmers and agriculture in today's context and as a part of the whole having to face trade-offs and competing demands for limited resources. Not as an absolute entity. For example, when we propose a substantial hike in MSP to help maize farmers, we should examine if buyers can buy at that price as they have to protect their economic interests. A few suggestions for Amrit Kal are given below.

a. Work towards SDG Goals – Zero Hunger and Halving Poverty

Of the 1.2 billion poor in the world, a sizeable proportion is in Sub-Saharan Africa and South Asia. India, besides solving its hunger and poverty issues, may even have to play a larger role in the world as an emerging world leader. As our population is still growing fast and would be the most populous country in the world soon, India has to struggle to produce enough nutritious food braving the headwinds created by climate change. Going by the recent Multidimensional Poverty Index report, India would possibly achieve SDG 2 i.e., halving poverty. The first goal of zero hunger seems to have moved away a bit. Climate-smart agriculture with the integration of scientific innovations and traditional practices

would increase productivity, sustainability, and resilience of agriculture. Hence, we should develop optimal crop- and location-specific packages of climate-smart practices blending scientific innovations and farmers' self-risk adjustment practices. Convergence of programmes and policies of various ministries concerned is a must (Birthal, 2022).

b. Frame comprehensive agricultural policy and bring reforms

The agricultural sector has been bypassed in reforms of 1990s barring freeing imports of several agri-commodities. Though there was a National Agricultural Policy declared in July 2000, it remained more of a wish list without any serious pursuit. There are a few policy changes in prices, credit and technology but not upgraded with time. On one hand, agriculture has evolved over the last seven decades from one of subsistence and passive farming to modern technology-driven active economic activity (Gulati and Juneja, 2018). However, whatever policies and programmes brought into force during the early Green Revolution years when scarcity was the major problem are continuing today when we have comfortable surplus production.

Any reform is not complete and cannot deliver in perpetuity and to the desired degree. We should review, revise, and revamp the policies from time to time to keep pace with the situation. First of all, our view of farmers as outdated, traditional, archaic, and averse to modern technology and thinking should change and we should start respecting their wisdom and choice. All the farm laws should be understood together and in conjunction with other related Acts. The goal should be to create an enabling ecosystem where all economic players can operate optimally. Whatever the measures, policy certainty, complementarity and consistency play important roles in encouraging sustainable private investments (Satyasai and Lingareddy, 2021).

Right now, we may require reforms in four areas: shifting focus from production to farmers' livelihoods, improving the allocation and efficiency of land and water, helping farmers to cope with the growing risks of weather and price volatility, and agricultural markets must be opened to greater competition and provided with better infrastructure (Gulati et al, 2019).

Advancement in science-led technology, the enhanced role of private sector in both pre-and post-harvest phases, liberalized output market, active land lease market, and emphasis on efficiency will equip agriculture to address the challenges of 21st Century and contribute towards goal of New India. A well-coordinated action and strategy between the Centre and the states are needed to ensure that agriculture marches to the next stage of development along with other sectors (Chand, 2022). We should also have a consensus on what we aim for through the given policy. For example, the price policy should be able to maintain intercrop price parity and ensure rational utilisation of inputs and natural resources. Also, it should enhance diversification to meet the growing food and nutritional security. Agricultural price policy should be able to protect the interest of both producers and consumers without increasing the subsidy burden (Kumar and Mittal, 2022). The goals of various policies for credit, subsidy, energy, water, etc. should be well-integrated keeping in view the trade-offs and complementarity.

c. *Improve incomes and shift to farmers' welfare paradigm*

Enhancing farmers' income can be achieved by improving the gross incomes and/or reducing costs. Improving productivity, changing cropping patterns to include high-value crops, enhancing output prices by increasing MSP or bettering market access are strategies for enhancing gross income. Besides recommending improved technologies, often increasing MSP is considered a solution to improve farmers' incomes. However, market access is more important. The access should be approached from a multi-dimensional framework. Mere physical access is not an adequate indicator of market access. Using one such framework constructed a composite index, the Farmers' Access to Markets Index (FAMI), combining nine indicators under three dimensions: market orientation, market agency choice and market information. It is evident that states with higher FAMI also showed higher net and gross incomes from crop cultivation. Other things being equal, 10% increase in FAMI can lead to an increase of 3.6% increase in net income and 3.2% increase in gross income. That works out to an increase of Rs 392 in net income and Rs 764 in gross income, at the margin. Thus, the findings indicate that even as MSP is declared uniformly for all states, farmers who have better access to markets, in its multiple dimensions, are likely to obtain higher incomes (Satyasai and Pereira, 2019).

