Ministry of Agriculture &
Farmers Welfare

Report of the Committee on Doubling Farmers' Income

Volume II

**"Status of Farmers' Income:
Strategies for Accelerated Growth"**

**Inter-linkages between Input Costs,
Diversification, Capital Formation and Income**

Document prepared by the Committee on Doubling Farmers' Income,
Department of Agriculture, Cooperation and Farmers' Welfare,
Ministry of Agriculture & Farmers' Welfare.

August 2017

Foreword

The country has witnessed a series of concerted discussions dealing with the subject of agriculture. In 1926, the Royal Commission of Agriculture was set up to examine and report the status of India's agricultural and rural economy. The Commission made comprehensive recommendations, in its report submitted in 1928, for the improvement of agrarian economy as the basis for the welfare and prosperity of India's rural population. The urban population was about 11 per cent of the whole, and demand from towns was small in comparison. The Commission notes, that communication and physical connectivity were sparse and most villages functioned as self-contained units. The Commission encompassed review of agriculture in areas which are now part of Pakistan, Bangladesh and Myanmar. The net sown area in erstwhile British India was reported as 91.85 million hectares and cattle including buffaloes numbered 151 million. Almost 75 per cent of the cultivated area was under cereals and pulses, with rice and wheat occupying 46 per cent of the net sown area. The area under fruits and vegetables was about 2.5 per cent and that under oilseeds and non-food crops was about 20 per cent. In the ensuing years, as well known, the country underwent vast changes in its political, economic and social spheres.

Almost 40 years later, free India appointed the National Commission on Agriculture in 1970, to review the progress of agriculture in the country and make recommendations for its improvement and modernisation. This Commission released its final report in 1976. It refers to agriculture as a comprehensive term, which includes crop production together with land and water management, animal husbandry, fishery and forestry. Agriculture, in 1970 provided employment to nearly 70 per cent of the working population. The role of agriculture in the country's economic development and the principle of growth with social justice, were core to the discussions. The country was then facing a high population growth rate. After impressive increase in agricultural production in the first two Five Year Plans, a period of stagnancy set in and the country suffered a food crisis in the mid-1960s. The report in fifteen parts, suggested ample focus on increased application of science and technology to enhance production.

Thirty years hence, the National Commission for Farmers was constituted in 2004 to suggest methods for faster and more inclusive growth for farmers. The Commission made comprehensive recommendations covering land reforms, soil testing, augmenting water availability, agriculture productivity, credit and insurance, food security and farmers competitiveness. In its final report of October 2006, the Commission noted upon ten major goals which included a minimum net income to farmers, mainstreaming the human and gender dimension, attention to sustainable livelihoods, fostering youth participation in farming and post-harvest activities, and brought focus on livelihood security of farmers. The need for a single market in India to promote farmer-friendly home markets was also emphasised.

The now constituted DFI (Doubling Farmers' Income) Committee besides all these broad sectoral aspects, invites farmers' income into the core of its deliberations and incorporates it as the fulcrum of its strategy. Agriculture in India today is described by a net sown area of 141 million hectares, with field crops continuing to dominate, as exemplified by 55 per cent of the area under cereals. However, agriculture has been diversifying over the decades. Horticulture now accounts for 16 per cent of net sown area. The nation's livestock population counts at more than 512 million. However, economic indicators do not show equitable and egalitarian

growth in income of the farmers. The human factor behind agriculture, the farmers, remain in frequent distress, despite higher productivity and production. The demand for income growth from farming activity, has also translated into demand for government to procure and provide suitable returns. In a reorientation of the approach, this Committee suggests self-sustainable models empowered with improved market linkage as the basis for income growth of farmers.

India today is not only self-sufficient in respect of demand for food, but is also a net exporter of agri-products occupying seventh position globally. It is one of the top producers of cereals (wheat & rice), pulses, fruits, vegetables, milk, meat and marine fish. However, there remain some chinks in the production armoury, when evaluated against nutritional security that is so important from the perspective of harvesting the demographic dividend of the country. The country faces deficit of pulses & oilseeds. The availability of fruits & vegetables and milk & meat & fish has increased, thanks to production gains over the decades, but affordability to a vast majority, including large number of farmers too, remains a question mark.

The impressive agricultural growth and gains since 1947 stand as a tribute to the farmers' resilience to multiple challenges and to their grit & determination to serve and secure the nation's demand for food and raw material for its agro-industries.

It is an irony, that the very same farmer is now caught in the vortex of more serious challenges. The average income of an agricultural household during July 2012 to June 2013 was as low as Rs.6,426, as against its average monthly consumption expenditure of Rs.6,223. As many as 22.50 per cent of the farmers live below official poverty line. Large tracts of arable land have turned problem soils, becoming acidic, alkaline & saline physico-chemically. Another primary factor of production, namely, water is also under stress. Climate change is beginning to challenge the farmer's ability to adopt coping and adaptation measures that are warranted. Technology fatigue is manifesting in the form of yield plateaus. India's yield averages for most crops at global level do not compare favourably. The costs of cultivation are rising. The magnitude of food loss and food waste is alarming. The markets do not assure the farmer of remunerative returns on his produce. In short, sustainability of agricultural growth faces serious doubt, and agrarian challenge even in the midst of surpluses has emerged as a core concern.

Farmers own land. Land is a powerful asset. And, that such an asset owing class of citizens has remained poor is a paradox. They face the twin vulnerabilities of risks & uncertainties of production environment and unpredictability of market forces. Low and fluctuating incomes are a natural corollary of a farmer under such debilitating circumstances. While cultivation is boundarised by the land, market need not have such bounds.

Agriculture is the largest enterprise in the country. An enterprise can survive only if it can grow consistently. And, growth is incumbent upon savings & investment, both of which are a function of positive net returns from the enterprise. The net returns determine the level of income of an entrepreneur, farmer in this case.

This explains the rationale behind adopting income enhancement approach to farmers' welfare. It is hoped, that the answer to agrarian challenges and realization of the aim of farmers' welfare lies in higher and steady incomes. It is in this context, that the Hon'ble Prime Minister shared the vision of doubling farmers' income with the nation at his Bareilly address on 28th February, 2016. Further, recognizing the urgent need for a quick and time-bound transformation of the

vision into reality, a time frame of six years (2016-17 to 2022-23) was delineated as the period for implementation of a new strategy.

At the basic level, agriculture when defined as an enterprise comprises two segments – production and post-production. The success of production as of now amounts to half success, and is therefore not sustainable. Recent agitations of farmers (June-July 2017) in certain parts of the country demanding higher prices on their produce following record output or scenes of farmers dumping tractor loads of tomatoes & onions onto the roads or emptying canisters of milk into drains exemplify neglect of other half segment of agriculture.

No nation can afford to compromise with its farming and farmers. And much less India, wherein the absolute number of households engaged in agriculture in 2011 (119 million) outpaced those in 1951 (70 million).Then, there are the landless agricultural labour who numbered 144.30 million in 2011 as against 27.30 million in 1951. The welfare of this elephantine size of India's population is predicated upon a robust agricultural growth strategy, that is guided by an income enhancement approach.

This Committee on Doubling Farmers' Income (DFI) draws its official members from various Ministries / Departments of Government of India, representing the panoply of the complexities that impact the agricultural system. Members drawn from the civil society with interest in agriculture and concern for the farmers were appointed by the Government as non-official members. The DFI Committee has co-opted more than 100 resource persons from across the country to help it in drafting the Report. These members hail from the world of research, academics, non-government organizations, farmers' organizations, professional associations, trade, industry, commerce, consultancy bodies, policy makers at central & state levels and many more of various domain strengths. Such a vast canvas as expected has brought in a kaleidoscope of knowledge, information, wisdom, experience, analysis and unconventionality to the treatment of the subject. The Committee over the last more than a year since its constitution vide Government O.M. No. 15-3/2016-FW dated 13th April, 2016 has held countless number of internal meetings, multiple stakeholder meetings, several conferences & workshops across the country and benefitted from many such deliberations organized by others, as also field visits. The call of the Hon'ble Prime Minister to double farmers' income has generated so much of positive buzz around the subject, that no day goes without someone calling on to make a presentation and share views on income doubling strategy. The Committee has been, therefore, lucky to be fed pro-bono service and advice. To help collage, analyse and interpret such a cornucopia of inputs, the Committee has adopted three institutes, namely, NIAP, NCAER and NCCD. The Committee recognizes the services of all these individuals, institutions & organisations and places on record their service.

Following the declaration of his vision, the Hon'ble Prime Minister also shaped it by articulating 'Seven Point Agenda', and these have offered the much needed hand holding to the DFI Committee.

The Committee has adopted a basic equation of Economics to draw up its strategy, which says that net return is a function of gross return minus the cost of production. This throws up three (3) variables, namely, productivity gains, reduction in cost of cultivation and remunerative price, on which the Committee has worked its strategy. In doing so, it has drawn lessons from the past and been influenced by the challenges of the present & the future.

In consequence, the strategy platform is built by the following four (4) concerns:

- Sustainability of production
- Monetisation of farmers' produce
- Re-strengthening of extension services
- Recognizing agriculture as an enterprise and enabling it to operate as such, by addressing various structural weaknesses.

Notwithstanding the many faces of challenges, India's agriculture has demonstrated remarkable progress. It has been principally a contribution of the biological scientists, supplemented by an incentivizing policy framework. This Committee recognizes their valuable service in the cause of the farmers. It is now time, and brooks no further delay, for the new breed of researchers & policy makers with expertise in post-production technology, organization and management to take over the baton from the biological scientists, and let the pressure off them. This will free the resources, as also time for the biological scientists to focus on new science and technology, that will shift production onto a higher trajectory - one that is defined by benchmark productivities & sustainability. However, henceforth both production & marketing shall march together hand in hand, unlike in the past when their role was thought to be sequential.

This Report is structured through 14 volumes and the layout, as the readers will appreciate, is a break from the past. It prioritizes post-production interventions inclusive of agri-logistics (Vol. III) and agricultural marketing (Vol-IV), as also sustainability issues (Vol-V & VI) over production strategy (Vol. VIII).The readers will, for sure value the layout format as they study the Report with keenness and diligence. And all other volumes including the one on Extension and ICT (Vol. XI), that connect the source and sink of technology and knowledge have been positioned along a particular logic.

The Committee benefited immensely from the DFI Strategy Report of NITI Aayog. Prof. Ramesh Chand identified seven sources of growth and estimated the desired rates of growth to achieve the target by 2022-23. The DFI Committee has relied upon these recommendations in its Report.

There is so much to explain, that not even the license of prose can capture adequately, all that needs to be said about the complexity & challenges of agriculture and the nuances of an appropriate strategy for realizing the vision of doubling farmers' income by the year of India's 75th Independence Day celebrations.

The Committee remains grateful to the Government for trusting it with such an onerous responsibility. The Committee has been working as per the sound advice and counsel of the Hon'ble Minister for Agriculture and Farmers' Welfare, Shri Radha Mohan Singh and Dr. S.K. Pattanayak, IAS, Secretary of the Department of Agriculture, Cooperation and Farmers' Welfare. It also hopes, that the Report will serve the purpose for which it was constituted.

12th August, 2017   **Ashok Dalwai**
                                                                                     Chairman, Committee on
                                                                                     Doubling Farmers' Income

About Volume II

The second volume of the Report of the Committee on Doubling Farmers' Income (DFI) examines the aggregated growth rates that need to be registered at both national and state levels, besides disaggregating them sub-sectorally. The analysis is on the basis, that it is the real income of the farmers that is to be doubled and not their nominal income. The analysis is on the basis that real income of farmers is to be doubled. Since the previous volume ascertains, that on an average 60 per cent of farmers' income is from agricultural output (including livestock), the targets are designed to double this component of income and also improve the ratio between farm and non-farm income from 60:40 as of now to 70:30 by the end of target period. In doing so, various other developments in the form of allied enterprises and support infrastructure are envisaged. These developments will create new sources of income and near-farm jobs, to add to income.

The agenda to double farmers' real income arises from the distress evidenced by farmers. The level of distress is not uniform across the country, and a large variance in farmers' income is seen across regions and agricultural sectors. Therefore, the interventions and growth rates have to assign priority to the areas, where current income levels are below the national average. Farmers' income is directly related to production and the marketing of the produce. Further, the input costs attributed to cultivation, impact on post-production profits and the net income saved. The growth targets include cost of inputs and hence address the net income transfers to farmers. However, growth in farmers' income can be expected to feed demand for input material and may affect such costs. This unknown market dynamics on input costs, is not evaluated for calculating future net income. It is only, expected that adoption of liberalized policies to trigger competition and application of new technology will bring down the cost of inputs.

A uniform doubling in every region may not be possible, albeit desirable, and due consideration to degradation and depletion of arable land and other resources, the human backdrop and other associated factors is necessary. More importantly as indicated earlier, the relatively poorer regions need to 'catch up' and hence their pace of change has to be higher. All these concerns and solutions are discussed in following volumes.

The Report considers prevailing environment, including the roll out of GST, and accordingly rationales a progressive scaling in the income based growth targets. While, the target growth rates projected for the later years may seem high, the positive impact of opening up of the agricultural marketing environment, the 'one India one market' initiative and other regulatory reforms in the pipeline will make this possible. As a nation, the decision is to aim to double farmers' income, and the economic targets for this are put forth in this volume.

Ashok Dalwai

Doubling Farmers Income
Volume II
"Status of farmers' Income: Strategies for Accelerated Growth"

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Chapter 1
Background

Agriculture has been playing an important role in the overall growth of the Indian economy despite its structural shift towards the services sector during the recent decades. Although the share of agriculture in GDP has declined from 55.1 per cent in 1950-51 to 13.9 per cent in 2013-14, this sector remains a major source of employment for rural workers. India achieved self-sufficiency in food production at the macro level, but still faces massive challenges of a large number of malnourished children and the high incidence of rural poverty. The dependence of the rural workforce on agriculture for employment has not declined in proportion to the falling contribution of agriculture to GDP. This has widened income disparity between the agricultural and non-agricultural sectors[1].

