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Indian Agriculture @ 75
Past achievements and future challenges

Ritika Juneja[*] **Ranjana Roy**[**] **Ashok Gulati**[***]

Abstract

India has experienced significant transformation in its economy since independence, especially agriculture. From a severely food-deficit nation during mid-1960s to a self-sufficient one, and becoming the largest exporter of rice and the largest producer of milk in 2020-21 is not a small achievement. Similar break-throughs have been achieved in poultry, fishery, fruits and vegetables, and cotton. All this was made possible with liberal infusion of modern technology, institutional innovations that made small holders part of this change, and enabling right incentives to cultivators. This holds lessons for many developing countries in south and south-east Asia as well as in African continent. But India still faces many challenges on food security front. Malnutrition rates amongst children remain high, and agricultural production begs the question of sustainability as water table in most parts of the country is falling rapidly. Also, the food system needs to move from 'tonnage centric to farmer centric' as incomes of agri-households remain pretty low, largely because of small holding sizes. It is high time that India opens up land lease markets, build efficient supply chains with Farmer Producer Organisations by infusing digital technologies to unleash next technological revolution that promotes efficiency, inclusiveness, and sustainability in agriculture through precision agriculture.

Keywords: Agricultural production, Food security, Agricultural productivity, Sustainability

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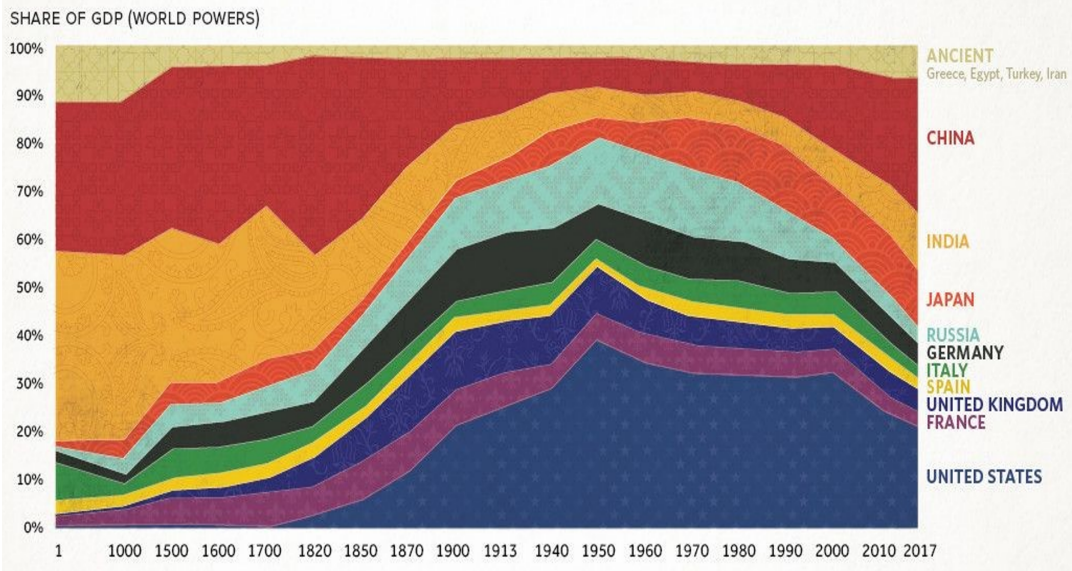
[*] Ritika Juneja is a Consultant at ICRIER
[**] Ranjana Roy is a Fellow at ICRIER
[***] Ashok Gulati is Infosys Chair Professor for Agriculture at ICRIER

I Introduction

India is one of the oldest civilisations in the world with incredible cultural diversity and rich economic history. Its economic performance since the beginning A.D. 1 was phenomenal. According to Angus Maddison, a British economic historian, India was the largest economy of any region in the world by gross domestic product (GDP) and purchasing power parity (PPP). In A.D. 1, India's contribution to the world's GDP was highest at 33 per cent [Figure 1]. However, as Britain's East India company began to grow in India in the mid-17th century, a phase of decline set in. The decline accelerated as the East India company handed over its operations to the British Crown (the Queen) in 1858, after the first war of independence broke out in 1857 in India (the British called it a rebellion) (Gulati, et al. 2021). The British Raj used India as its richest colony, as a source of raw material supply as well as a market for feeding Britain's industrial revolution. By the time India got freedom from the British in 1947, India was a poor economy.

Figure 1: Percentage share in World GDP



Source: "Statistics on World Population, GDP, Per Capita GDP, 1-2008 AD", Angus Maddison; IMF (visualcapitalist.com)

Partition and Tryst with Destiny

At the time of independence in 1947, India's population was subject to frequent famines, had one of the world's lowest life expectancy, suffered from pervasive malnutrition and was largely illiterate. Partition had made things worse. The country was faced with a challenge to feed 347 million people, while the grain production at that time was just 45 million metric tonnes (MMT) (Chopra, 1984). Shortage of basic staples and negligible foreign exchange reserves to buy grains from global markets on commercial terms, pushed the country into an unprecedented 'ship-to-mouth' crisis by mid 1960s when India was faced with a back-to-back drought. USA's help under PL-480 program to supply

almost 10 MMT of grains per annum at that time saved millions of lives. This experience also sowed the seeds of the green revolution.

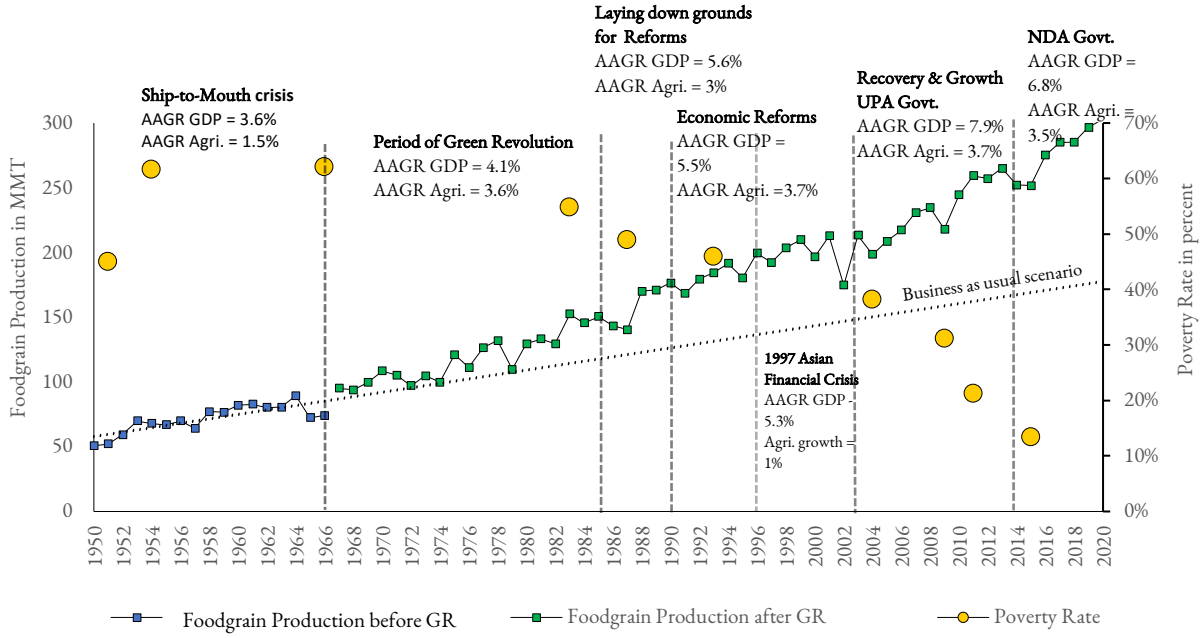
During 1951-52 to 1966-67, the overall growth in GDP remained at a low level of 3.5 per cent due to a very high share of agriculture in overall GDP and lacklustre performance of agriculture (just 1.5 per cent per annum). With population growing at almost 2 per cent per annum during this period, the per capita growth was a meagre 1.5 per cent per annum. This despite the economic strategy of heavy industrialisation that Jawaharlal Nehru followed since the second five-year plan (1956-57 to 1961-62).