For reducing costs, the strategies include improving input use efficiency, evolving, and adopting new technologies that can reduce input use (e.g., nanotechnology), and integrated farming systems invoking circular economy principles, among others. Since farmers are diversifying their income sources, a special focus on the livestock economy is a must to enhance incomes. Technology adoption and planning to suit the natural resource endowment of various regions, enhancing public spending, ensuring feed and fodder supply, effective delivery of veterinary services, ensuring credit flow, etc are essential for livestock economy growth (Birthal, 2022).

As evidence shows, agricultural households tend to augment their incomes more from the non-farm avenues. This helps reduce disguised unemployment in agriculture and living standards of farmers would improve especially in those resource-scarce areas (rainfed areas) where pursuing intensive agriculture is not possible.

It is not enough if farmers' incomes are enhanced. Their welfare, which has several dimensions beyond income, should be targeted. That includes improvement in living standards, health, education, sanitation, ecology, and so on. This aspect has been explored and a framework suggested by Dalwai (2019) and Satyasai et al (2021, 2022a, 2022b).

d. *Manage water scarcity and produce more (crop) per drop*

The major agenda for irrigation development should be focussed on improving water use efficiency and water saving. Micro-irrigation should be promoted across the country and inter-basin water transfers should be taken up subject to feasibility. The present situation of water-scarce rainfed areas (especially in the Deccan Plateau region) is not going to change much if we continue water use as usual. Often, the watershed programmes and other efforts to address water scarcity may lead to farmers continuing water-intensive crops like rice and sugarcane due to the larger availability of water, defeating the very purpose of such programmes (Jevon's paradox). In the absence of assured food security with good quality grains and remunerative alternatives to crops like sugarcane, farmers' choice to go for these crops is the most rational and recommending banning these crops is ignoring the trade-offs involved (Satyasai, 1995, 1997).

The scarcity value of water should be highlighted to arrest wastage. In this context, water markets can help move water from low to high-value uses, promote investment in increasing the efficiency of water use, and transform water from being a 'scarce but free' resource into an economic good with an opportunity cost (Shah, 2022).

Tank irrigation is the best candidate for the semi-arid tropics. Ideally, improving the livelihood of the rural community through increasing the benefits from multiple uses of tanks should be the objective of future tank rehabilitation programmes. Accordingly, a few time-tested options for future modernisation would be: desilting fully or in 20 to 30% of the water spread area, converting the tanks into percolation ponds by closing the sluices when the tank water storage is less than 40% in the last 5 years, providing 1-2 fillings from canal/anicut/river systems, developing groundwater in the command area, and adopting sluice rotation to enable conjunctive use with groundwater (Palanisami, 2022).

Rainfed areas need special attention as they suffer from water scarcity, frequent droughts, and pervasive poverty but aspirations are comparable to well-endowed regions. Strengthening institutions like National Rainfed Area Authority (NRAA), micro irrigation, drive towards millet production through incentives to compensate for the loss of income by switching away from remunerative but water-intensive crops, and special drives for diversification of economy towards secondary and tertiary sectors (Deshpande 2022).

e. Technology– is the game changer

Technology is the only solution to address multiple problems facing agriculture such as rising input costs, low yields, pests and diseases, dwindling natural resources, etc. Technologies we should work in agriculture are concerned with (i) genetic enhancement, (ii) natural resource management, (iii) farm mechanization, (iv) conservation agriculture, (v) climate-smart agriculture, (vi) biotechnology and genetic modified, (vii) biofortification, (viii) frontier technologies, and (ix) digital technologies. However, we need to ensure certain crucial factors to ensure the successful adoption of technology such as effective agriculture extension systems, access to credit, human capital, and direct benefit transfers. To enable small and marginal farmers for easy access to information and credit, the role of public sector programs such as Krishi Vigyan Kendra's and the Kisan Credit Card scheme. Next-generation technologies, such as climate-smart agriculture, frontier technologies and digital agriculture require a different approach in technology generation and their dissemination. Agricultural research and extension system needs more financial resources, improving the capacity of human resources, creating enabling management structure, promoting multi-disciplinary and multi-institutional research, strengthening public-private partnership, and developing appropriate research infrastructure (Joshi and Varshney, 2022).