1.1 Introduction

The experiences of developed countries show that the transfer of the labour force from agriculture to non-agriculture, in particular to the manufacturing sector, took place during their early stages of growth and development. This resulted in enhanced productivity, growth in agriculture, and hence higher income. However, India's manufacturing sector witnessed volatile growth and its share in GDP has almost remained stagnant at around 16 per cent for the last two decades. Further, given the fact that the pattern of current economic growth is driven by the services sector, labour absorption outside agriculture will be slow unless rural education improves and the people move out of farming. Alternately, farming needs a fillip so that it can connect to markets as avenues of growth, which will sustain that growth. For this, agriculture needs to be empowered so as to function as a market led commercial enterprise.

An analysis of the trends in annual growth rates over two decades starting 1993–94 reveals that agriculture and allied activities have registered more volatile growth than overall GDP estimated at 2011-12 constant prices (Figure 1.1). The volatility in agricultural growth can be attributed to various factors including the vagaries of rainfall, fluctuations in temperature and other natural conditions. The growth in agriculture and allied activities declined continuously during the period 1993–94 to 2002–03 and the annual average growth rate during this period was 2.9 per cent. The sector's growth rate seems to have recovered thereafter, with the sector registering an impressive annual average growth of 3.2 per cent during the period 2003–04 to 2007–08. This was also the period during which the overall GDP growth was high at 7.2 per cent per annum. The trend has been fluctuating thereafter.

Since 2008-09, the growth in agriculture plummeted due to the frequent occurrence of drought in different parts of the country. The growth of the overall economy has also been declining since 2008–09, the year when the global financial crisis occurred. The annual average growth in agricultural GDP was 3.1 per cent and that of overall GDP was 7.1 per cent during the period 2008-09 to 2014-15. For the entire period 1993-94 to 2014-15, agriculture and allied activities registered an average growth rate of 3.0 per cent, while the overall GDP was 6.4 per cent. The analysis clearly shows that though the share of agriculture in the overall GDP has declined over time, the magnitude of agricultural growth still influences the overall economic growth.

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[1] Chand and Chauhan, 1999.

Figure 1.1 Annual growth in agriculture and the allied sector and overall GDP (3-year moving average)
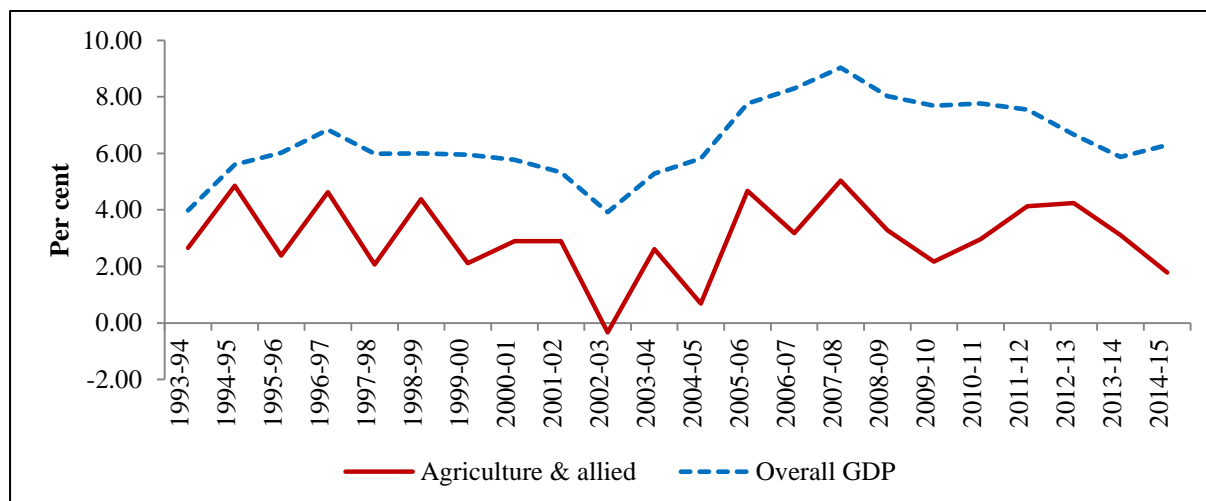
India's agricultural sector is dominated by marginal and small farm holdings. As per the Agricultural Census data, the number of marginal holdings accounted for about two-thirds of the total operational holdings in 2010-11 (Table 1.1). The proportion of marginal and small holdings taken together increased considerably from 74.5 per cent in 1980–81 to 85.0 per cent in 2010–11 with an addition of about 51 million holdings over three decades.

Table 1.1 Operational holding and total area operated in India (%)

Size Group	1980–81	1985–86	1990–91	1995–96	2000–01	2005–06	2010–11
Marginal (<1.0 ha)	56.4 (12.0)	57.8 (13.4)	59.4 (15.0)	61.6 (17.2)	62.9 (18.7)	64.8 (20.2)	67.0 (22.2)
Small (1.00-1.99 ha)	18.1 (14.1)	18.4 (15.6)	18.8 (17.4)	18.7 (18.8)	18.9 (20.2)	18.5 (20.9)	17.9 (22.1)
Semi-medium (2.0-3.99 ha)	14.0 (21.2)	13.6 (22.3)	13.1 (23.2)	12.3 (23.8)	11.7 (24.0)	10.9 (23.9)	10.0 (23.6)
Medium (4.0-9.99 ha)	9.1 (29.6)	8.1 (28.6)	7.1 (27.0)	6.1 (25.3)	5.5 (24.0)	4.9 (23.1)	4.3 (21.2)
Large (>10.0 ha)	2.4 (23.0)	2.0 (20.1)	1.6 (17.3)	1.2 (14.8)	1.0 (13.2)	0.8 (11.8)	0.7 (10.9)
All Sizes	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100 (100)	100.0 (100.0)

Note: Figures in parentheses represent the per cent operated area.

The numbers of semi-medium, medium and large holdings have witnessed secular decline over time. The decline in the share of medium size holdings was the highest followed by the decline in the semi-medium category. In terms of the operated area, large and medium farm size groups shrank by 12.1 per cent and 8.5 per cent, respectively between 1980-81 and 2010-11. The long-term trends in operational holdings and areas operated indicate that there has been a progressive increase in the number of operational holdings and fragmentation of operated area. These trends are likely to continue in the near future due to increasing pressure on land arising from a growing rural population that is dependent on agriculture, land acquisition for industrial purposes and increased demand for real estate purposes. Thus, any policy focus on agriculture should accord priority to improving the conditions of marginal and small peasants.

The initial promise of agrarian reforms was to distribute land to the landless and provide title of ownership to the cultivators. However, unfortunately India's agrarian reforms did not ensure egalitarianism in the agricultural community. The persistent policy bias against agriculture, coupled with the rise in population, has adversely affected the availability of land for cultivation. The policy bias has impacted the overall conditions of peasants in terms of declining income, low output prices, and increased dependence on markets for the purchase of inputs.

Figure 1.2 Average size of operational holdings
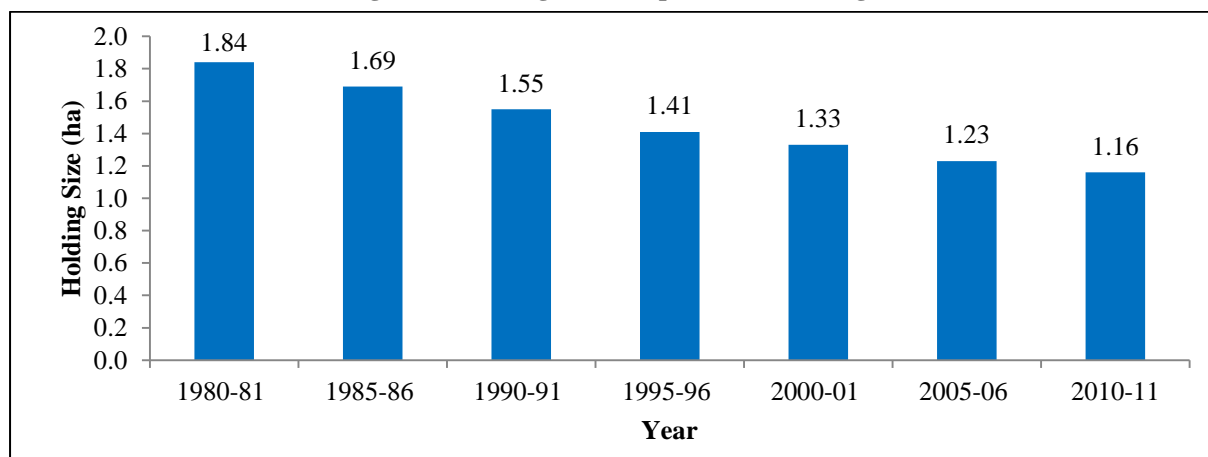
Source: Government of India (2012).

The average size of holdings affects the scale of production, adoption of technology, marketable surplus, credit and access to other support services. Figure 1.2 shows that the average size of operational holdings has declined dramatically over time. This decline can be attributed to an increase in the rural population and reduction in the size of agricultural land in some states due to its diversion for non-agricultural activities. The average size of operational holdings was 1.84 ha in 1980-81, which declined to 1.41 ha in 1995-96, and then to 1.16 ha in 2010-11.

Table 1.2 Average size of operational holdings by farm size groups (ha)

Size Groups	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2010-11
Marginal	0.39	0.39	0.39	0.40	0.40	0.38	0.38
Small	1.44	1.43	1.43	1.42	1.42	1.38	1.42
Semi-medium	2.78	2.77	2.76	2.73	2.72	2.68	2.71
Medium	6.02	5.96	5.90	5.84	5.81	5.74	5.76
Large	17.41	17.21	17.33	17.21	17.12	17.08	17.37
All Sizes	1.84	1.69	1.55	1.41	1.33	1.23	1.16

Source: DFI Committee's estimates based on Government of India (2012).

It may be observed that the average size of marginal and small holdings has been much lower than that of the holdings of other categories of farmers. These cultivators generally use family labour for agricultural operations and also work as agricultural labourers outside their farms since the sizes of the farms they own are too small to be able to generate sufficient incomes for meeting their family requirements. The medium and large cultivators have greater control over resources and generate enough agricultural surpluses. These cultivators use hired labour for

agricultural operations. Further, the degree of farm mechanisation is also found to be high among these farm groups. When compared to other farm size classes, the average size of the operational holdings of large cultivators was high at 17.37 ha in 2010-11.

Table 1.3 Agricultural workers in India

Particulars	1991		2001		2011	
	Absolute (Million Numbers)	Share in Total Agricultural Workers (%)	Absolute (Million Numbers)	Share in Total Agricultural Workers (%)	Absolute (Million Numbers)	Share in Total Agricultural Workers (%)
Cultivators (Main)	--	--	103.6	44.3	95.9	36.5
Cultivators (Marginal)	--	--	23.7	10.1	22.9	8.7
1. Total Cultivators	110.7	59.7	127.3	54.4	118.8	45.1
Agricultural Labourers (Main)	--	--	63.5	27.1	86.2	32.7
Agricultural Labourers (Marginal)	--	--	43.3	18.5	58.2	22.1
2. Total Agricultural Labourers	74.6	40.3	106.8	45.6	144.3	54.9
Total Agricultural Workers (1 +2)	185.3	100.0	234.1	100.0	263.1	100.0
Decadal Annual Growth Rate (%)	2.3		2.4		1.2	

Source: DFI Committee's estimates based on Census data.

Table 1.3 details changes in the number of agricultural workers, that is, cultivators and labourers, over a period of two decades, viz., 1991–2011. As the table shows, the share of agricultural labourers in the total agricultural workers increased from 40.3 per cent in 1991 to 54.9 per cent in 2011.

Figure 1.3 Relationship between poverty and agricultural income
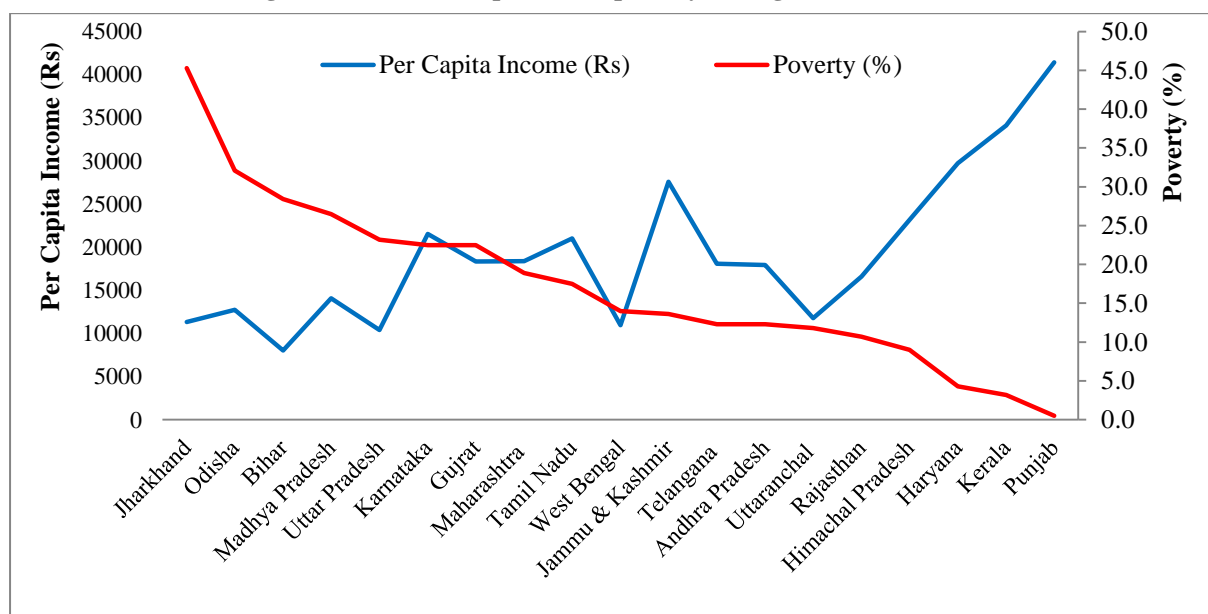
Sources: Estimated by DFI committee from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households); Chand (2017)

The Committee finds an inverse relationship between agricultural income and rural poverty: the states with lower incidence of poverty also register higher agricultural income (Figure 1.3). Thus, it is important to augment agricultural incomes to reduce rural poverty. The DFI Committee has observed that Indian agriculture is passing through difficult times, as has been pointed out by various writers on the subject.[2] Although the government has introduced a number of developmental programmes and rehabilitation packages in the distress-affected areas, the effectiveness of such programmes is yet to be observed in the field.