Since then, India has come a long way becoming the sixth largest economy in the world in 2020 in US current dollar terms (IMF, 2019), and the third largest after China and the US in purchasing power parity (PPP) terms at 2011-12 prices. Furthermore, economic growth, measured in terms of the average annual growth in GDP has accelerated from 5.4 per cent during the 1980s to 5.6 per cent in the 1990s to 7.5 per cent during the decade of the 2000s, and remained roughly at 6.7 per cent from 2011-12 to 2019-20 (National Accounts Statistics, 2019). This increase in overall GDP growth rates also resulted in rising per capita incomes, leading to a gradual decline in extreme poverty in India. Measured by a per day per capita income of USD 1.9 (at PPP of 2011-12 prices), the head count ratio (HCR) gradually declined from more than 70 per cent at the time of independence to 54.8 per cent in 1983 to 45.9 per cent in 1993 to 38.2 per cent in 2004 and to 13.4 per cent in 2015 (World Development Indicator, 2019). As per recent estimates, poverty HCR lies somewhere between 8.1 and 11.3 per cent in 2017 (Gulati, 2021).

From Food Scarcity to Surplus

On the food and agriculture front, India has experienced an impressive transformation from being a 'begging bowl' during the mid-1960s to a food sufficient and a food surplus one. With the introduction of miracle seeds of wheat and rice in 1966, a noticeable acceleration in agricultural production and agri-GDP growth was recorded. Agri-GDP, accelerated from 1.5 per cent during 1951-52 to 1966-67 to 3.6 per cent per annum between 1967-68 to 1983-84. The food grain production increased to more than double from 74.2 MMT in 1966-67 to 152.3 MMT in 1983-84 [Figure 2]. Overall, the economy also showed signs of improvement, registering a growth of 4.1 per cent per annum. Not only this, India also emerged as the largest producer of milk, cotton, pulses and spices; second largest producer of wheat, rice, fruits and vegetables; third largest producer of eggs; and the fifth largest producer of poultry meat. It is also the largest exporter of rice, spices, and bovine meat. All this became possible with the infusion of modern technologies supported by right incentives and institutions. Most critical of all, remains the adoption of high-yielding variety seeds of wheat and rice, along with irrigation, fertilizers, and positive price policy that ushered in the famous Green Revolution in India. In 2020-21, food grain production is estimated to touch 309 MMT with India continuing to be the largest exporter of rice (17.7MMT) in the global market that hovers around 45 MMT.

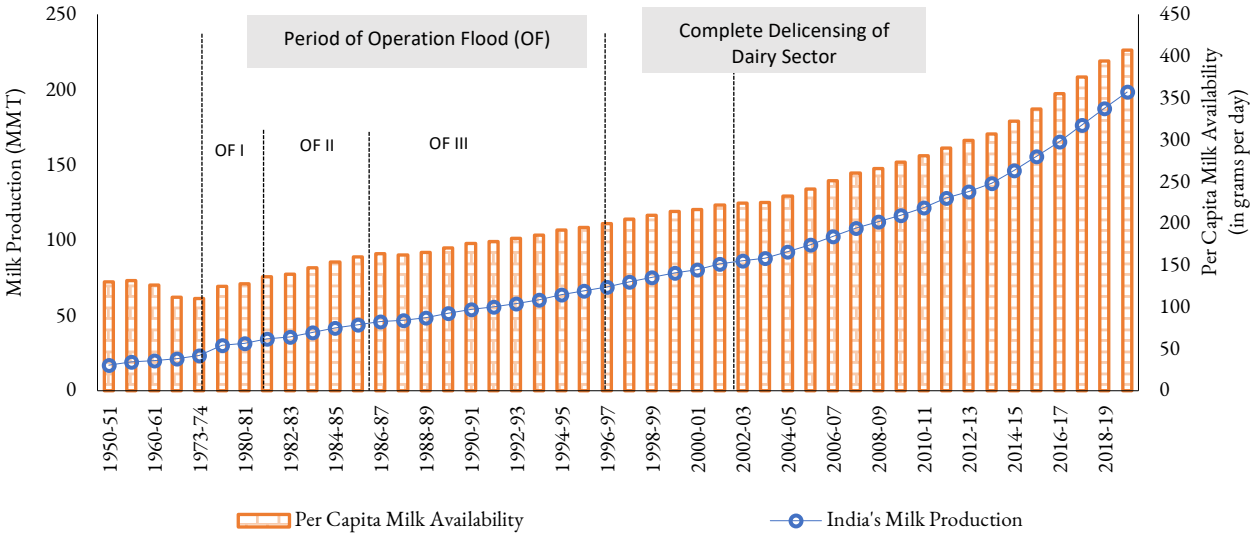
Figure 2: Economic and Agriculture performance indicators



Note: Average Annual Growth rate (AAGR) of India's Gross Domestic Product (GDP), Agriculture Gross Value Added (GVA) and Per Capita Income (PCI) is calculated at constant 2011-12 prices.
Source: The World Bank,2019; GOI 2020; MOSPI 2021

This was followed by the White Revolution in the dairy sector during the 1970s through to the mid-1990s. The institutional innovation of `Operation Flood' significantly transformed the system of milk collection from smallholders under a co-operative structure, homogenisation, pasteurisation, and distribution to mega cities as far as 1,800 kilometres away. The innovation allowed transportation in bulk coolers designed to keep the temperature controlled at 3.9 degrees Celsius, through an organised retail network (Gulati, Paroda, Puri, Narain, & Ghanwat, 2021). Milk production in India increased from 23 million MT in 1973-74 to 208 MMT in 2020-21 securing the top spot in the world, followed by the USA whose milk production hovered around 100 MMT.