Biotechnology's application especially for the development of transgenic varieties is wrought with severe opposition on several grounds. While farmers are willing to embrace varieties such as Bt cotton and Ht cotton, Bt brinjal and so on, several people oppose their adoption. Bt cotton has revolutionised cotton production in India even as there are attempts to discredit the achievements by misreading data (Rao, 2013, Sujatha, 2020). I firmly believe biotechnology is the next technology to jumpstart agriculture and how we will leverage it while building consensus is important. Nanotechnology too has the potential in ushering in new products such as nutrient-coated seeds, nano-stickers for improving fruit and vegetable shelf life and many more that can reduce the costs of inputs and reduce wastage (NABARD, 2022).

For all these to happen, we need to invest more in agricultural research from the present 0.6 % of GDP from agriculture to at least 1% (Gulati 2022). Also, agricultural research and education systems should be geared up to meet future needs.

f. Go organic

Sustainability of agriculture is an urgent need as we have been witnessing the ill effects of the excessive use of chemical fertilisers and pesticides in agriculture damaging soils, groundwater, ecology, and causing irreversible damage to human health and wellbeing. Else, we hand over a very grim agricultural situation to our future generation. Going organic is one of the options. Going organic and eliminating chemical fertiliser use may land us in serious food shortages. Hence, we need to go for a gradual approach by curbing the excessive use of fertilisers and pesticides substituting them with bio-alternatives. Though bio-fertilisers and bio-pesticides have been there around for several years, their adoption levels are much lower. For example, as per an estimate by the Ministry of Agriculture and Farmers Welfare, GoI, New Delhi, 11% of the area that adopted any pest control measure has gone only for biocontrol and another 10% area has seen a combination of bio- and chemical control. The extent of use of biological control should increase to restore pest-predator balance which can reduce the need for chemical use and hence, the toxic effects thereof.

g. Invest more on farms-ensure better credit access

Investment on farms should be enhanced both on public and private accounts. Farmers need both short- and long-term capital for their needs and their investment would be triggered when there is an overall conducive economic environment, when returns are lucrative enough and when there is a minimum threshold level of public investment that can induce complementary private investment. For private investment, credit is one of the important inducers besides proper policy framework. Existing policies on interest subvention and loan waivers, etc need dispassionate review and revision. Loan waivers may be appealing in the short run to address the distress, but in the long run, they eat away at the fiscal space of the states and spoil the credit discipline. Governments should address distress by proper targeting of waivers (Saini et al, 2022) and without distorting the markets. Despite the serious efforts, many households do not have access to institutional credit in several geographies, especially in Eastern and North-Eastern states. Around 3.3 million outlets are serviced by Banking Correspondents (BCs) in the country by Dec 2021 (RBI, 2022). Fintechs are doing very well in reaching out the financial services to people. Research shows that regions which have poor physical banking infrastructure, digital penetration is better and hence, to reach out to difficult geographies, we may have to depend on the digital revolution (Satyasai and Kumar, 2020a&b). Digital lending is one such innovation though can be risky to borrowers if left unregulated and RBI has recently issued guidelines for the regulation of digital lending (RBI, 2022).

h. Organise producers

FPOs are here to stay. For them to cater to the needs of farmers effectively, they should learn business rules, compliance needs and market preferences and accordingly, develop sound business plans with the participation of all members. Financial institutions need to innovate credit products for FPOs, based on region-specific business models and extend credit support for creating farm gate infrastructure

facilities. Credit guarantee offered through a NABARD-subsidiary, NABSANRAKSHAN may provide an incentive for bank lending to FPOs. Digitization of all the FPOs for creating a database, monitoring of fund utilization, and sharing the database with other stakeholders for facilitating online business transactions and convergence with government schemes for subsidization of costs and obtaining input licenses in a hassle-free manner would be two steps further in developing rural business ecosystem. FPOs can also be leveraged to play an effective role in value chain finance models (Nanda et al, 2022).

i. Build appropriate infrastructure

Building infrastructure should be the priority in many critical geographies such as East and North East states. Roads, bridges, storage, cold chains, veterinary facilities, hatcheries, power, ropeways, custom hire centres, financial institutions, etc become bottlenecks often for expression of full potential. Dependence on renewable energy should be increased. Digital infrastructure needs a big push in rural areas as they need to be ready for future growth that is bound to come from the digital revolution.