Under these circumstances, the aim of achieving higher growth in agriculture assumes great importance. This has been a matter of concern for policy planners and research scholars in recent times.[3] A sustained agricultural growth, which is facilitated through a strong and consistent policy and institutional support, has the potential to augment growth in the rural economy and associated secondary activities like formal supply chains, food processing and retail trading. However, agriculture-led rural industrialisation has not received due attention from policymakers in the country, notwithstanding the fact that the emphasis on the growth of agriculture per se was obliterated during the 1990s. In fact, the growth performance of agriculture at the national level was impressive during the 1980s and its deceleration during the 1990s was attributed to the reduction in and/or stagnation of public expenditure on agricultural infrastructure, defunct extension services, and biased economic reforms.[4]

There has been a renewed policy thrust from the government to revive agricultural growth since the mid-2000s. The government has initiated various development programmes such as interest subvention on crop loans, National Food Security Mission, Rashtriya Krishi Vikas Yojana, Pulses Development Programme, Soil Health Card Scheme, Pradhan Mantri Krishi Sinchai Yojana, National Agricultural Market for Electronic Trading, National Livestock Mission, and Pradhan Mantri Fasal Bima Yojana for improving the performance of the sector. These projects are aimed at augmenting agricultural growth and farmers' incomes across the country by providing greater flexibility to state governments in allocating resources for prioritising agricultural development.

Although a revival was reported in agricultural growth, the improvement in the yield of major crops was not as remarkable as that observed in the 1980s. Various studies have also shown that diversification and the output price have emerged as important drivers of output growth in recent years.[5] However, unless parallel efforts are made to ensure income security for farmers, these drivers of growth may not be sufficient to sustain the interest of farmers in cultivation.

Many developed and developing economies have progressively shifted from a price-based support policy to an income support policy, which is considered more equitable and perhaps easier to implement than the price-based policy due to the large sizes of landholdings. In the context of India, the income support policy will certainly benefit the marginalised sections of

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[2] Vasavi, 2012, p. 27; Bhende and Thippaiah, 2010.
[3] Chand, et al., 2007; Bhalla and Singh, 2009; Vaidyanathan, 2010; Sen, 2016.
[4] Thamarajakshi, 1999; Mahendra Dev, 2000; Vyas, 2001; Rao, 2003.
[5] Birthal, et al., 2014; Chand, et al., 2015.

the farming community, as also the underdeveloped regions and crops. The announcement by the Government of India to double the farmers' income in seven years (from 2015-16 to 2022-23) reflects its serious concern about the welfare of farmers.

This is a sharp departure from the past wherein the focus had all along been on increasing the production (output). The focus has now shifted to the income approach. This realisation has come from the fact that the production approach does not accord importance to value realisation from post-production activities. In the existing set-up, farmers produce some crops abundantly in some years, which have a minimal real growth in demand in the market. Consequently, the farmer may not earn a positive return from the cultivation leading to farmers' distress.

On the other hand, the income approach would take into account the following additional pillars of production that farmers face: (a) quantum of the output; (b) price of the output; (c) quantum of input use; and (d) price of the input. Thus, increasing the net income of farmers necessitates efficient monetisation of production, without which there would be no benefit for the farmers. This would be possible by first ensuring food security and thereafter promoting the production of that particular segment of activity which has a demand in the market. In this context, there is need for creating an enabling environment for post-production activities such as harvesting, preparing harvest for market, transportation, storage, pledge loan processing and marketing.

New ways of thinking are emerging for ensuring better monetisation of farmers' produce. The government is seriously reviewing the post-production policy regime along with facilitating better understanding of what the markets demand. This points to the need for promoting "fork-to-farm" demand and price signals, rather than a "farm-to-fork" push.

While this is a step in the right direction, it is also fraught with various challenges and constraints, including the preponderance of small and marginal holdings, the absence of a major breakthrough in technology, inadequate investment in rural infrastructure and capital formation, an inefficient system of marketing of the agriculture produce, huge post-harvest losses, and lacunae in the transfer of technology to farmers. Further, the occurrence of droughts in recent years has exposed the lack of adequate capacity in the system for effectively drought-proofing Indian agriculture through the application of drought-resistant crop varieties and the sustainable management of surface and ground water resources. Although it is imperative to create an income support system, that alone may not work as a long-term solution for tackling farmer distress, particularly in the backdrop of the depletion of natural resources and the uncertainty caused by climate change, as also the dependence of a huge labour force on the farm economy for sustenance.

The DFI Committee has observed that an increase in the Minimum Support Price (MSP) could be one of the instruments for enhancing farmers' income. However, increasing the MSP may not always have a positive outcome from the macroeconomic point of view. For example, it raises the procurement cost of agricultural commodities (especially cereals), leading to a trade-

off between inflation and growth, thus camouflaging the effect of total factor productivity (TFP) vis-à-vis physical productivity growth caused by technical change.[6]

A more straightforward, and potentially more beneficial, means of raising farm incomes could be reforming the marketing system of agricultural produce, while also developing new institutions and reviving existing ones to facilitate linking of the farmer to the markets (LFTM). It is well known that small-holders face various constraints in accessing markets. Literature suggests that the potential benefits are not pervasive; they are product- and content-specific, implying that one type of model is not suitable for all small-holders.

While some of the Farmer Producer Organisations (FPOs) have been successful in covering the commodity chain (including collection, grading, post-harvest operations and storage), they also face problems pertaining to contracts and access to infrastructure and market information. Hence, nurturing an enabling institutional environment is important for ensuring the success of FPOs, which, in turn, would benefit the small-holders.[7]

Needless to emphasise, in order to achieve the ambitious goal of doubling farmers' income, there is need to examine some of the innovative models that seek not only investment but also cooperation and coordination from multi-stakeholders in a PPP mode. In this context, the initiative of Partnership for Indonesia's Sustainable Agriculture (PISAgro) is worth mentioning. This initiative aims to increase farm yields by 20 per cent, reduce poverty by 20 per cent, and also reduce greenhouse emissions by 20 per cent by 2020[8].

Indian agriculture is still not well linked with the rest of the economy through improved infrastructure and integrated markets. While within Asia, countries such as Indonesia, Malaysia and Thailand have been highly successful in integrating agriculture with the rest of the economy, the South Asian countries have lagged far behind in this respect. Since the rising share of high-value crops facilitates greater diversification of agriculture and the promotion of agribusinesses, the role of suppliers of inputs like farm equipment, seeds, fertilisers, and pesticides, as also of logistics firms and other market providers, acquires added importance.

It is precisely for these reasons that huge investments are required in agriculture and the issue of "co-ordination failure between the private and public sectors" needs to be addressed. This necessitates extending the rationale of industrial policy to farms and agribusinesses. In this context, several lessons can be learnt from the experience of Asian economies like Indonesia and Thailand, wherein the share of agribusiness in the GDP has touched the impressive figures of 33 per cent and 43 per cent, respectively.[9]

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[6] During the period 2004-05 to 2011-12, the growth of value added in agriculture was impressive (at 3.8 per cent per annum). About one-third of this growth came from an increase in real agricultural prices (Chand and Saxena, 2014).
[7] National Academy of Agricultural Sciences, 2015.
[8] PIS Agro Factsheet, 2015.
[9] World Bank, 2009a; ADB, 2013.

The growing importance of agribusiness has also led to a structural transformation in agriculture. However, the interests of small-holders must be safeguarded by (i) reducing their risk and vulnerability through social safety nets, as also "innovative insurance products, protection against catastrophic loss, and reduced risk of major livestock disease outbreaks"[10], (ii) ensuring that their participation in supply chains and supermarkets is profitable by providing public goods, including appropriate infrastructure, and ensuring food safety standards and conducive conditions for the enforcement of contracts, among other things, (iii) arranging for the transfer of technology to them, through the PPP mode, and (iv) providing security of tenure and land rights to create incentives for investment. These measures would also offer landless labourers more opportunities to cultivate and even own land.[11]

Some authors have pointed out that the focus on cultivation may not be adequate to achieve the goal of doubling the farmers' income. It is also important to increase non-farm incomes and examine what constrains the growth of the latter.[12] Recent evidence shows that the stagnation in public expenditure after 2012-13 may have led to a reduction in the non-farm incomes (especially wages for construction activity) of rural workers. It may be noted that not all farmers/cultivator households of different farm size groups in different regions gain equally from the growth of non-farm incomes. A longer term analysis is thus required to understand the nature of growth of the non-farm incomes of rural/farm households of different farm size groups.

This volume, therefore, seeks to understand the current level of farmers' income for different categories of farmers in order to identify the strategies required for doubling farmer's income. However, it is first important to clearly define the terms 'farmers' and 'farmers' income'. These issues are discussed in the next section.

1.2 Definitional Issues: Sources of Data and Farmers' Income

The term 'farmer' in this study corresponds to an agricultural household as defined in the Situation Assessment Survey of Agricultural Households, NSSO 70th Round. [13] This is the major source of estimating the income of agricultural households.

The reason for this is that unlike other countries, India's Central Statistical Organisation (CSO) does not undertake periodic income surveys for its households. An 'agricultural household' has been defined as a household receiving some value of produce from agricultural activities (for example, cultivation of field crops, horticultural crops, fodder crops, plantation, animal husbandry, poultry, fishery, piggery, bee-keeping, vermiculture, and sericulture, among others) during the last 365 days.[14]. In contrast to the definition of 'farmer' used in the NSSO 59th

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[10] World Bank, 2009b; Sen (2016).
[11] The National Institution for Transforming India (NITI) Aayog (2015) also highlights the need for liberalizing the land lease market.
[12] Chandrasekhar and Mehrotra, 2016; Sen, 2016
[13] This was a repeat survey of the NSSO, 59th Round, with marginal differences regarding the selection of respondents, as described later.
[14] A group of persons normally living together and taking food from a common kitchen constituted a household.

Round, the necessary condition of 'land possession' was dispensed with in the 70th Round.[15]

In this connection, it is also important to note that apart from agricultural labourers, households receiving income entirely from coastal fishing, activities of rural artisans and agricultural services were not considered as agricultural households and were thus kept out of the scope of the survey. Further, to eliminate households pursuing agricultural activities of an insignificant nature, households with at least one member self-employed in agriculture in either the principal status or subsidiary status, and having a total produce value of more than Rs. 3000 during the last 365 days, were considered for selection in this survey. In this round, a total of 35,200 households were surveyed across 4,529 villages during the period January to December 2013.

While NSSO's 70th Round would be the principal source of data for understanding the income dimension of the farmer household, the DFI Committee would supplement the analysis by using data from another large-scale household survey, which was conducted by NCAER around the same time, that is, the India Human Development Survey (IHDS), 2011-12[16]. While the NSSO, 70th Round is entirely for agricultural households (not all rural households), the IHDS-II sample covers rural households, which may or may not receive some value of produce from agricultural activities.

Although the agricultural activities covered in the two surveys correspond to each other, it is essential to consider only rural households from the IHDS whose value of agricultural produce is more than Rs. 3000 to ensure that the sampling units in the two surveys match with each other. It should be noted that the sample size in both these large surveys (NSSO, 70th Round and IHDS-II) for Union Territories and small states are rather small. Consequently, the estimates of income per household for Union Territories and small states should be read with caution.

The NSSO 70th Round provides information for agricultural households on the value of output and expenses by the following activities: (a) cultivation, (b) livestock, and (c) non-farm business. It also provides information on wages and salary earnings (received or receivable) for the work done. This includes the wage and salary component originating from agriculture and the allied sector, and outside the agricultural sector. The non-farm business sector income includes income being generated in the off-farm farm-linked enterprises and also that generated in off-farm enterprises not linked with the farm sector.

The income from the first three activities has been obtained by estimating net receipts (values of produce minus expenses) for each of these activities. The total income for agricultural households has thus been obtained by aggregating the income received from these activities

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[15] In this respect, the definition for 'agricultural household' in the NSSO 70th Round is similar to the definition of farmer given by the *National Commission of Farmers* under the chairmanship of Dr M.S. Swaminathan.
[16] The India Human Development Survey (IHDS), jointly organised by researchers from the National Council of Applied Economic Research and the University of Maryland, is a nationally representative, multi-topic survey of 41,554 households in 1503 villages and 971 urban neighbourhoods across India. The first round of interviews was completed in 2004-05; data are publicly available through ICPSR. A second round of IHDS re-interviewed most of these households in 2011-12 - Desai, Vanneman and NCAER 2011-12

and income received from wages and salaries. It should be noted that the NSSO data on expenses includes only paid-out expenses. Thus, family labour contributing towards agricultural activity is not taken into account in estimating income from NSSO data. Methodologically, this should not be an issue since unpaid labour is also not included in estimating India's GVA/GNP.