Figure 3: Production and Availability of Milk in India

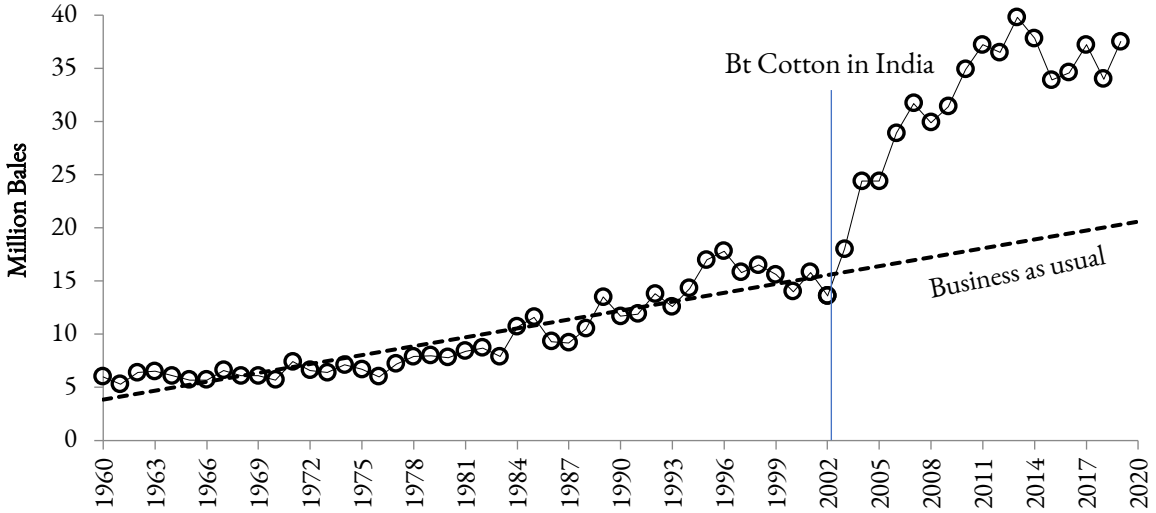


Source: DoAHD&F (2020)

Within livestock, India's poultry sector experienced a remarkable transition from a backyard system in the seventies to an integrated and commercial industry, largely driven by the private players. The institutional innovation of contract farming and vertical integration of farm operations made poultry one of the fastest growing sectors in India between 2000-01 and 2019-20, registering an estimated growth of around 10 per cent per annum. Besides this, owing to the massive coastline of over 8,000 kms and a vast network of rivers, the fisheries sector also witnessed significant growth of about 4.5 per cent between 2000-01 to 2019-20 (Department of Fisheries, 2020) and has contributed about 14 per cent share in India's agricultural exports (in FY 2020-21).

Infusion of Bt (Bacillus thuringiensis) technology is another remarkable success story in Indian agriculture that ushered in the famous Gene Revolution. The effect of fertilizers, seed technology and insecticides made India the largest producer of cotton in the world with doubling output from 13.6 million bales in 2002-03 to 37.5 million bales in 2019-20 [Figure 4], resulting in India surpassing China in 2014-15 to become the largest cotton-producing country in the world (DCD, 2017). Currently, Bt cotton cultivation covers more than 90 per cent of the total area under cotton in the country.

Figure 4: Cotton Production in India



Source: USDA, 2019-20

Another sector where India is making a significant impact is horticulture (Fruits, Vegetables, Spices, Floriculture). The sector contributes the largest share of 21 per cent in the total agriculture value of output (2018-19) (MOSPI, 2021). The National Horticulture Mission (2004-05) played an important role in the development of this sector making India the second largest producer of fruits and vegetables globally, next only to China. According to the 2019-20 estimates, fruit production has crossed the mark of 100 MMT, up from 28.6 MMT in 1991-92, while vegetable production has increased from 58.5 MMT to 189.4 MMT over the same period.

Over the last few decades, the revolutionary transformations enabled India to achieve the much-needed food, feed and fibre security, which can inspire many developing countries. However, Indian agriculture is not free from perils. It faces serious production risks due to climate change as the country experiences "prolonged droughts in the Deccan plateau states of the west and southern

peninsula and floods in the Himalayan foothills from melting glaciers in the Himalayas" (Gulati, Kapur, & Bouton, 2019). Agriculture is still volatile and depends heavily on rainfall. So, the farmers always have the fear of crop failure and income volatility.

Recent IPCC report predicted that temperature in India will rise in the range of 0.5–1.2 degree Celsius (°C) by 2020, 0.88–3.16°C by 2050 and 1.56–5.44°C by the year 2080. This will have drastic consequences on crops, lowering the yields by 4.5 to 9.0 per cent, depending on the magnitude and distribution of warming (NICRA, 2018).

Another challenge for Indian agriculture is to reduce the number of cultivators in agriculture to arrest the shrinking size of holdings, which has already come down from 2.3 hectares (ha) in 1971-72 to less than one hectare (0.9ha) in 2018-19. Normally, with structural transformation, the labour force shifts away from the agricultural sector towards a more productive industry and service sector. But in India this structural transformation has been rather slow. While the share of agriculture in GDP declined steadily from 29 per cent in 1990-91 to 15 per cent in 2018-19, the share of workforce engaged in agriculture declined from 63 per cent to 43 per cent (World Bank) over the same period, implying low labour productivity. Thus, the need of the hour is to develop such an agri-food system that not only produces enough food, feed and fibre, but also provides safe and nutritious food that is environmentally sustainable.

II Reforms and Economic Growth

In 1984, Rajiv Gandhi took office after the assassination of Indira Gandhi. In the early years of his terms, he sowed the seeds for economic liberalisation and gave a new direction to political debates. The economic growth during 1984-85 and 1990-91 was recorded to be 5.6 per cent per annum. However, before the full-fledged implementation of the reforms, Rajiv Gandhi was assassinated, and the country landed in a serious economic crisis in July 1991. During 1991-92, growth plummeted to 1.1 per cent and inflation soared to more than 13 per cent. It is at this juncture, in July 1991, that India ushered in economic reforms, steering the country away from a regime of controls and protectionist policies to a somewhat market-oriented system. The growth rate of the Indian economy accelerated to 5.5 per cent per annum between 1991-92 and 1996-97. However, the year was followed by the Asian Financial Crisis that gripped much of East Asia and Southeast Asia beginning in July 1997 and raised fears of a worldwide economic meltdown due to financial contagion. The deceleration in agricultural growth started from 1997-98 with global food prices plummeting and India being hit by a severe drought in 2002-03. Agricultural GDP grew by a meagre rate of 1 per cent per annum (between 1997-98 and 2002-03). The UPA government came in power in 2004, and worked towards economic stabilisation. Soon a period of recovery and growth followed. Under the UPA government (2004-05 to 2013-14) the overall GDP registered a growth rate of 7.9 per cent per annum and agri-GDP grew at 3.7 per cent per annum.

India and Her Neighbours

As Indians, we feel proud of India's development journey over the last 75 years. India made substantial progress in economic growth, reduction in extreme poverty, and producing enough food

for Indians to have food security, although nutrition security still remains a challenge to be met. But it is interesting to explore how other nations who started with similar base or even worse conditions have performed.

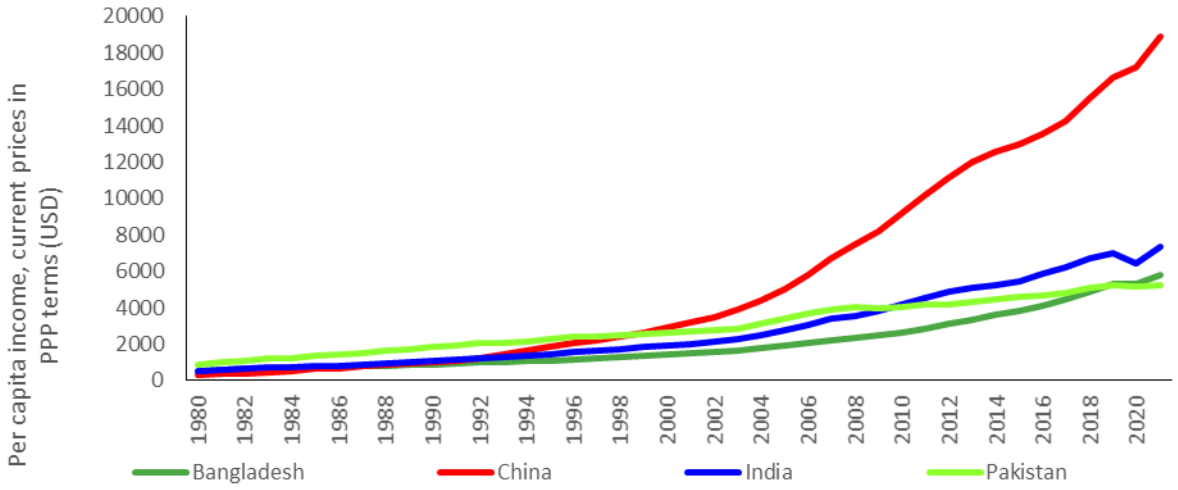
Let us begin with India's adjoining neighbours, who were very much part of India in the pre-independent era, namely Pakistan and Bangladesh. In terms of per capita income, India has certainly done better than Pakistan. India's per capita income in US dollar terms was reported to be USD 1,930 in 2020 (and USD 6,510 in current purchasing power parity (PPP) terms), compared to just USD 1,250 (and USD 5,150 in current PPP terms) for Pakistan. On the other hand, Bangladesh that became independent much later in 1971, recorded per capita income of USD 1,960 (and USD 5,290 in current PPP terms), which was slightly higher than even India at least for the year 2020 in current USD terms (although India is higher in PPP terms), and much higher than Pakistan (International Monetary Fund, 2021).