Amrit Kal – The Time for Action

Agriculture has performed well during the last 75 years in terms of ensuring food security and the production of nutrients. However, there have been several vexing issues the sector has to tackle. Some of these issues cropped up while addressing the fundamental problems such as food shortages, continued use of technology ignoring the context, hanging on to the archaic and outlived policies and interventions, interfering in markets in a bid to help farmers thereby disturbing the fundamentals, dependence on poorly targeted, ill-conceived subsidies, among others. We need to make farmers the partners in the development process, conceding them freedom and due dignity, rather than treating them as beneficiaries. During the Amrit Kal, we have to address the above concerns by focusing on inclusive growth – of less developed areas and disadvantaged people including tenants, improving resource use efficiency – getting more from less, ensuring higher returns to efforts of farmers- better price realisation and moving towards perfect markets, (re)building institutions, ensuring better, diversified, and stable incomes, among others.

8

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Annexure

Annexure Table 1. Compounded annual growth rates for successive 15-year moving periods

End year for 15-year moving period	Agriculture, Livestock, forestry, and fishing	Crops+ Livestock	Crops	Livestock	Forestry and logging	Fishing and aquaculture	Overall GVA
1964-65	2.27	2.32	2.33	2.31	1.40	**4.69**	**3.84**
1965-66	1.92	1.87	1.87	1.85	1.92	**4.49**	**3.72**
1966-67	1.83	1.73	1.73	1.71	2.34	**4.33**	**3.68**
1967-68	1.71	1.57	1.58	1.56	2.55	**4.21**	**3.59**
1968-69	1.81	1.69	1.69	1.67	2.56	**4.00**	**3.62**
1969-70	2.04	1.93	1.94	1.92	2.67	**3.80**	**3.69**
1970-71	2.09	1.97	1.98	1.95	2.86	**3.75**	**3.67**
1971-72	2.05	1.92	1.92	1.90	2.90	**3.84**	**3.61**
1972-73	1.97	1.84	1.85	1.82	2.77	**3.87**	**3.46**
1973-74	1.98	1.86	1.87	1.84	2.72	**4.00**	**3.35**
1974-75	2.16	2.07	2.07	2.04	2.69	**4.11**	**3.33**
1975-76	2.26	2.19	2.20	2.16	2.48	**4.11**	**3.34**
1976-77	2.49	2.50	2.51	2.47	1.98	**4.01**	**3.44**
1977-78	2.61	2.68	2.69	2.65	1.54	**3.71**	**3.54**
1978-79	2.35	2.46	2.47	2.42	0.96	**3.44**	**3.47**
1979-80	2.52	2.72	2.73	2.66	0.27	**3.30**	**3.59**
1980-81	2.41	2.62	2.64	2.56	-0.07	**3.03**	**3.59**
1981-82	2.12	2.32	2.33	2.25	-0.35	2.69	**3.51**
1982-83	2.26	2.49	2.51	2.43	-0.70	2.74	**3.61**
1983-84	2.31	2.56	2.58	2.50	-1.00	2.91	**3.69**
1984-85	2.39	2.67	2.69	2.61	-1.28	**3.06**	**3.84**
1985-86	2.53	2.83	2.85	2.77	-1.45	**3.10**	**4.04**
1986-87	2.49	2.79	2.80	2.73	-1.52	**3.20**	**4.16**
1987-88	2.56	2.84	2.86	2.79	-1.57	**3.41**	**4.30**
1988-89	2.68	2.95	2.96	2.91	-1.43	**3.76**	**4.49**
1989-90	2.72	2.94	2.95	2.91	-1.10	**4.21**	**4.60**
1990-91	2.87	**3.05**	**3.06**	**3.03**	-0.64	**4.70**	**4.73**
1991-92	2.91	**3.04**	**3.04**	**3.03**	-0.26	**5.11**	**4.81**
1992-93	**3.12**	**3.24**	**3.25**	**3.24**	-0.15	**5.55**	**4.97**
1993-94	**3.37**	**3.48**	**3.47**	**3.48**	0.17	**5.99**	**5.20**
1994-95	**3.12**	**3.17**	**3.17**	**3.19**	0.26	**6.28**	**5.23**
1995-96	**3.22**	**3.26**	**3.26**	**3.28**	0.35	**6.51**	**5.36**
1996-97	**3.22**	**3.24**	**3.23**	**3.25**	0.54	**6.51**	**5.46**
1997-98	**3.20**	**3.22**	**3.22**	**3.24**	0.71	**6.05**	**5.53**
1998-99	**3.33**	**3.35**	**3.35**	**3.38**	0.86	5.93	**5.71**
1999-00	**3.35**	**3.37**	**3.36**	**3.39**	1.04	5.85	**5.81**
2000-01	**3.38**	**3.39**	**3.39**	**3.41**	1.25	5.71	**5.87**
2001-02	**3.09**	**3.06**	**3.06**	**3.07**	1.38	5.43	**5.85**
2002-03	2.82	2.78	2.78	2.80	1.38	5.04	**5.82**
2003-04	2.77	2.75	2.74	2.76	1.34	4.56	**5.92**
2004-05	2.73	2.73	2.73	2.71	1.44	4.21	**6.08**