By and large, the DFI Committee has followed the same approach (net receipts = value of produce – value of expenses) in estimating income from IHDS data. However, the IHDS data of agricultural households classifies agricultural activities under more detailed heads, namely: (a) cultivation, (b) livestock, (c) fisheries, (d) forestry, (e) agricultural wages, (f) non-agricultural wages and salaries, (g) non-farm business, (h) remittances, and (i) other income.

This report has been organised in seven chapters. After this introductory chapter, the second chapter discusses the status of farmers' income and its benchmarking. The third chapter analyses public and private capital formation in agriculture. The status of crop diversification, post-harvest management and processing has been presented in the fourth chapter. The fifth chapter examines the changes in input cost and crop income at the state level. The sixth chapter outlines the all-India and state level target agricultural growth rates for doubling of farmers' income. The final chapter delineates policy recommendations.

Key Extracts

- The dependence of the rural workforce on agriculture for employment has not declined in proportion to the falling contribution of agriculture to GDP.

- The agriculture and allied sector has registered more volatile growth, attributed to various factors including the vagaries climatic conditions.

- The relationship between poverty and agricultural income has been established over time: states which have lower poverty also register higher agricultural income.

- Government of India has focused on doubling the farmers' income in seven years (from 2015-16 to 2022-23), marking a significant departure from past policies when the emphasis had been only on production rather than its marketability.

- The income approach would take into account the following additional pillars of production: (a) the quantum of output; (b) price of the output; (c) quantum of input; and (d) price of the input. Thus, increasing the net income of farmers necessitates efficient monetisation of production, without which there is no benefit for farmers.

- The post-production understanding of what the markets demand, points to the need for promoting "fork-to-farm" signals rather than a "farm-to-fork" discussion.

Chapter 2
Current Status of Farmers' Income

This chapter analyses farmers' income using the two primary sources of data mentioned in Chapter 1. As mentioned earlier, the term 'farmers' here corresponds to agricultural households that fulfil all the criteria of the responding units in the NSSO 70th Round data. In other words, the agricultural households should have at least one member who is self-employed in agriculture either in the principal or in the subsidiary status, with a total produce value of more than Rs. 3000 during the last 365 days.

2.1   Structure of Income

All-India perspective

Table 2.1 provides estimates of the average income of agricultural households by broad components for the year 2012–13. The income is estimated by using two large-scale primary data sources, namely the NSSO 70th Round, and the India Human Development Survey (IHDS), 2011–12. As seen in the table, the average annual income of agricultural households from all components of income (cultivation, livestock, non-farm business, and wages and salaries) was Rs. 77,976 in 2012–13 as per the NSSO 70th Round data. On the other hand, the average income is estimated at Rs. 97,799 for the same year if one uses unit level data of IHDS, 2011–12, after taking due care to include only respondents who satisfy NSSO's definition of a farmer household. The difference between the two turns out to be nearly Rs. 20,000. As Table 2.1 shows, the income from cultivation according to the two sources is nearly the same, while there is a difference of Rs. 3,000 in the case of non-farm business (which is shown as being higher in case of IHDS) and Rs. 4,000 in the case of livestock (higher in the case of NSSO).

However, there is a significant difference in the case of wages and salaries, which is Rs. 24,801 as per the NSSO's estimate as opposed to Rs. 45,783 according to the IHDS data. These differences could be attributed to the differences in the sampling frames adopted by the two surveys or due to non-sampling errors. Since the objective of the study is to ensure doubling of incomes of agricultural households, the DFI committee would consider estimates of income obtained from the NSSO unit level data as the base level income. The IHDS data would be used only to complement the analysis based on NSSO data where the latter fails to provide information on certain aspects like the farmers' characteristics or their income generation.

Table 2.1 Overall average annual estimated income: at 2012-13

Survey	Average Annual Income from				Average Total Income (Current Price)	Average Total Income (2011–12 Price)
	Cultivation	**Livestock**	**Non-farm Business**	**Wages and Salaries**		
NSSO 70th Round	36,950 (47)	10,016 (13)	6,209 (8)	24,801 (32)	77,976	70,118
IHDS	36,954 (38)	6,018 (6)	9,044 (9)	45,783 (47)	97,799	87,943

Source: DFI Committee's estimates from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households) and India Human Development Survey, (IHDS), 2011–12 (http://doi.org/10.3886/ICPSR36151.v2).

Note: *Figures in parentheses indicate the share of the total income as estimated by the author.

The relative contributions of different components of the overall income are intrinsically related to the types of the farmers. The NSSO data can be used to classify farmers (agricultural households) into marginal, small, medium, semi-medium and large farmers according to the sizes of the landholdings owned by them.[17]

For the analysis, farmers (agricultural households) have been aggregated into three broad categories, viz., marginal and small farmers (owning land size of less than 2 hectares), medium and semi-medium farmers (owning land size in the range of 2 to 10 hectares) and large farmers (owning land size of more than 10 hectares). The relevant data is shown in Figure 2.1.

As this figure indicates, the share of income from cultivation increases with the size of the landholdings. At the lower end of the spectrum of land size, wages and salaries constitute the principal source of income. It may be noted that the shares of income from wages and salaries, non-farm business and livestock decline as land sizes increase.

The message emerging from this analysis is, therefore, that differential strategies need to be adopted depending on the size distribution of agricultural households.

Figure 2.1 Land size-wise sources of income in 2012-13 (%)

	Marginal + Small	Medium+Semi-medium	Large
Wages & Salaries	39.5	13.0	3.2
Non-farm Business	9.2	4.8	4.4
Livestock	14.8	11.5	6.9
Cultivation	36.5	70.8	85.5
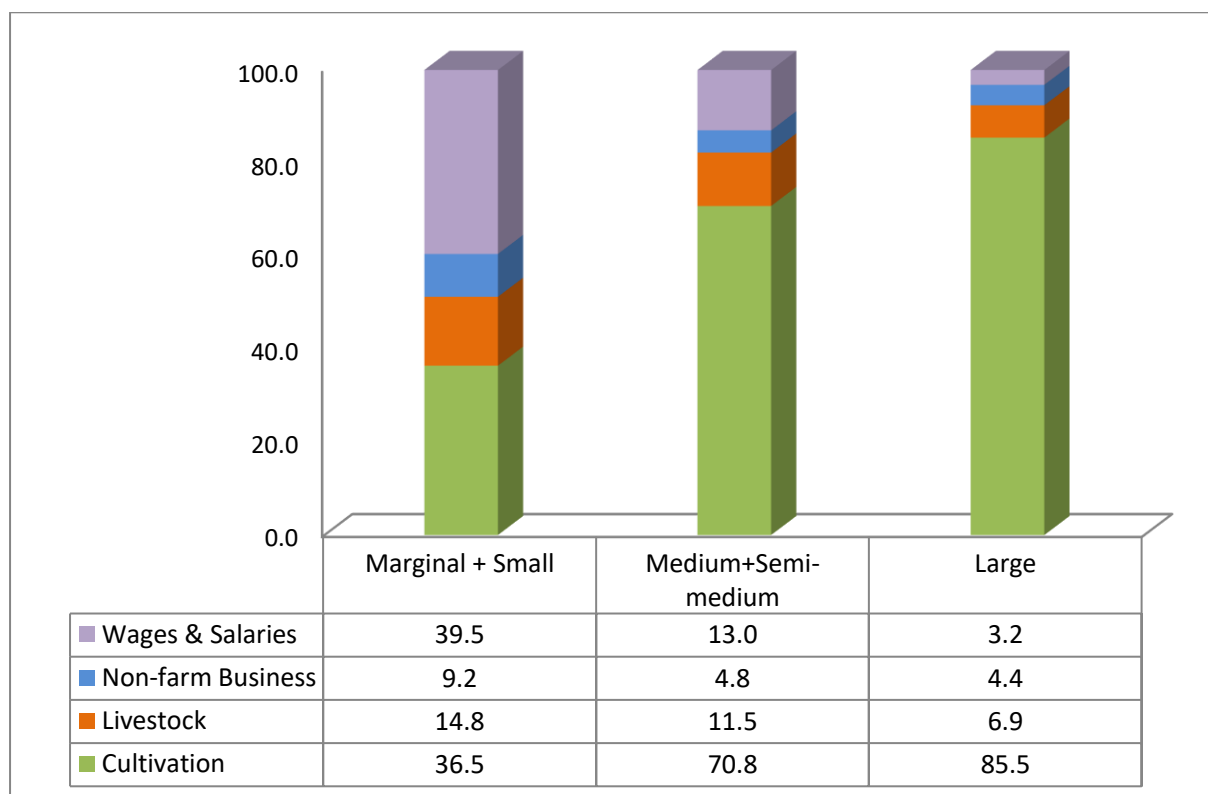
Source: Estimated by the DFI Committee based on the NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households).

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[17] The sizes of land owned by marginal, small, medium, semi-medium and large farmers are, less than 1 hectare, 1-2 hectares, 2-4 hectares, 4-10 hectares, and more than 10 hectares, respectively.

2.2 Regional perspective

Detailed information on the incomes of agricultural households across states is given in Annexure (Annex Table 2.1 to Annex Table 2.7). In this section, the aggregate results are reported across eight broad geographical regions of India. The classification of states by region is in Box 2.1.

Box 2.1: Zone-wise Classification of States/Union Territories

Northern Zone: Haryana, Punjab, Uttar Pradesh

North-Eastern Zone: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura

Eastern Zone: Bihar, Jharkhand, Odisha, West Bengal (WB)

Central Zone: Madhya Pradesh (MP), Chhattisgarh

Western Zone: Goa, Gujarat, Maharashtra, Rajasthan

Southern Zone: Andhra Pradesh (AP), Karnataka, Kerala, Tamil Nadu (TN), Telangana

Northern Hill Zone: Jammu & Kashmir (J&K), Himachal Pradesh (HP), Uttarakhand (UK)

Union Territories (UTs): Andaman & Nicobar Islands, Chandigarh, Daman & Diu, Dadra & Nagar Haveli, Delhi*, Lakshadweep, Puducherry

*Delhi is clubbed with UTs as it is not a full-fledged state

There is a wide variation in the average agricultural household income across regions. It ranges from Rs. 1,35,780 in Union Territories to Rs. 50,512 in the Eastern zone (Table 2.2). At the state level, the highest income of Rs. 2,17,450, accruing to agricultural households is registered in Punjab.

The sources of income differ across regions (Table 2.2). The share of cultivation in income ranges between 33 and 64 per cent, barring in the Union Territories for which the average share is about 14 per cent.

By and large, non-farm business is the predominant source of income next to cultivation in many zones. For instance, it is about 48 per cent in the Northern Hill zone, 41 per cent in the Eastern zone, 32 per cent in the Western zone, and 35 per cent in the Southern zone. The share of non-farm business, at 68 per cent, is very high in the Union Territories.

The share of livestock income is the highest at 16 per cent in the Eastern zone. Overall, it varies between 9 and 16 per cent, with an average of about 11 per cent.

Wages and salaries play a minimal role as a source of income in all the regions. By and large, their contribution to the average annual income is in the range of 4–10 per cent, with an exception in the Central zone, where it is below 2 per cent.

Table 2.2 Average annual income of agricultural households from all four income components (Rs)

Zone	State	Cultivation	Livestock	Non-farm Business	Wages and Salaries	Total
Northern Zone	Average	45,132	9961	18,790	4941	78,823
	Share	57%	13%	24%	6%	100%
	Highest	Punjab: 1,30,163	Haryana: 32,683	Punjab: 8800	Punjab: 57,330	Punjab: 2,17,450
North-Eastern Zone	Average	50,661	9694	24,372	3878	88,682
	Share	57%	11%	27%	4%	100%
	Highest	Arunachal Pradesh: 77,814	Manipur: 18,470	Sikkim: 11,986	Nagaland: 64,718	Meghalaya: 1,43,315
Eastern Zone	Average	16,636	7947	20,649	5279	50,512
	Share	33%	16%	41%	10%	100%
	Highest	Bihar: 20,633	Jharkhand: 16,919	WB: 8008	WB: 25,484	Odisha: 59,440
Central Zone	Average	45,701	6708	17,800	1103	71,313
	Share	64%	9%	25%	2%	100%
	Highest	MP: 48,039	MP: 9174	MP: 1569	Chhattisgarh: 22,177	MP: 74,712
Western Zone	Average	40,584	13,608	28,779	8240	91,211
	Share	44%	15%	32%	9%	100%
	Highest	Maharashtra: 46,385	Gujarat: 24,179	Goa: 12,243	Goa: 46,865	Gujarat: 95,957
Southern Zone	Average	39,984	10,377	32,543	9591	92,494
	Share	43%	11%	35%	10%	100%
	Highest	Karnataka: 59,047	TN: 13,623	Kerala: 31,303	Kerala: 63,211	Kerala: 1,45,299
Northern Hill Zone	Average	33,995	11,385	50,759	10,471	1,06,609
	Share	32%	11%	48%	10%	100%
	Highest	J&K: 36,635	HP: 12,905	J&K: 18,081	J&K: 88,220	J&K: 1,54,064
Union Territories	Average	19,015	11,929	92,358	12478	1,35,780
	Share	14%	9%	68%	9%	100%
	Highest	Chandigarh: 40,387	Chandigarh: 57,604	Andaman & Nicobar Islands: 26,476	Lakshadweep: 1,99,921	Chandigarh: 2,59,942
All India		**36,950**	**10,016**	**6209**	**24,801**	**77,976**

Source: Estimated by DFI Committee from NSSO 70th Round unit level data (Situation assessment survey of agricultural households).

The contribution of different components of income by zone is also shown in Figure 2.2. As this figure indicates, the share of non-farm business in income is highest in the Union Territories. It may also be noted that the share of non-farm business in the cultivation-rich Northern zone is lower than in the other zones. This could point to a scope for agro-processing in the region, for the suitable crop types, to achieve higher value addition.