Even more interesting is India's comparison with China. As many would know, both nations kick-started their journey as independent nations after a long struggle for freedom in the late 1940s. They both undertook a series of economic reforms but followed different growth models. In 1947, India chose to be a full democracy and a nation of equals, while China chose a system where choices were limited to a few. Before the 1990s, India outstripped China in terms of per capita income (at PPP) [Figure 5]. The turnaround came in 1992, when China's per capita income increased from USD 966.5 in 1990 to USD 1241 in 1992 vis-à-vis India's per capita income rose from USD 1,101 in 1990 to USD 1193.5 in 1992 (International Monetary Fund, 2021). The trend continued and in 2020, India's per capita income (at PPP) was recorded as USD 6461.5 compared to USD 17191.7 in China. This has led to a certain strand of discourse that questions the structure of democracy in India for being challenging for the implementation of policy changes / reforms (Gulati & Fan, 2007). It may be worth noting that China also imposed a one-child norm in 1981 that continued till 2016. As a result of this, their per capita income growth was much faster than India's. Also, a point to be noted is that China started off its economic reforms in 1978 with agriculture, dismantling the commune system and introducing household responsibility system in agriculture and somewhat liberating the output markets of agriculture. As a result, agriculture GDP grew by 7.1 per cent during 1978-84, and farmers' real incomes increased by almost 15 per cent per annum. This not only reduced poverty dramatically but also provided demand for industrial products, triggering a manufacturing revolution in China through its town and village enterprise (TVEs).

Comparing India's performance with respect to socio-economic indicators such as life expectancy at birth, literacy rate, and women's education reveals lagging performance of India compared to both China and Bangladesh. According to the World Bank estimates, in India, life expectancy at birth was reported to be 69.4 years compared to 72 years in Bangladesh and 76.7 years in China (2019). In terms of education, adult literacy rate in India was at 74 per cent in 2019 compared to 75 per cent in Bangladesh and 96.8 per cent in China (World Development Indicators, 2019). For females (aged between 15 years and above), India's literacy rate was even lower at 66 per cent compared to 95 per cent in China and 72 per cent in Bangladesh (World Development Indicators, 2019). Thus, after achieving several milestones in the course of this long journey of 75 years since Independence, India's crucial target over the next decade or so should be to achieve the standards of its neighbours, especially China and also learn some lessons from Bangladesh in terms of these human development indicators. In this context, it is important to remember that China started its reforms with agriculture early on,

while Bangladesh by navigating a similar route has evidenced an impressive growth trajectory. India, however, till date has been avoiding large scale agricultural reforms. But to achieve the dream of becoming a manufacturing-led economy, India needs to leverage the purchasing power of its rural people, and hence work towards augmenting rural incomes.

Figure 5: Per capita income, in PPP terms (USD)



Source: International Monetary Fund, 2021

To do this, India should focus on increasing productivity by not distributing freebies but by investing in education, skills, health and physical infrastructure, besides much higher R&D. Further, given that India is a natural resource constrained country, and the constraints are likely to become more severe with the massive increases in population and the greater consumption it should start thinking towards policies in the broader context of natural resource management. One of the important measures is to break the archaic subsidy syndrome, otherwise the constraints will be magnified and become graver as the existential threats posed by climate change become more manifest (Gulati, Kapur, & Bouton, 2019).

Moving from tonnage (production) to Farmers' Income

The NDA government took over in 2014-15. It was hit by a back-to-back drought in 2014-15 and 2015-16. Yet, it could get an agri-GDP growth of 3.5 per cent from 2014-15 to 2019-20. In 2016, Narendra Modi announced his 'dream' of doubling farmers' income by 2022 at a kisan rally in Bareilly, Uttar Pradesh. Initially it was not clear whether it was a political statement, or a policy measure followed by a proposed plan of action. But the statement assumed a serious note when former Finance Minister Arun Jaitley reiterated this in the budget speeches of 2016-17 and 2017-18. A committee was set up under the chairmanship of Ashok Dalwai to formulate a strategy to double farmers' income. The committee submitted its final report containing 14 volumes to the government of India in 2018. The report set a target to double farmers' real income (DFY) in seven years i.e., by 2022-23 over the income level of 2015-16. To attain the target within the mentioned timeline, farmers' real incomes needed to grow at 10.4 per cent per annum.

This received a lot of attention from academic circles as well as the opposition. An estimate of agricultural household income is the most important indicator of the wellbeing of farmers but until very recently, the tonnage centric indicators (production, yield, value of output) were the parameters used to determine the situation of Indian agriculture. This pledge gave an opportunity to uplift the situation of farming households but it was also necessary to set an attainable goal. The main objective was to examine the level and composition of farmers' incomes and see whether it was possible to achieve such an ambitious goal. In real terms (applying consumer price index for Agricultural labour (CPI-AL) in 2020-21 prices) farmers' incomes grew at 3.5 per cent per annum in the period of 2002-03 to 2012-13. The National Statistical Office (NSO) has released its Situation Assessment Survey (SAS) of Agricultural Households for the year 2018-19. Hence, the recent release of the SAS 2018-19 offers a mid-term assessment of PM's promise.

Data Source for Analysis of Farmers' Income

The National Statistical Office (formerly known as National Sample Survey Organization), Ministry of Statistics and Programme Implementation conducts large sample surveys of agricultural households titled "Situation Assessment of Agricultural Households (SAS)" in regular intervals. The survey provides various estimates based on a wide range of information relating to the situation of agricultural households in India. Some important indicators covered in the survey being: income, productive asset, indebtedness, farming practices, awareness and access to various technological services. This survey is available at three points of time: 2002-03 (59th round), 2012-13 (70th round) and 2018-19 (77th round). In 2015-16, a similar survey was conducted by the National Bank for Agricultural and Rural development (NABARD) and is named the NABARD All India Financial Inclusion Survey (NAFIS).