End year for 15-year moving period	Agriculture, Livestock, forestry, and fishing	Crops+ Livestock	Crops	Livestock	Forestry and logging	Fishing and aquaculture	Overall GVA
2005-06	2.72	2.75	2.74	2.78	1.44	3.96	**6.28**
2006-07	2.66	2.73	2.71	2.76	1.37	3.69	**6.38**
2007-08	2.60	2.71	2.65	2.93	1.17	3.50	**6.41**
2008-09	2.48	2.61	2.45	**3.14**	0.90	3.45	**6.42**
2009-10	2.55	2.74	2.52	**3.45**	0.60	3.51	**6.47**
2010-11	2.45	2.66	2.41	**3.46**	0.44	3.52	**6.50**
2011-12	2.71	2.99	2.69	**3.97**	0.03	3.79	**6.58**
2012-13	2.78	**3.11**	2.73	**4.32**	-0.31	4.05	**6.59**
2013-14	**3.01**	**3.39**	2.96	**4.77**	-0.49	4.13	**6.59**
2014-15	**3.15**	**3.54**	2.99	**5.26**	-0.51	4.35	**6.65**
2015-16	**3.16**	**3.51**	2.81	**5.66**	-0.43	4.70	**6.70**
2016-17	**3.36**	**3.67**	2.81	**6.21**	-0.14	5.19	**6.74**
2017-18	**3.36**	**3.57**	2.58	**6.41**	0.28	5.89	**6.69**
2018-19	**3.46**	**3.58**	2.42	**6.79**	0.82	6.58	**6.64**
2019-20	**3.53**	**3.57**	2.28	**7.01**	1.36	6.98	**6.52**
2020-21	**3.63**	**3.60**	2.22	**7.15**	1.82	7.27	**6.15**

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JOURNEY OF INDIAN AGRICULTURE SINCE INDEPENDENCE:
Vision for Amrit Kal

K J S Satyasai, Abhishek Tiwari and Deblina Patra

India has celebrated Azadi Ka Amrit Mahotsav (AKAM) as it turned 75 since Independence. In these 75 years, India has crossed several milestones, transforming it from a very traditional to a vibrant modern economy. The research study covered the performance of agriculture in 7 decades through 4 major prisms. i. Production -the thinking is around increasing production and food security for teeming millions; ii. Income – where the focus is on farmers' income; iii. Nutrition- the focus is to provide nutrition and not just quantity; and lastly, iv. Farmers' Welfare. Apart from the above, the study has also highlighted the vision of the agriculture sector for Amrit Kal.

The performance of Indian agriculture is indicating that India has done considerably well in an increase in production, however, farmers' income, nutrition, and farmer's welfare are yet to be improved. The focus should be shifted to increasing the farmers' welfare during the Amrit Kal.

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