Figure 2.2 Zone-wise sources of income in 2012–13 (%)
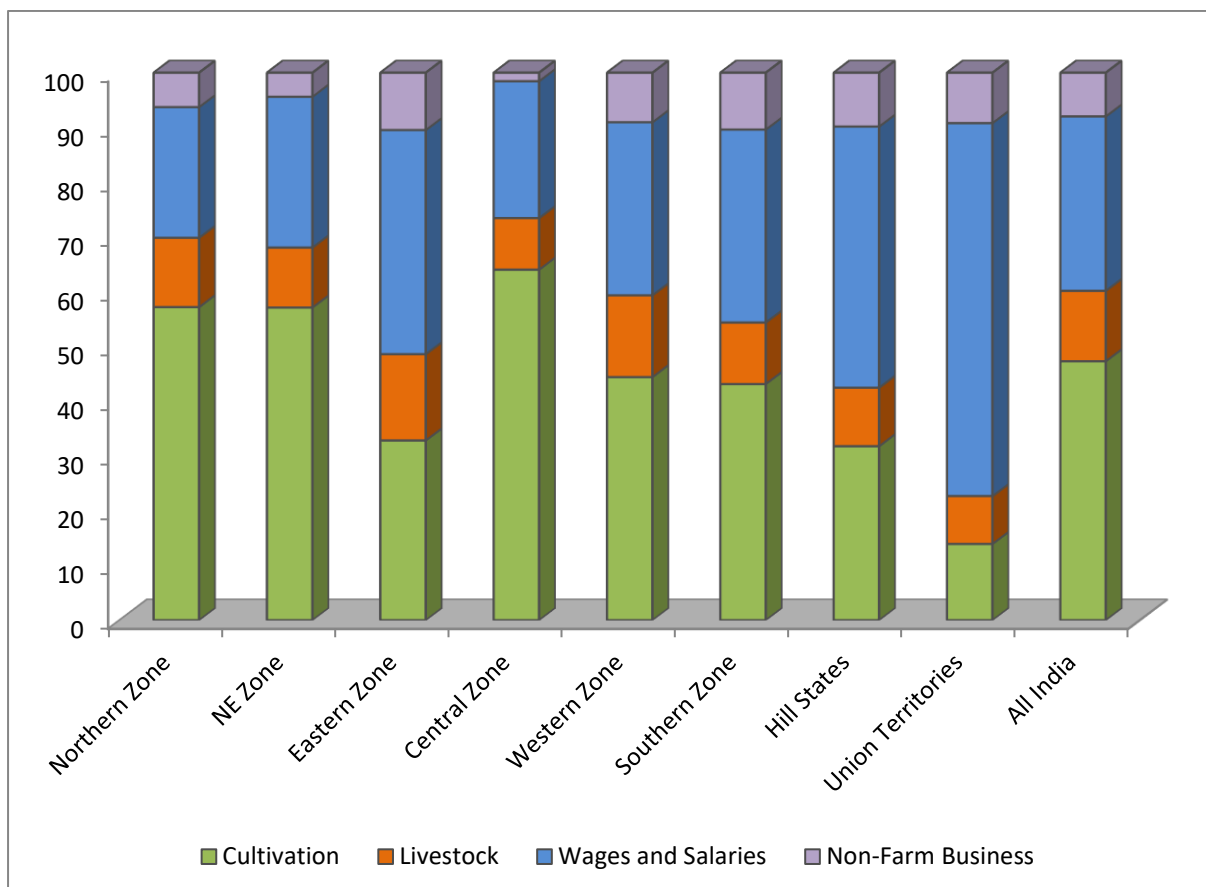
The NSSO data has also been used to identify the sources of income by land size and states. The relevant figures for small and marginal farmers, medium and semi-medium farmers, and large farmers by states are shown in Figures 2.3, 2.4 and 2.5, respectively.

To recapitulate, small and marginal famers have land sizes of less than 2 hectares, medium/semi-medium farmers have land sizes ranging between 2 and 10 hectares, and large farmers have land sizes of more than 10 hectares.

The state-wise figures on sources of income by land sizes reinforce the earlier findings depicted in Figure 2.1, reiterating the fact that as land size increases, dependence on cultivation as a major source of income also increases.

As seen in Figure 2.3, non-farm business is a major source of income in all the states. However, cultivation emerges as the principal source of income for semi-medium farmers. This trend is reinforced in the case of large farmers.[18] It may also be noted that there is negative income or losses from some activities in some states for medium/semi-medium and large farmers.

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[18] However, in some states, the category of large farmers has been eliminated after land reforms/land fragmentation, as seen in Figure 2.5.

Figure 2.3 Sources of income for small and marginal farmers in 2012–13 (%)
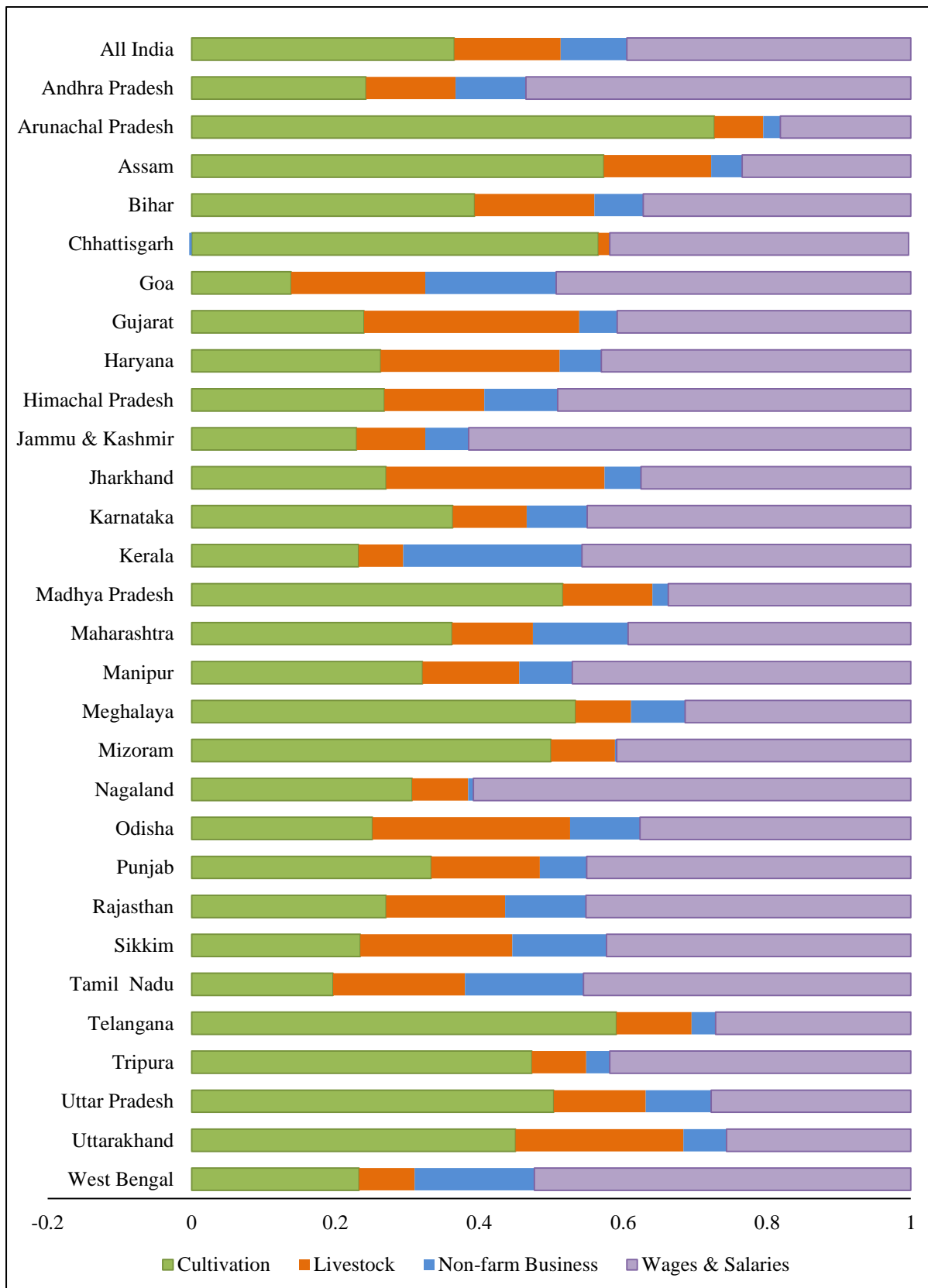
Figure 2.4 Sources of income for medium and semi-medium farmers in 2012–13 (%)
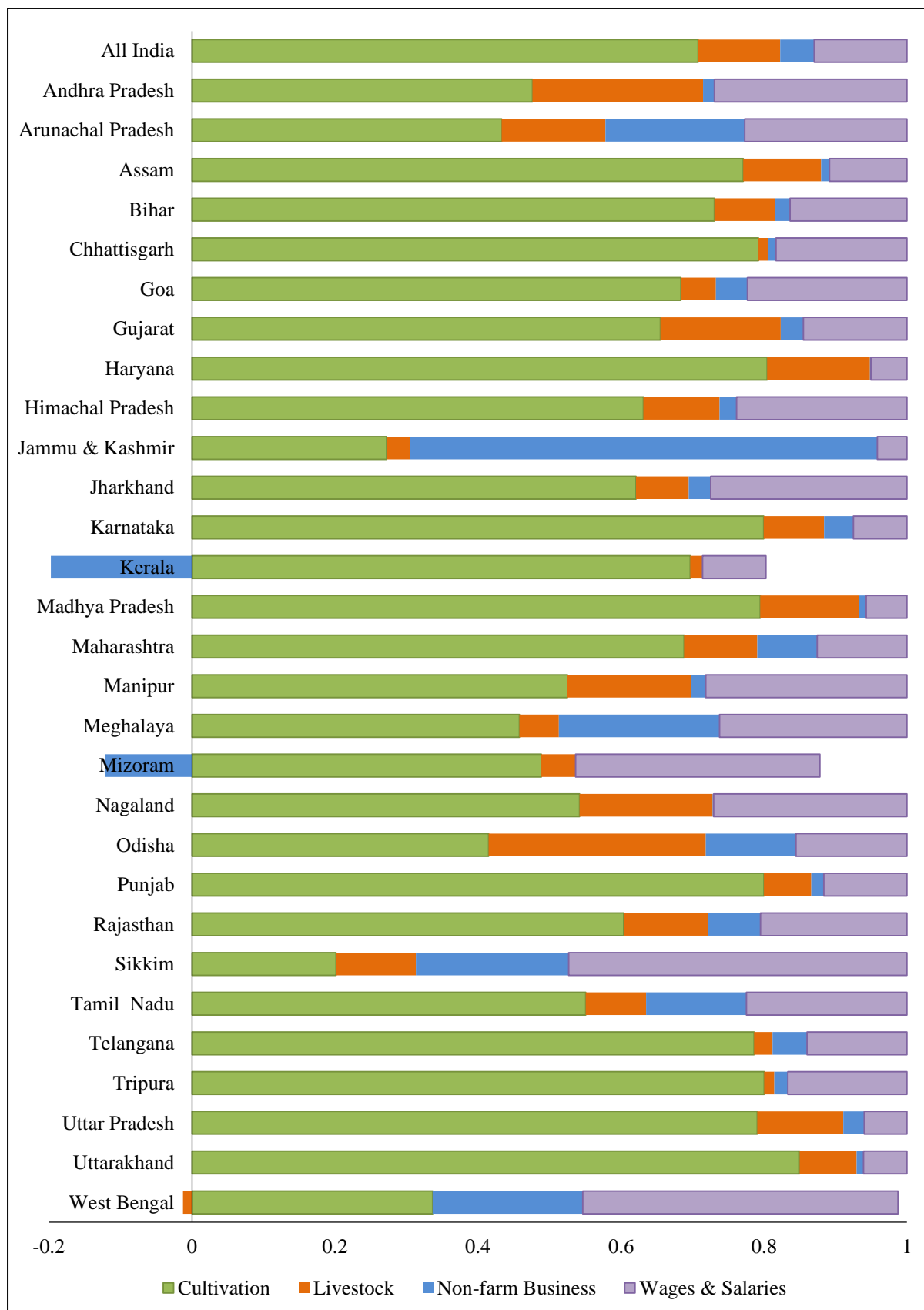
Figure 2.5 Sources of income for large farmers in 2012–13 (%)
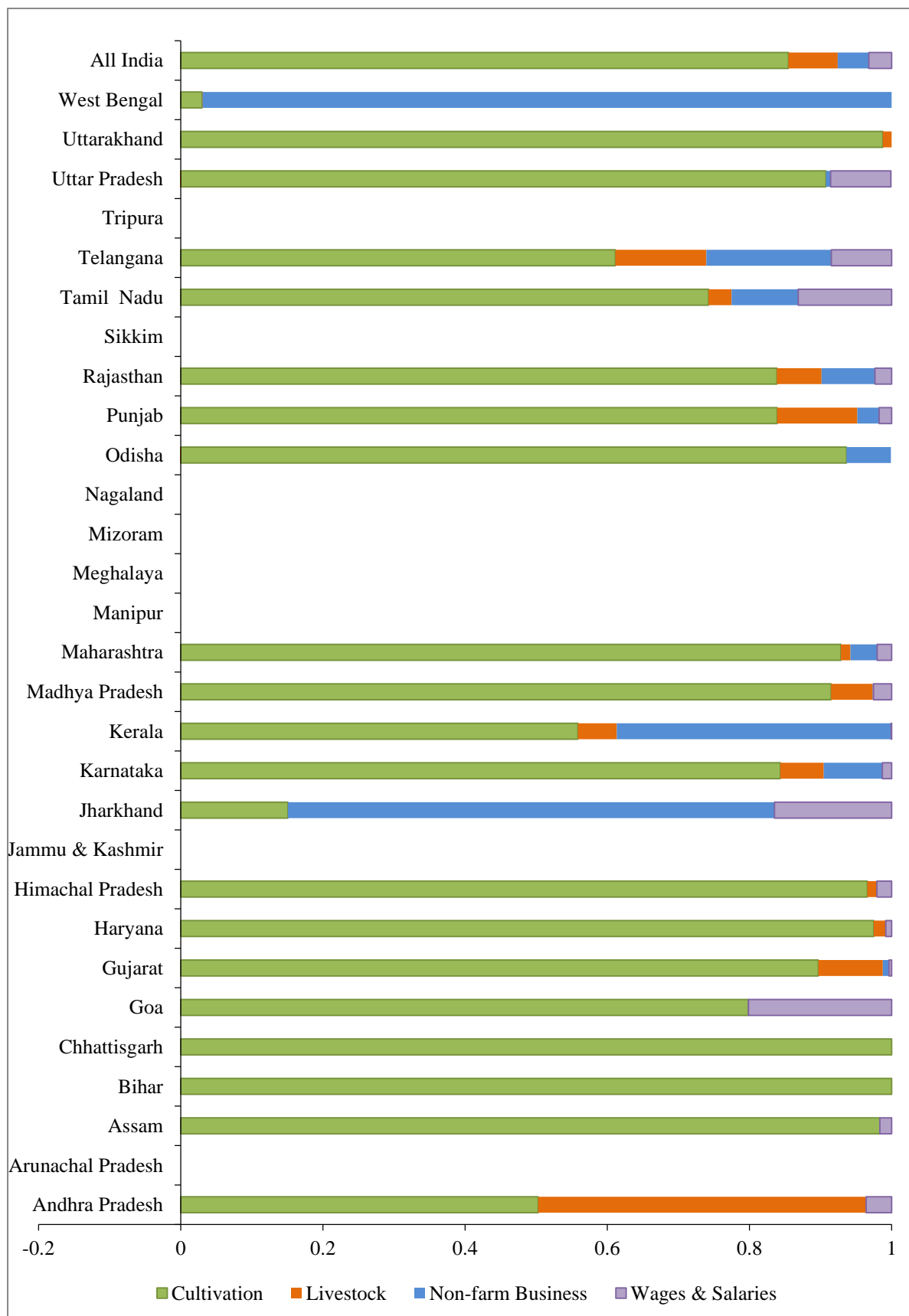
2.3 Seasonal perspective