There are small differences across all NSO and NABARD surveys in the definition of "farmer" as well as their coverage. In 2002-03, a farmer was defined as a person who operates some area of land and is engaged in agricultural activities in the last 365 days. To eliminate households with trivial agricultural production from the coverage of agricultural households, an income cut-off from self-employment activities was included as the basis of defining agricultural households in the following survey rounds of 2012-13 and 2018-19. In 2012-13 (2018-19), "Agricultural households are those who receive value of produce more than Rs. 3000 (Rs. 4000) from agricultural activities and have at least one member self-employed in agriculture in the last 365 days" (NSS Report No 587). This income cut-off has been updated by adjusting for inflation for identifying agricultural households in the 77th round. In NAFIS 2015-16, Agricultural households are those who receive a value of produce of more than Rs. 5000 from agricultural activities and have at least one member self-employed in agriculture in the last 365 days. As farmers' data is only available at four points of time, scholars are left with no choice but to use these surveys for analysis, disregarding these minor differences in definitions.

Trends and Composition of Farmers' Income

In 2002-03, an average Indian farmer earned Rs 2115 (Rs. 6830 in 2020-21 prices), which increased to Rs. 6426 (Rs. 9672 in 2020-21 prices) in 2012-13 and further to Rs. 10,218 (Rs. 11,572 in 2020-

21 prices) in 2018-19 [Figure 6]. Agricultural household income increased in both nominal and real prices but the rate of growth has not been satisfactory.

The growth of income in real prices portrays the accurate condition of the farmers however the choice of deflator is critical in this matter. If CPI-AL (Consumer Price Index -Agricultural Labour) is used to deflate nominal income which should ideally be the case, then the CAGR is just 3 per cent between 2012-13 and 2018-19. If we replace the CPI deflator with WPI (Wholesale Price Index for all commodities), real income growth increases to 6.1 per cent in the same period [Figure 7].

Figure 6: Average Monthly Income of Agricultural Households

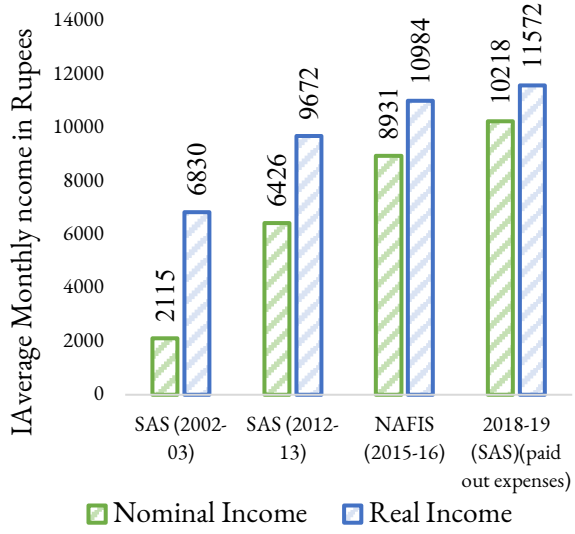
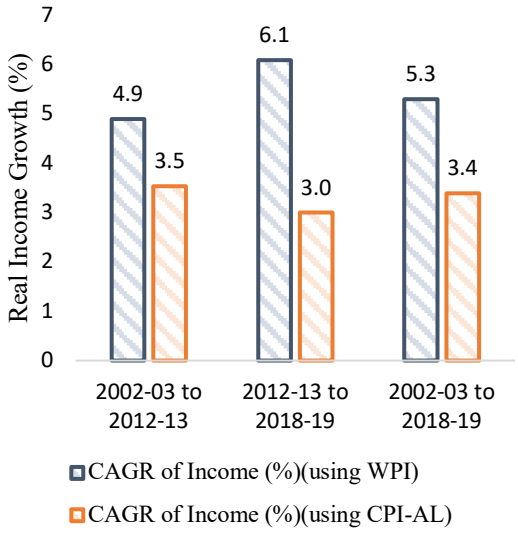


Figure 7: Real Income Growth(%)



Source: SAS various Years, MOSPI

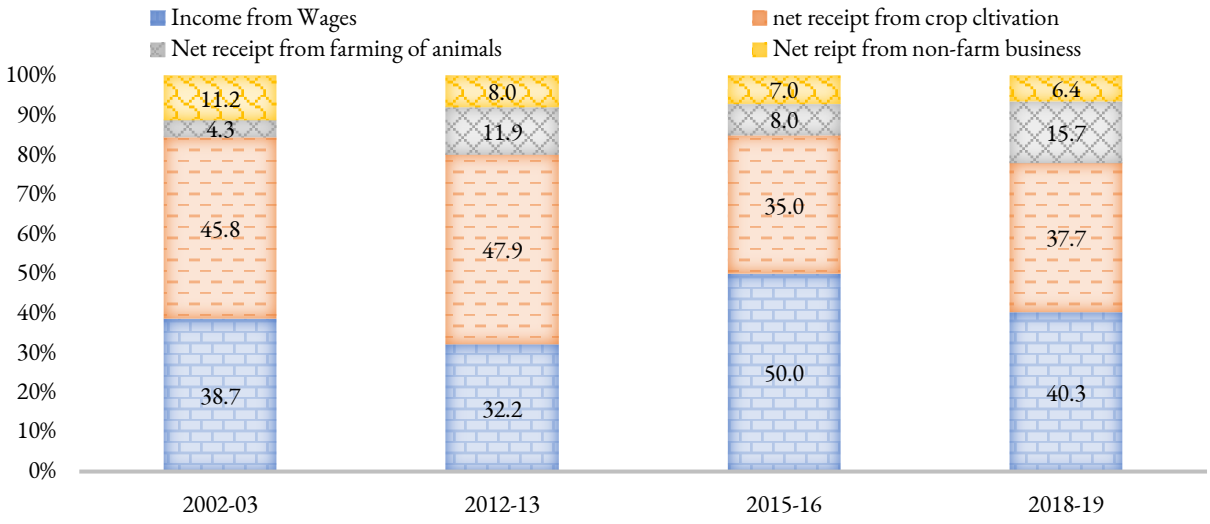
Note: Real Income in figure 1 is calculated by deflating nominal income by using CPI-AL, 2020-21=100 Real Income Growth in figure 2 is calculated using both WPI (2011-12=100) and CPI-AL (2020-21=100)

An agricultural household generates income from four major sources i) income from cultivation ii) income from farming of animals iii) wages and salaries iv) income from non-farm work. In the latest round of the surveys, data on income from "leasing out of land" was also compiled. The NABARD All India Rural Financial Inclusion Survey" (NAFIS) data classifies income into six categories: cultivation, livestock rearing, other enterprise, wage labour, govt/private services and other sources. To make it comparable with the SAS data, income from "wage labour" and "govt/private services" are clubbed together and named as "wages and Salaries".

The composition of farmers' income brings out some interesting results. The percentage of income coming from cultivation has been declining over the years. In 2002-03, out of the total income of Rs. 2115, 46 per cent of income was derived from crop cultivation, 4.3 per cent from farming of animals, 39 per cent from wages and salaries and 11.2 per cent from non-farm business [Figure 8]. Over the years, the share of wages and salaries in income increased and that of crop cultivation declined. India experienced severe drought in 2002-03 and 2015-16 with -18.6 per cent and -15.2 per cent deviation of rainfall from long period average (LPA), respectively. Crop failures in drought years forced farmers to move from cultivation to wage employment which is evident from the high share of income coming

from wage employment in both the years (39 per cent and 50 per cent respectively). Another major change in the composition of income is the growing importance of the livestock sector (that includes dairy, poultry/duckery, piggery, fishery) with share of income increasing from 4.3 per cent in 2002-03 to 15.7 per cent in 2018-19. The contribution of non-farm sector has been declining steadily over the years.