The data of annual income in the NSSO 70th Round was collected in two visits: visit 1 corresponding to accrual of income during the Kharif season (July- December 2012), and visit 2 corresponding to accrual of income during the Rabi season (January–June 2013). In order to examine whether income receipts are subject to seasonal variation, income has been estimated separately for the Kharif and Rabi seasons. The relevant statistics for the various components, including cultivation, livestock, non-farm business, and wages and salaries, are shown in Table 2.2-2.8.

Table 2.3 reports both all-India and zone-wise incomes per household from cultivation. It is observed that the average household income in Visit 1 (Kharif season) is higher than that reported in Visit 2 (Rabi season). The all-India average household income is Rs. 21,490 for Visit 1 and Rs. 15,460 for Visit 2, that is, it is lower by 39 per cent for Visit 2. Income during the Rabi season is invariably lower than during the Kharif season. In fact, there is a difference of over 100 per cent in income from cultivation in the Kharif season over the Rabi season in the Central and Northern Hill zones, the principal reason for which could be that land is kept fallow during the Rabi season in many parts of India due to lack of irrigation.[19]

Table 2.3 Average income of agricultural households from cultivation (Rs.)

Zone	Visit 1 – Kharif (July 2012– December 2012)	Visit 2 –Rabi (January 2013– June 2013)	Visit 1 + Visit 2	Difference between Visit 1 and Visit 2 (%)
Northern Zone	1,39,823	1,18,962	2,58,785	17.5
North-Eastern Zone	2,52,652	1,34,991	3,87,643	87.2
Eastern Zone	38,821	27,826	66,647	39.5
Central Zone	58,869	29,399	88,268	100.2
Western Zone	84,025	52,026	1,36,051	61.5
Southern zone	1,20,593	78,947	1,99,540	52.8
Northern Hill Zone	82,785	19,203	1,01,988	331.1
Union Territories	75,488	51,517	1,27,005	46.5
All India	**21,490**	**15,460**	**36,950**	**39.0**

Source: DFI Committee's estimates from NSSO 70th Round unit level data.

Table 2.4 reports the data on income from livestock for the different regions of India. The Union Territories followed by the North-East zone seem to perform best. The DFI Committee finds that the states in Central India earn the least income from livestock among all zones. By and large, the average income per household from livestock in other zones is about half or less than half the income received by households in the North-East zone. Thus, there is considerable scope for policy intervention to augment income from livestock for households in the other zones. Another point to be noted is the significant variation in income from livestock across the two visits in some zones.

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[19] Chand, 2017b, p. 12.

Table 2.4 Average income of agricultural households from livestock (Rs.)

Zone	Visit 1 (July 2012– December 2012)	Visit 2 (January 2013– June 2013)	Visit 1 + Visit 2	Difference between Visit 1 and Visit 2 (%)
Northern Zone	30,512	30,439	60,951	0.2
North-Eastern Zone	53,234	31,189	84,423	70.7
Central Zone	4387	5721	10,108	-23.3
Northern Hill Zone	17,358	17,069	34,427	1.7
Eastern Zone	15,181	24,996	40,177	-39.3
Western Zone	24,055	36,423	60,478	-34.0
Southern Zone	25,072	24,893	49,965	0.7
Union Territories	54,406	55,964	1,10,370	-2.8
All India	**4683**	**5333**	**10,016**	**-12.2**

Source: DFI Committee's estimates from NSSO 70th Round unit level data.

There were eight broad categories recorded during the survey of the livestock (animal farming) sector, including milk; eggs; live animals; wool; fish; honey; hide, bones and manure; and other sources. Most of the households were engaged in more than two activities. Since it is important to determine the returns from these activities for devising a strategy, an attempt has been made here to identify the number of households engaged in mono activities, and their respective average incomes. Only the reporting households or households reporting sale value for just one particular activity have been selected here. Table 2.5 shows the income from different activities in Visit 1 and Visit 2 separately. The table indicates that the numbers of sample reporting households and estimated reporting households are quite low in the case of some of the activities under study. Hence, the results should be seen with caution.

Table 2.5 Households and average income from solo livestock activities, all-India, 2012–13

Items	Visit 1			Visit 2		
	Sample Reporting Households	Estimated Reporting Households (No.)	Average Income (Rs.)	Sample Reporting Households (No.)	Estimated Reporting Households (No.)	Average Income (Rs.)
Milk (Dairy, Sheep, Goat, etc.)	5335	12,537,693	6903	4076	96,97,438	10,450
Egg (Poultry, Duckery, etc.)	458	9,37,611	-2409	547	13,31,785	-42
Live Animals (Cattle, Sheep, Goat, Pig, Poultry and Duckery, etc.)	790	16,22,171	37,720	666	13,65,705	37,967
Wool (Sheep, Goat, etc.)	8	9603	38,948	6	4035	19,617
Fish	85	1,49,396	68,951	89	89,258	1,25,646
Honey	1	NA	NA	4	10,962	6126
Hide, Bones, Manure	**1509**	**48,36,877**	**-1329**	**2324**	**72,03,881**	**-1337**

Source: DFI Committee's estimates from NSSO 70th Round unit level data.

The number of households reporting mono activities was higher in Visit 1 for milk followed by that for hide, bones and manure, live animals, eggs and fish. It is observed that the average

returns were higher in the case of activities pertaining to fish. The households engaged in the production of eggs, and hide, bones, and manure suffered losses by recording negative average income. This indicates that the input expenses in the case of these activities were higher than the sale receipts.

In Visit 2, households engaged in only milk activities recorded higher incomes. However, the returns from milk per household were worth only Rs. 10,450. The returns from activities relating to fish were higher as compared to those from other activities. One of the interesting observations in Visit 2, was that 10,962 households were solely engaged in honey or beekeeping activities while there were no such households in Visit 1.

The average returns from milk, at Rs. 6903, are reportedly lower in Visit 1 as compared to Rs. 10,450 in Visit 2. In contrast, income from wool during the same period showed a decline. Among all activities, those relating to fish can be seen as the most profitable.

Table 2.6 details the share of values of output of all the eight livestock activities in Visit 1 and Visit 2. Among all the eight activities, the shares of values of output in both Visit 1 and Visit 2 were higher in the case of milk. This can be attributed to three reasons: first, higher production of milk as compared to other activities, second, the high per unit price of milk as compared to others, and third, a combination of both the above. Milk is followed by live animals, hide, bones, and manure, others, and fishery. The shares of both milk and fish in Visit 2 were higher than the corresponding shares in Visit 1. However, the opposite was true in the case of live animals.

Table 2.6 Share of values of output in visit 1 and visit 2 (%)

Activities	Visit 1	Visit 2
Milk (Dairy, Sheep, Goat, etc.)	68.1	70.0
Egg (Poultry, Duckery, etc.)	0.7	0.9
Live Animals (Cattle, Sheep, Goat, Pig, Poultry and Duckery, etc.)	18.5	15.4
Wool (Sheep, Goat, etc.)	0.4	0.1
Fish	1.6	2.0
Honey	0.0	0.0
Hide, Bones and Manure	6.3	6.8
Others	4.4	4.8
Total	**100**	**100**

Source: DFI Committee's estimates from NSSO 70th Round unit level data.

The region-wise average incomes from non-farm businesses for agricultural households in Visit 1 and Visit 2 are shown in Table 2.7. A much lower variation in income is observed for all zones barring the North-eastern zone. It seems that deeper integration of the non-farm business with cultivation/livestock could be one way of minimising seasonal variation in the incomes of agricultural households.

Table 2.7 Average income of agricultural households from non-farm business (Rs.)

Zone	Visit 1 Kharif (July 2012-December 2012)	Visit 2 Rabi (January 2013-June 2013)	Visit 1 + Visit 2	Difference between Visit 1 and Visit 2 (%)
Northern Zone	9807	8811	18,618	11.3
North-Eastern Zone	18,889	27,797	46,686	-32.0
Central Zone	732	851	1583	-14.0
Northern Hill Zone	14,813	15,999	30,812	-7.4
Eastern Zone	9299	10,923	20,222	-14.9
Western Zone	15,472	19,851	35,323	-22.1
Southern Zone	25,628	34,418	60,046	-25.5
Union Territories	28,966	34,079	63,045	-15.0
All India	**2883**	**3326**	**6209**	**-13.3**

Source: DFI Committee's estimates from NSSO 70th Round unit level data.

Table 2.8 reports the region-wise average income from wages and salaries for the two visits separately. It is observed that this component of income is always higher during the Rabi season. The difference in income is highest in the Central zone, followed by the Eastern and Western zones.

Table 2.8 Average income of agricultural households from wages and salaries (Rs.)

Zone	Visit 1 –Kharif (July 2012–December 2012)	Visit 2 –Rabi (January 2013–June 2013)	Visit 1 + Visit 2	Difference between Visit 1 and Visit 2 (%)
Northern Zone	55,223	57,756	1,12,979	-4.4
North-Eastern Zone	1,43,965	1,61,376	3,05,341	-10.8
Central Zone	14,681	23,426	38,107	-37.3
Northern Hill Zone	72,356	77,116	1,49,472	-6.2
Eastern Zone	35,885	48,171	84,056	-25.5
Western Zone	56,895	77,831	1,34,726	-26.9
Southern Zone	84,858	92,392	1,77,250	-8.2
Union Territories	3,46,600	4,38,308	7,84,908	-20.9
All India	**11,236**	**13,565**	**24,801**	**-17.2**

Source: DFI Committee's estimates from NSSO 70th round unit level data.

Figure 2.6 shows the season-wise sources of income for the different zones of India. It may be noted that the principal sources of income differ between the seasons only in some of the zones but by and large, the trends are the same irrespective of the season.

Figure 2.6 Season-wise total sources of income
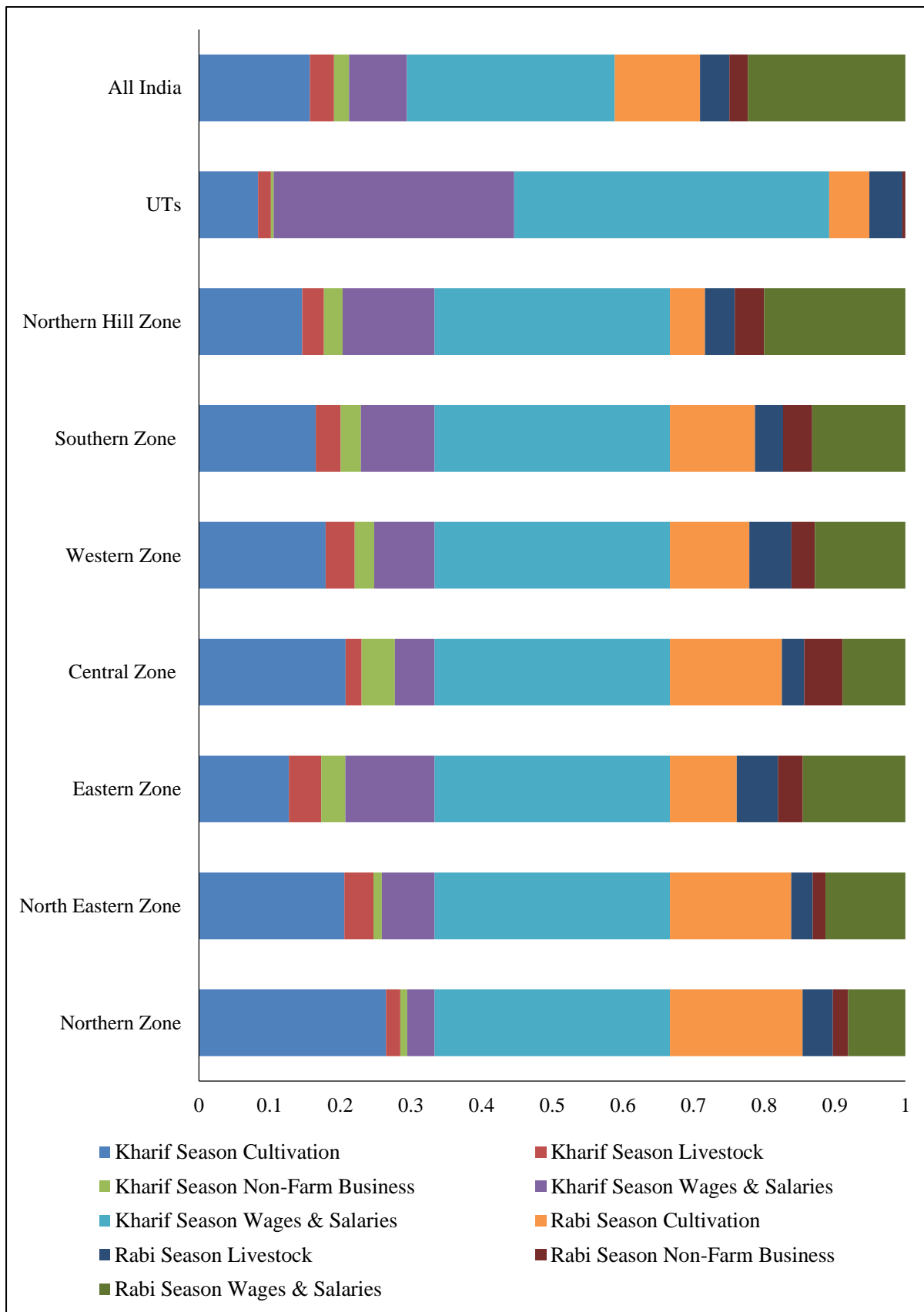
Source: DFI Committee's estimates from NSSO 70th Round unit level data.

2.4   Growth in Income

Before assessing the situation of agricultural households in its 70th Round, NSSO also conducted the 59th round in 2002–03.

However, as noted earlier, the two surveys are not strictly comparable as in the 59th Round, land ownership was used as a criterion for the selection of a household, whereas in the 70th Round, only households whose agricultural produce was valued at above Rs. 3,000 were considered.

In order to understand the growth dynamics of income for agricultural households, the estimates of income from the two rounds have been compared by including only those households from the NSSO 59th Round, whose value of agricultural produce was more than Rs. 3,000 in 2002–03, measured at constant 2012–13 prices.

Although this adjustment takes care of the 'value of produce' criterion in the NSSO 70th Round, no adjustment has been made for the 'land ownership' criterion in the NSSO 59th Round.

However, it may be mentioned that only 0.06 per cent of the agricultural households covered in the NSSO 70th Round do not possess land. Given these caveats, it is important to examine the income dynamics of agricultural household between the years 2002–03 and 2012–13.

Table 2.9 lists the state-wise total incomes from the four components for the years 2002–03 and 2012–13, at current and constant prices, along with the concomitant growth rates for incomes for each zone and the Union Territories.

It may be observed that the all-India income of agricultural households at current prices rose from Rs. 25,622 in 2002–03 to Rs. 77,977 in 2012–13, amounting to an annual growth rate of 11.8 per cent at current prices and merely 3.6 per cent at constant prices. It may be noted that this is significantly lower than the agricultural GDP growth rate in real terms.

The DFI Committee observes that negative growth was registered in seven states and Union Territories, and only nine states/Union Territories registered a growth rate of above 5 per cent in real terms.

The top three performing states in terms of growth rates in real income are Odisha (8.7 per cent), Haryana (7.8 per cent), and Rajasthan (7.5 per cent).

Table 2.9 State-wise income at current and constant prices, 2011-12

SN	Zone	State	2002–03 (59th Round)		2012–13 (70th Round)		Growth Rate (%)	
			Current	Constant	Current	Constant	Current	Constant
1	Northern Zone	Haryana	38,409	74,099	1,74,168	1,56,615	16.32	7.77
2		Punjab	74,301	1,43,343	2,17,450	1,95,535	11.34	3.15
3		Uttar Pradesh	20,683	39,902	59,716	53,698	11.19	3.01
4	North-Eastern Zone	Arunachal Pradesh	74,901	1,44,501	1,22,115	1,09,808	5.01	-2.71
5		Assam	35,985	69,423	80,327	72,231	8.36	0.40
6		Manipur	31,081	59,962	1,06,146	95,448	13.07	4.76
7		Meghalaya	52,303	1,00,903	1,43,315	1,28,872	10.61	2.48
8		Mizoram	65,230	1,25,842	1,09,401	98,375	5.31	-2.43
9		Nagaland	40,697	78,513	1,14,394	1,02,865	10.89	2.74
10		Sikkim	36,766	70,930	83,251	74,861	8.52	0.54
11		Tripura	20,164	38,902	65,146	58,581	12.44	4.18
12	Eastern Zone	Bihar	22,827	44,038	44,167	39,716	6.82	-1.03
13		Jharkhand	23,211	44,778	59,305	53,329	9.83	1.76
14		Odisha	12,065	23,276	59,440	53,450	17.29	8.67
15		West Bengal	24,145	46,581	48,192	43,336	7.16	-0.72
16	Central Zone	Chhattisgarh	17,209	33,199	63,354	56,969	13.92	5.55
17		Madhya Pradesh	19,524	37,667	74,712	67,182	14.36	5.96
18	Western Zone	Goa	51,886	1,00,099	91,098	81,917	5.79	-1.98
19		Gujarat	30,993	59,792	95,957	86,286	11.96	3.74
20		Maharashtra	26,867	51,832	91,501	82,280	13.04	4.73
21		Rajasthan	19,873	38,339	88,012	79,142	16.05	7.52
22	Southern Zone	Andhra Pradesh	18,009	34,743	71,456	64,255	14.78	6.34
23		Karnataka	30,073	58,018	1,07,558	96,718	13.59	5.24
24		Kerala	48,587	93,735	1,45,299	1,30,656	11.58	3.38
25		Tamil Nadu	24,553	47,367	85,031	76,461	13.23	4.90
26		Telangana	20,577	39,698	77,459	69,653	14.17	5.78
27	Northern Hill Zone	Himachal Pradesh	38,729	74,718	1,05,969	95,289	10.59	2.46
28		Jammu & Kashmir	63,779	1,23,044	1,54,064	1,38,537	9.22	1.19
29		Uttarakhand	35,625	68,729	56,666	50,955	4.75	-2.95
30	Union Territories	Andaman & Nicobar Islands	57,575	1,11,076	1,34,044	1,20,535	8.82	0.82
31		Chandigarh	77,548	1,49,608	2,59,942	2,33,744	12.86	4.56
32		Dadra & Nagar Haveli	29,272	56,473	87,894	79,036	11.62	3.42
33		Daman & Diu	28,467	54,919	87,946	79,083	11.94	3.71
34		Delhi	96,458	1,86,089	2,32,734	2,09,279	9.21	1.18
35		Lakshadweep	83,144	1,60,402	2,11,562	1,90,241	9.79	1.72
36		Puducherry	33,693	65,001	71,262	64,080	7.78	-0.14
		All India	**25,622**	**49,431**	**77,977**	**70,118**	**11.77**	**3.56**

Source: Estimated by DFI Committee from NSSO unit level data, 59th and 70th Rounds.

Table 2.10 State-wise real income growth rates by sources of income between 2002–03 and 2012–13 (%)

SN	Zone	State	Cultivation	Livestock	Non-farm Business	Wages and Salaries
1	Northern	Haryana	7.6	N.A.	-4.7	2.3
2	Zone	Punjab	2.5	10.2	-2.4	4.2
3		Uttar Pradesh	3.7	16.3	0.1	-0.5
4	North-Eastern	Arunachal Pradesh	6.6	-0.9	-19.1	2.3
5	Zone	Assam	2.0	9.7	-6.8	-3.9
6		Manipur	4.2	84.3	4.7	1.6
7		Meghalaya	-0.3	11.9	5.3	6.9
8		Mizoram	-3.5	-6.5	3.0	0.6
9		Nagaland	-1.2	N.A.	-23.4	6.6
10		Sikkim	-1.1	-2.2	13.4	0.5
11		Tripura	5.0	7.6	-3.6	3.7
12	Eastern Zone	Bihar	-1.4	-3.8	-5.9	2.0
13		Jharkhand	-0.6	23.1	-5.2	-0.9
14		Odisha	9.0	41.7	6.3	3.4
15		West Bengal	-4.2	5.3	-2.0	1.4
16	Central	Chhattisgarh	9.2	N.A.	-40.1	2.2
17	Zone	Madhya Pradesh	4.5	N.A.	-4.3	1.3
18	Western	Goa	-2.7	15.0	-5.9	-2.9
19	Zone	Gujarat	2.6	7.6	2.5	2.9
20		Maharashtra	5.3	10.5	4.5	2.5
21		Rajasthan	11.3	23.4	5.1	2.7
22	Southern	Andhra Pradesh	4.0	17.4	1.9	6.4
23	Zone	Karnataka	7.4	9.9	5.2	1.6
24		Kerala	3.8	7.3	5.6	1.8
25		Tamil Nadu	3.6	17.3	10.3	1.9
26		Telangana	9.9	10.5	-2.2	-0.5
27	Northern	Himachal Pradesh	5.5	7.3	-4.5	1.7
28	Hill	Jammu & Kashmir	-4.2	1.2	1.0	4.9
29	Zone	Uttarakhand	-3.4	1.9	-12.7	-0.3
30	Union	Andaman & Nicobar Is	-3.6	-2.2	7.6	2.4
31	Territories	Chandigarh	1.6	-2.2	N.A.	11.5
32		Dadra & Nagar Haveli	-2.7	-2.5	17.4	2.7
33		Daman & Diu	-3.6	-3.8	4.4	4.9
34		Delhi	-12.6	-0.2	-2.1	4.8
35		Lakshadweep	-12.5	23.5	-19.4	4.3
36		Puducherry	-0.9	N.A.	0.2	-0.4
	All India		**3.8**	**14.7**	**0.5**	**1.6**

Source: Estimated by DFI Committee from NSSO unit level data, 59th and 70th Rounds.

Table 2.10 shows the growth rates in real income for the various states by the four main components of income between 2002–03 and 2012–13. As seen in this table, there was largely positive real growth in the wages and salaries component of income across all zones during this period except in seven states/Union Territories.

In contrast, a negative real growth rate was exhibited in 17 states with respect to non-farm business, in 9 states/Union Territories with respect to livestock, and in 16 states/Union Territories with respect to cultivation. It is observed that a growth rate of more than 5 per cent was registered in 11 states/Union Territories for cultivation, in 16 states/Union Territories for livestock, in 6 states/Union Territories for non-farm business, and in 4 states/Union Territories

for wages and salaries. Rajasthan achieved the highest growth rate (11.3 per cent) in cultivation during this period.

2.5   Benchmarking of Income

The preceding section discusses the overall and regional dimensions of the incomes of agricultural households for the period 2002-03 to 2012-13. However, as the base year of the doubling of income is 2015-16, there is a need to derive estimates of income for agricultural households for this year. To derive these estimates, the state-wise net state domestic product (NSDP) growth rate in real terms (at 2011-12 prices) for the period 2012-13 to 2015-16 have been collated.[20]

Table 2.11 State-wise average income of agricultural households at 2011-12 prices (Rs.)

SN	Zone	State	2012-13	2013-14	2014-15	2015-16
1	Northern	Haryana	1,56,615	1,61,119	1,60,278	1,59,337
2	Zone	Punjab	1,95,535	2,02,479	1,95,931	1,97,981
3		Uttar Pradesh	53,698	53,971	5,2,731	53,466
4	North-Eastern Zone	Arunachal Pradesh	1,09,808	1,12,940	1,17,710	1,22,823
5		Assam	72,231	71,844	73,585	72,553
6		Manipur	95,448	96,532	93,932	95,304
7		Meghalaya	1,28,872	1,35,316	1,38,823	1,47,844
8		Mizoram	98,375	1,04,228	1,03,721	1,02,108
9		Nagaland	1,02,865	1,16,659	1,17,734	1,12,419
10		Sikkim	74,861	76,719	77,894	79,813
11		Tripura	58,581	68,611	72,531	66,574
12	Eastern Zone	Bihar	39,716	35,863	35,918	36,333
13		Jharkhand	53,329	52,313	55,144	53,595
14		Odisha	53,450	50,304	54,867	47,988
15		West Bengal	43,336	44,641	49,413	55,634
16	Central	Chhattisgarh	56,969	58,470	63,897	59,779
17	Zone	Madhya Pradesh	67,182	65,956	70,020	80,711
18	Western	Goa	81,917	93,016	94,587	89,840
19	Zone	Gujarat	86,286	1,09,605	1,08,594	1,01,495
20		Maharashtra	82,280	93,024	78,356	84,553
21		Rajasthan	79,142	83,834	83,431	82,136
22	Southern	Andhra Pradesh	64,255	71,389	73,492	79,623
23	Zone	Karnataka	96,718	1,07,050	1,08,384	1,04,051
24		Kerala	1,30,656	1,27,221	1,23,022	1,26,966
25		Tamil Nadu	76,461	90,617	97,681	88,253
26		Telangana	69,653	70,978	67,444	64,746
27	Northern	Himachal Pradesh	95,289	1,07,711	1,06,287	1,03,096
28	Hill	Jammu & Kashmir	1,38,537	1,49,950	1,33,090	1,40,526
29	Zone	Uttarakhand	50,955	49,348	49,915	52,041
30	Union	Andaman & Nicobar Islands	1,20,535	1,29,974	1,32,912	1,27,807
31	Territories	Chandigarh	2,33,744	2,36,946	2,38,823	2,35,417
32		Dadra & Nagar Haveli	79,036	83,663	82,956	83,533
33		Daman & Diu	79,083	83,713	83,005	83,583
34		Delhi	2,09,279	1,96,253	2,22,102	2,09,211
35		Lakshadweep	1,90,241	2,05,139	2,09,776	2,01,719
36		Puducherry	64,080	64,439	69,940	79,123
	All India		**70,118**	**74,223**	**73,596**	**74,108**

Source: DFI Committee's estimates.