Figure 8: Composition of Income



Source: SAS and NAFIS

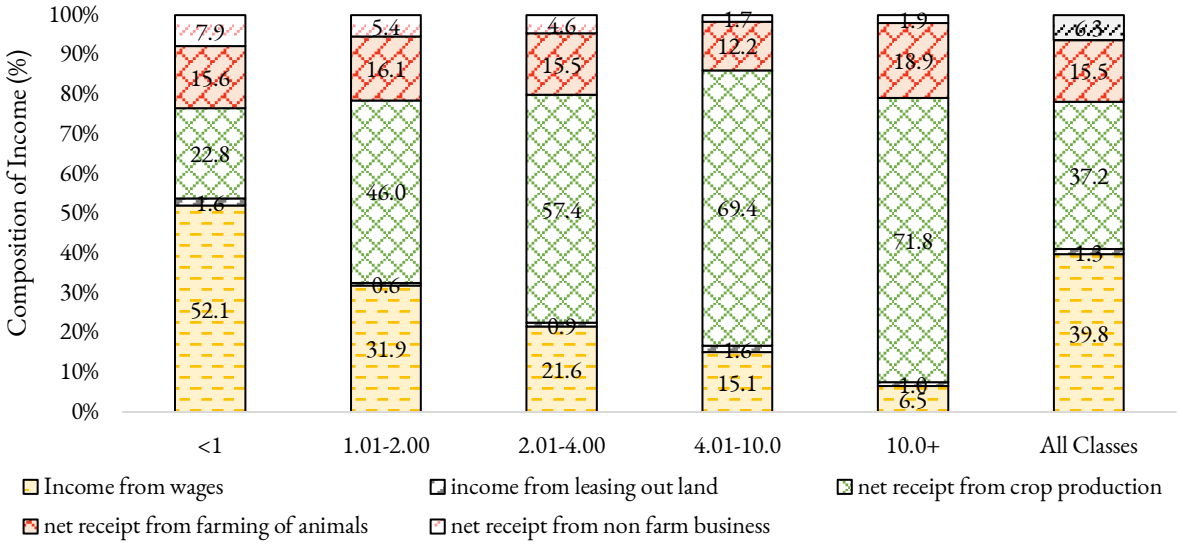
Note: For comparability across rounds "income from leasing out of land" is excluded while analysing 2018-19 data.

Composition of Income across Landholding Classes over the Survey Rounds

The average size of operational holding is shrinking in India and as per agricultural censuses it has declined from 2.28ha in 1970-71 to 1.08ha in 2015-16 (Agricultural Census) and again to 0.921ha as per SAS, 2018-19. In 2010-11, 67 per cent of marginal holdings with less than 1ha of land operated 22.5 per cent of the area. Over the years the percentage share of marginal holdings have increased and in 2018-19, 73 per cent of marginal holdings operated 32 per cent of area.

As income from small and marginal farms is not enough to maintain a healthy and respectable life, they are seen to diversify their source of income to backyard poultry, work as labourers on farms of bigger landholdings and so on. It is observed that agricultural households belonging to marginal and small landholding classes, received significant share of their incomes from "wages and salaries" and "farming of animals". With increase in landholding size, the share of income from cultivation increases [Figure 9].

Figure 9: Composition of Income by Landholding Class, 2018-19



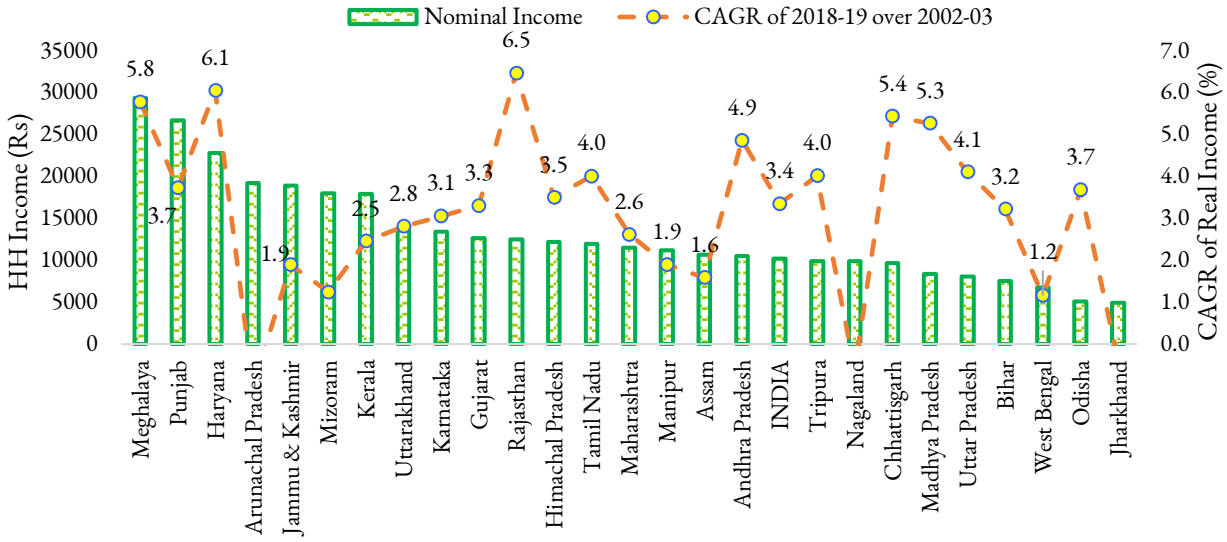
Source: SAS-2018-19, MOSPI

State-wise Analysis of Farmers' Income

Disaggregated state level analysis reveals large variations in agricultural household income across states. As per SAS 2018-19 data, highest incomes were achieved by Meghalaya (Rs.29,348) farmers followed by Punjab (Rs. 26,701), Haryana (Rs. 22,841), Arunachal Pradesh (Rs.19,225) and Jammu & Kashmir (Rs.18,918). Farmers in the eastern part of India turned out to be the poorest with Bihar (Rs. 7,542), West Bengal (Rs.6,762), Odisha (Rs.5,112) and Jharkhand (Rs.4,895) earning the lowest incomes among all the states [Figure 10]. These states not only received lowest income but also experienced low-income growth in the period of 2002-03 to 2018-19. This indicates that starting with a low base and with no satisfactory growth in income the farmers in these states are trapped in a level of destitution. Highest growth has been experienced by Rajasthan (6.5 per cent), followed by Haryana (6.1 per cent), Meghalaya (5.8 per cent) and Chhattisgarh (5,4 per cent) in the period of 2002-03 to 2018-19 [Figure 10].

This is the first time a state has surpassed Punjab's level of income. But the state level comparison on agricultural income should be on a fair scale as the holding size varies broadly across states. Once incomes are standardised s by their holding sizes given in SAS, the ranking completely changes. Punjab and Haryana go down from their current positions of second and third to eleventh and fifteenth positions respectively [Figure 11]. The states that perform better on per hectare basis are Jammu & Kashmir, Kerala, Meghalaya and Arunachal Pradesh, all of them specialising in high value agriculture like Fruits and vegetables, spices and livestock. Average landholding data is compiled by both SAS and Agriculture Census (latest 2015-16) but there is a huge disparity between the two data sources particularly for states like Punjab, Rajasthan, Haryana and Gujarat, which needs to be solved. As per SAS, average operated area per holding for Punjab is 1.44 ha, but Census gives a much higher value of 3.62 ha of average operational holding. If agri-household income is normalised using landholding data from agri-census, Punjab's position would further deteriorate to 21st position (with Rs 7376) out of 28 states.

Figure 10: Farmers' Average Nominal Income (Rs) and Real Income Growth (%)

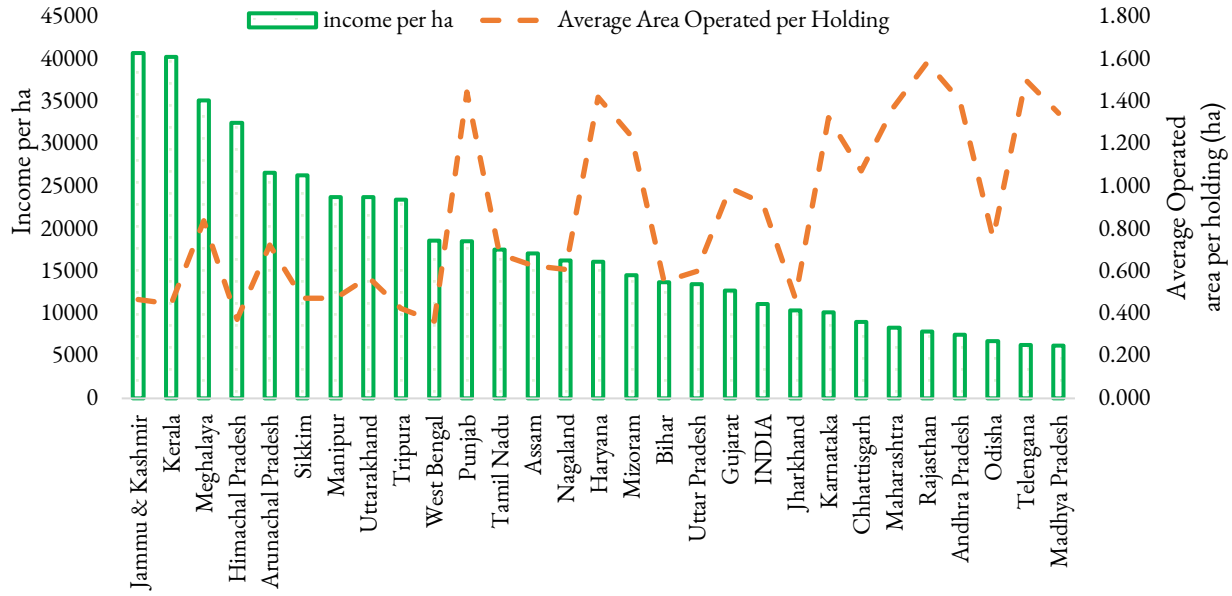


Source: SAS, 2018-19

Punjab and Haryana have historically been frontrunners in all parameters of agricultural progress since the zenith of the Green Revolution. Massive increases in production of wheat and rice helped India come out of the "ship to mouth" crisis that it fell into during the mid-sixties. High-yielding varieties of seeds, institutionalisation of the Food Corporation of India (FCI), extensive irrigation, fertiliser, and farm mechanisation in these two states played a key role in ensuring food security for the country. This policy-mix was very effective when India was going through a crisis resulting from severe food scarcity. However, this process of resource intensification has unfavourably impacted the natural resources and environment, leading to soil, water, and air degradation in the paddy belt of Punjab-Haryana resulting in a serious environmental crisis. Open-ended procurement has ensured a safety-net to the farmers of this region and is encouraging them to produce more and more rice even if it is environmentally unsustainable. India is currently the second largest producer of rice and wheat in the world and has sufficient supply of cereals for the coming years. We no longer rely on these states for food security. India should start thinking towards policies in the broader context of natural resource management. One of the necessary measures is breaking the archaic subsidy syndrome, otherwise the constraints will be magnified and become even graver as the existential threats posed by climate change become more manifest (Gulati, Kapur, & Bouton, 2019).

State wise change in the composition of income reveals a shift in income from "crop cultivation" and "non-farm business" towards income from "wages and salaries" and "farming of animals" for all the states. A significant increase in income from farming of animals has taken place for Madhya Pradesh (31.5 percentage point), Haryana (26 percentage point), Rajasthan (18.6 percentage point), Uttarakhand (14.3 percentage point) for the period of 2002-03 to 2018-19. Most of the states have a share of income from wages higher than the national level. Among them Jammu & Kashmir (65.3 per cent), Jharkhand (57.1 per cent), Kerala (57.4 per cent), Himachal Pradesh (52.9 per cent) are states where wage income is high. Temporal changes in the composition of income are presented in the appendix.

Figure 11: Income per ha of Average Operated Area per holding

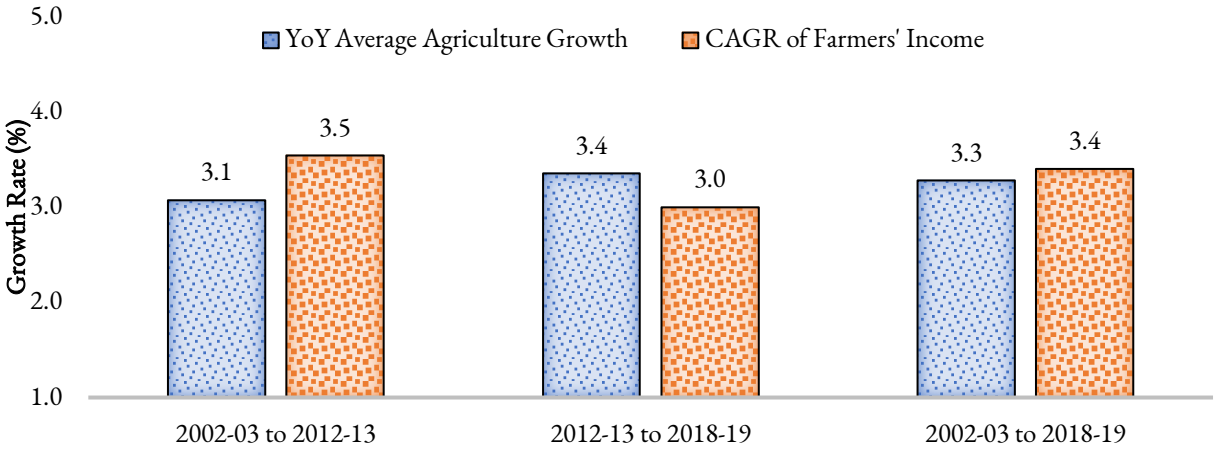


Source: SAS 2018-19, MOSPI

Agriculture GDP Growth Rate versus Farmers' Income Growth Rates

Currently, the income data is available for only four years- 2002-03, 2012-13, 2015-16 and 2018-19 and all these four years were rain-deficient years. It is likely that income estimates would be higher in normal rainfall years. And with crop failure due to inadequate rainfall, farmers are forced to move out of crop cultivation and work as wage labourers outside farming. These volatilities will be better captured if income data is available for a longer period with continuous data points. As farmers' income data is only available at four points of time, compound annual growth rate is the only option to measure income growth. In a CAGR comparison, the situation in base and terminal year influences the growth rate in great magnitude. Since temporal statistics is not available for incomes of agricultural households we need to rely on agriculture GDP values. Theoretically, agricultural GDP and farmers' household income should follow a similar trend in any economy, and this holds true for India as well [Figure 12]. But a disaggregated state level analysis shows huge gaps between agriculture GDP and farmers' income growth in many states (Kerala, Gujarat, Jharkhand, Madhya Pradesh) and these states experienced some form of natural calamities in those years. For example, Gujarat (27per cent) and Jharkhand (31per cent) experienced more than 25 per cent deficient rainfall than normal while Kerala experienced severe floods in 2018-19. If we take a closer look at the year-on-year growth rate of agricultural GDP for Gujarat, for both the years 2002-03 and 2018-19 the state attained negative growth rates (−13.5per cent and −8.7per cent)]. However, the average annual growth rate for the period of 2002-03 to 2018-19 is 6.5per cent, one of the highest in India. For state level interventions, it is important to consider both the indicators to get a fairer picture.

Figure 12: Farmers' Income and Agriculture Growth Rates (%)



Source: Central Statistical Office, MOSPI

III Policy Implications

During India's development journey over the last 75 years the country has achieved substantial progress in terms ofeconomic growth, reduction in extreme poverty among other economic indicators. But there is a long journey ahead of us. The analysis of the NSO 2018-19 data reveals that farmer incomes have grown at a much sluggish rate than expected. As suggested by Dalwai committee report, doubling of farmer income required the real incomes to grow at 10.4 per cent (between 2015-16 and 2022-23). However, between the last two SAS rounds (2012-13 to 2018-19) real income grew only at a CAGR of 3 per cent and in the remaining four years no miracle is going to take place. Major revamping is needed in the agriculture policies which are currently biased towards the crop sector. Some important policy implications follow from these results.

Firstly, the importance of the livestock sector is going to be even more prominent in the coming years. Rearing of animals, fishery, beekeeping etc will generate a substantial share of income for 89 per cent of agri-households belonging to marginal and small landholding class. It is worth mentioning that the livestock market is not protected with a safety net of minimum support price and procurement mechanism in India. Entire system is driven by demand supply interplay and sale of products takes place outside Agricultural Produce Market Committee (APMC) mandis. This trend will continue in the years to come.

Investment should be directed towards technological innovations to upgrade livestock breeding through world class reproduction management technologies. Strategies must be devised to increase milk procurement by involving more private participation in states like Uttar Pradesh, Odisha, West Bengal, Bihar, Chhattisgarh and Jharkhand where the dairy cooperative coverage is moderate or low, but profitability is higher compared to crop cultivation. Backyard Poultry generates additional income, and also improves nutrition of the poorest section. Until now there has been little support through the 'Rural Backyard Poultry Development' program for BPL families. But the level of support is very low compared to demand which needs to be upscaled. Waterlogged areas, saline water bodies should be brought under development of fisheries. Government should provide capital assistance to utilise untapped capacity in the sector. Development of horticulture must be supported

by appropriate processing, grading and packaging infrastructure. Employment possibilities should be generated in these areas outside cultivation especially for the small and marginal farmers earning subsistence income from crop production. A more intensive policy to build efficient value chains for fruits and vegetables, livestock and fisheries is needed. They are more nutritious and ensure higher profitability too than in crop cultivation, especially cereals.

Another prospective source of income is from leasing out of land. Farmers from marginal and small holding categories can earn some additional income by leasing out land, while farmers with larger pieces of land can generate an economically feasible size of the holdings by leasing in. Land lease market needs to be opened and the rights of both owner and tenant should be protected by bringing the land records in order.

Cultivation of rice in Punjab and Haryana is depleting the water table fast and impacting the environment by emission of hazardous methane and other GHGs. State governments should take serious steps to incentivise farmers for switching from paddy to corn. A corpus fund of Rs 25,000 crore (with state and centre each contributing Rs12500 crore) should be created for at least five years to fulfil this goal. Maize Corporation of Punjab (MCP) could be created to buy maize from farmers at MSP and the procured maize could be channelled towards production of ethanol. MCP should enter into medium term agreements with ethanol companies. This step will automatically promote sustainability since maize needs less than one-fifth of the water than paddy needs for irrigation. Saving in power subsidy (budgeted at Rs 8275 crore in FY 2020-21) can be directed towards MCP. It can be a win-win situation for farmers, sustainable production practices, and less pollution.

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Appendix

State wise Composition of farmers Income (%) in 2002-03, 2012-13 and 2018-19

	2002-03				2012-13				2018-19			
	Income from Wages(%)	Net receipt from crop cultivation(%)	Net receipt from farming of animals (%)	Net receipt from non-farm business (%)	Income from Wages (%)	Net receipt from crop cultivation (%)	Net receipt from farming of animals (%)	Net receipt from non-farm business (%)	Income from Wages (%)	Net receipt from crop cultivation (%)	Net receipt from farming of animals (%)	Net receipt from non-farm business (%)
INDIA	38.7	45.8	4.3	11.2	32.2	47.9	11.9	8.0	40.3	37.7	15.7	6.4
Andhra Pradesh	39.4	45.5	5.7	9.5	41.5	33.8	18.0	6.7	47.1	26.6	19.9	6.4
Assam	30.8	56.7	4.5	8.1	21.4	62.9	11.9	3.8	52.5	30.7	10.5	6.4
Bihar	27.5	46.7	14.6	11.2	37.2	48.2	7.8	6.7	33.6	36.7	23.3	6.4
Chhattisgarh	43.8	50.1	-0.2	6.2	35.7	64.7	-0.4	0.0	46.2	45.0	5.4	3.3
Gujarat	22.3	35.7	38.7	3.4	33.9	37.0	24.4	4.8	35.1	34.3	27.6	2.9
Haryana	44.0	51.8	-8.2	12.4	24.2	54.5	18.3	3.0	35.4	40.9	18.1	5.6
Himachal Pradesh	47.3	28.8	7.6	16.4	45.9	32.8	11.9	9.4	52.9	21.1	15.0	11.0
Jammu & Kashmir	37.5	44.2	7.0	11.3	57.8	24.2	6.3	11.7	65.3	10.6	12.2	11.8
Jharkhand	44.7	41.2	4.2	10.0	39.0	30.7	25.3	5.0	57.1	22.6	17.0	3.2
Karnataka	40.2	48.4	5.0	6.4	30.3	55.8	6.8	7.1	34.3	51.2	12.5	2.0
Kerala	50.3	28.0	3.8	17.9	44.2	29.7	4.8	21.3	57.4	20.5	5.9	16.2
Madhya Pradesh	39.2	69.7	-15.9	7.1	21.5	64.7	11.8	2.1	30.0	52.0	15.6	2.3
Maharashtra	32.4	51.3	5.8	10.4	29.2	52.2	7.3	11.3	37.7	41.4	13.4	7.4
Odisha	54.0	31.6	1.5	12.9	34.5	28.3	26.4	10.8	52.1	30.9	8.2	8.8
Punjab	29.5	56.9	4.8	8.9	26.5	60.1	9.2	4.2	24.9	52.4	18.5	4.2
Rajasthan	62.1	24.0	0.3	13.6	34.5	42.7	13.2	9.7	43.0	30.0	18.9	8.0
Tamil Nadu	53.3	31.8	5.3	9.6	41.6	27.5	15.8	15.2	54.8	22.3	16.9	6.0
Uttar Pradesh	34.2	51.2	3.2	11.3	23.4	58.0	11.0	7.6	36.5	41.4	17.2	4.9
Uttarakhand	16.0	58.3	10.4	15.4	22.7	53.8	18.0	5.4	27.9	39.5	24.6	8.0
West Bengal	42.7	35.4	3.7	18.2	53.4	24.6	5.7	16.3	55.8	23.2	7.0	14.0