[20] This data has been obtained from the CSO.

As shown in Table 2.11, these year-on-year growth rates have been applied on the state-wise income figures of agricultural households estimated at 2011-12 prices for the year 2012-13 to 2015-16.[21] The relevant data of the benchmarked income by states/UTs at 2011-12 prices is shown in Table 2.11. According to the DFI Committee's estimates, the income of agricultural households at the all-India level for 2015–16 turns out to be Rs. 74,108 at 2011–12 prices.

Table 2.12 State-wise average income of agricultural households at current prices (Rs.)

SN	Zone	State	2012–13	2013–14	2014–15	2015–16
1	Northern	Haryana	1,74,168	1,92,208	1,95,298	1,87,225
2	Zone	Punjab	2,17,450	2,33,868	2,41,399	2,30,905
3		Uttar Pradesh	59,716	66,398	70,256	78,973
4	North	Arunachal Pradesh	1,22,115	1,34,987	1,53,420	1,76,152
5	Eastern Zone	Assam	80,327	87,064	90,496	85,962
6		Manipur	1,06,146	1,25,355	1,37,165	1,22,889
7		Meghalaya	1,43,315	1,51,708	1,60,200	1,80,384
8		Mizoram	1,09,401	1,28,802	1,47,279	1,28,494
9		Nagaland	1,14,394	1,42,187	1,54,835	1,37,139
10		Sikkim	83,251	93,279	1,04,315	1,20,633
11		Tripura	65,146	80,438	91,302	78,962
12	Eastern Zone	Bihar	44,167	41,752	44,848	45,317
13		Jharkhand	59,305	65,946	74,398	84,820
14		Odisha	59,440	60,762	71,242	63,285
15		West Bengal	48,192	57,412	66,230	78,708
16	Central	Chhattisgarh	63,354	71,518	78,321	71,064
17	Zone	Madhya Pradesh	74,712	87,939	98,167	1,16,878
18	Western	Goa	91,098	1,37,090	1,27,042	1,18,410
19	Zone	Gujarat	95,957	1,26,955	1,31,217	1,18,043
20		Maharashtra	91,501	1,10,449	98,147	1,00,033
21		Rajasthan	88,012	92,969	97,759	92,914
22	Southern	Andhra Pradesh	71,456	82,228	93,127	1,04,092
23	Zone	Karnataka	1,07,558	1,27,975	1,48,659	1,54,399
24		Kerala	1,45,299	1,56,457	1,65,608	1,55,788
25		Tamil Nadu	85,031	1,10,126	1,32,715	1,33,568
26		Telangana	77,459	85,003	86,916	86,291
27	Northern	Himachal Pradesh	1,05,969	1,19,944	1,18,714	1,14,876
28	Hill	Jammu & Kashmir	1,54,064	1,78,193	1,84,390	1,72,216
29	Zone	Uttarakhand	56,666	57,390	57,507	61,833
30	Union	Andaman &Nicobar Island	1,34,044	1,57,062	1,65,830	1,52,312
31	Territories	Chandigarh	2,59,942	2,85,749	3,18,075	3,38,362
32		Dadra & Nagar Haveli	87,894	99,996	1,06,309	1,09,002
33		Daman & Diu	87,946	1,00,056	1,06,373	1,09,067
34		Delhi	2,32,734	2,50,017	2,71,237	2,76,026
35		Lakshadweep	2,11,562	2,47,893	2,61,730	2,40,395
36		Puducherry	71,262	75,891	88,589	1,03,652
	All India		**77,977**	**88,713**	**94,314**	**96,703**

Source: DFI Committee's estimates.

Benchmark income for the year 2015–16 at current prices for the major states. This has been estimated by applying the year-on-year state/UT level NSDP growth rates at current prices on the derived income of agricultural households, using the NSSO 70th Round database as the

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[21]Since the absence of data limitation, all-India growth rates have been applied for the Union Territories Daman and Diu, and Lakshadweep.

source. The relevant data is shown in Table 2.12. It may be noted that the income of agricultural households at the all-India level for 2015–16 turns out to be Rs. 96,703 at current prices.

The DFI Committee has also benchmarked income for the year 2015-16 at current prices/constant (2011-12 prices by the major size classes. This has been estimated by applying year-on-year state level NSDP growth rate at current prices (constant prices) on the derived income of agricultural households, using the NSSO 70th Round database as the source.

The relevant data are shown in Tables 2.13 and 2.14. It may be noted that the income of agricultural households for small and marginal farmers for 2015-16 turns out to be Rs. 79,779 at current prices. The corresponding income for large farmers turns out to be Rs. 6,05,393.

Table 2.13 Average household income by size classes in 2015-16 at constant 2011–12 prices (Rs.)

Size Class	Cultivation	Livestock	Non-farm Business	Wages & Salaries	Total
Small and Marginal Farmers	22,325	9056	5625	24,132	61,138
Medium and semi-medium farmers	1,09,098	17,688	7341	19,972	1,54,099
Large farmers	3,96,596	32,193	20,380	14,770	4,63,939
All sizes	35,117	9519	5901	23,570	74,108

Source: DFI Committee's estimates.

Table 2.14 Household income by size classes in 2015–16 at current prices (Rs.)

Size Class	Cultivation	Livestock	Non-farm Business	Wages and Salaries	Total
Small and Marginal Farmers	29,132	11,817	7341	31,490	79,779
Medium and semi-medium farmers	1,42,362	23,080	9580	26,061	2,01,083
Large farmers	5,17,517	42,009	26,594	19,273	6,05,393
All sizes	45,824	12,422	7700	30,757	96,703

Source: DFI Committee's estimates.

Following the discussion on the status of farmers' income and its benchmarking with the aim of doubling it by 2022-23, it is important to assess the amount of resources required for achieving this objective by the target year.

An assessment on the quantum of both public and private investment required will help to identify the sources for mobilisation of finances and for expenditure on the growth-promoting infrastructures. The next chapter discusses the public and private capital formation in Indian agriculture, while also delineating future investment targets.

Key Extracts

- The average annual income of agricultural households from all components of income (cultivation, livestock, non-farm business, and wages and salaries) was Rs. 77,976 in 2012-13 as per NSSO's 70th Round data, out of which cultivation accounted for the principal share (47 per cent), followed by wages and salaries (32 per cent), livestock (13 per cent), and non-farm business (8 per cent).

- Cultivation is the predominant source of income for agricultural households as the size of their landholdings increases. At the lower end of the spectrum of land size, wage and salaries account for the principal source of income. The message emerging from this analysis is that differential strategies need to be adopted depending on the size distribution of land owned by agricultural households.

- There is a wide variation in the average incomes of agricultural households across regions. The share of cultivation in income ranges between 33 and 64 per cent, barring in the Union Territories, for which the average share is about 14 per cent.

- Fisheries comprise the most profitable category within the livestock segment.

- By and large, non-farm business is the predominant source of income next to cultivation in many zones.

- The penetration of non-farm business is highest in the Union Territories. It is important to note that the share of non-farm business in the cultivation-rich Northern zone is lower than in the other zones. This implies that there is scope for food-processing in the region for attaining higher value addition.

- The DFI Committee observes that there is considerable seasonal variation in the various components of income, including cultivation, livestock, non-farm business, and wages and salaries, across regions.

- The analysis indicates that the all-India income of agricultural households has registered an annual growth rate of 11.8 per cent in current prices and a mere 3.6 per cent in constant prices during the period 2002-03 to 2012-13. This is significantly lower than the GDP growth rate in real terms.

- Negative growth is observed in seven states and Union Territories.

- The income of agricultural households at the all-India level in 2015-16 is estimated to be Rs. 96,703 at current prices, which amounts to Rs. 74,108 in 2015-16 at 2011-12 prices.

- According to the DFI Committee, the estimated income of agricultural households for small and marginal farmers in 2015-16 is Rs. 79,779 at current prices. The corresponding figure for large farmers is Rs. 6,05,393, which points to a significant variation in income across land classes.

Chapter 3
Public and Private Capital Formation in Agriculture

High investments contribute to higher growth in production and income, mitigation of poverty and enhanced food security, at both the national and household levels. Capital, be it in physical or human form, greatly contributes towards increasing the efficacy of the productive effort (Schultz, 1964). Physical farm capital broadly comprises land improvement, irrigation structures (wells and canals), machinery, storage warehouses, livestock and animal husbandry, and research and development (R&D) in agriculture. Human capital, on the other hand, signifies the skill and knowledge that farmers acquire and develop further. While most of the physical investments[22] are undertaken by the farmers or the corporate sector, mainly in tea and coffee plantations, investments in major and medium irrigation systems, R&D, extension services, storage warehouses, roads and other infrastructure squarely fall under the public domain.

3.1 Introduction and Objectives

Literature highlights that the most important pre-requisite in the agricultural sector is the need to encourage farmers to make long-term investments. Inevitably, public support is required not only through an increased flow of credit and creation of infrastructural investments but also through the development of agri-markets and investment in agro-processing. There is ample evidence to show that rural infrastructural investments have contributed immensely to increased agriculture productivity across many developing countries,[23] which have, in turn, enabled the mitigation of poverty in the long run.[24] The investment needs may differ across countries/regions given their diverse agro-climatic conditions, and the level of agricultural development, and the crop and allied activities being undertaken by them.

The pertinent question is: What is the existing size of investment in agriculture, its composition and the future requirements that can help accomplish higher rates of growth in this sector? Several studies have been undertaken by the Food and Agriculture Organisation (FAO) to estimate the projected capital stock required to meet certain production targets.[25] A recent study by Schmidhuber and Bruinsma (2011) estimated the investment needs by 2050 for as many as 93 developing countries, irrespective of investments made on private and public accounts. The cumulative gross investment requirements for South Asia are estimated at US$ 2,286 billion, which amounts to 25 per cent of the total projection made for all the countries taken together. Out of this, almost 50 per cent is on account of crop production and support services each, generally provided by the State, and hardly 0.6 per cent is for livestock production. In terms of capital stock per worker (US$ 1000), the existing requirement in South Asia is relatively lower at 3.88 (US$ 1000), as compared to Latin America and the Caribbean at 25.24 (US$ 1000), and East/North Africa at 11.61 (US$ 1000). In the South Asia, it will have to be increased to 6.10

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[22] The terms 'capital formation' and 'investment' are often used interchangeably. As per the National Accounts Statistics (NAS), capital formation refers to the accounting value of the additions of non-financial produced assets to the capital stock less the disposals of these assets. It implies an addition to the existing stock of assets like equipment, building, etc. for enhancing the productivity capacity. Investment is a broader concept that includes the purchase of all kinds of capital assets, be they in the form of physical property or financial assets, which yield an income in the future.
[23] Fan, Hazell and Thorat, 2000; Ravallion and Datt, 2002; Mogues, et al.2012.
[24] Fan Gulati and Thorat, 2008; Syed and Miyazako,2013.
[25] FAO, 1981; Schmidhuber, et al., 2009.

(US$ 1000) by 2050. The study does not provide separate estimates on the capital requirements forecast for Indian agriculture.

In another study, Lowder et al. (2012) have estimated the relative size of private and public investments required to meet crop production targets. The estimates pertained to 67 low-and middle-income countries for 2005-07 based on the FAO database on capital stock and International Food Policy Research Institute (IFPRI) database on public expenditure. Of the total estimated US$ 168,577 million on-farm private capital, the share of East Asia and the Pacific was the maximum at 30.6 per cent followed by South Asia (which includes India) at 21.7 per cent. The corresponding figure on public account, which included spending on R&D, Overseas Development Assistance (ODA) and Foreign Direct Investment (FDI), was as high as US$ 11,204 million. The share of East Asia and the Pacific in the total public investment was as high as 36.1 per cent, followed by Latin America and the Caribbean, at 24.9 per cent each, and South Asia at 14.5 per cent, respectively. The on-farm investment in India was reasonably high at US$ 22,506 million (13.3 per cent), as compared to other developing economies, and so was the government investment at US$ 4,624 million (20.7 per cent). However, the ODA and FDI in agriculture were relatively much lower as compared to other countries, at US$ 555 million and US$ 6 million respectively.

In India the investment requirements have not been estimated for agricultural growth at state level, though various attempts have been made at national level. The Planning Commission[26]estimated that a 20.41 per cent rate of investment was required to achieve a growth target of 3.5–4.2 per cent during the Twelfth Five Year Plan (2012-17). This investment rate, based on the incremental capital output ratio (ICOR) of 5.32 per cent, is to be met through the public and private (farm household) sectors. Studies undertaken for the earlier periods also reported higher ICORs in agriculture, varying between 2.2 and 4 per cent, which indicates that a one-rupee increase in output per year requires a one-time investment of Rs. 2.2–4.[27] The capital requirement would almost double if public investment in infrastructure and supportive investments are also taken into account.

This chapter attempts to estimate the futuristic investment requirements in agriculture with the aim of doubling farmers' income by 2022-23 from its current 2015-16 level. The capital requirements within the stipulated period are estimated separately on private (farm households) and public accounts, at the state–level, based on the estimated ICORs from 1981-82 to 2013-14.

For the purpose of this Committee's deliberations, the public investment **'in' agriculture**, refers primarily to agricultural and allied activities, and in major, medium and minor irrigation systems. The Committee has also considered public investment in rural roads and transport, and rural energy. These are termed as supportive public investments and accounts for other rural infrastructural requirements of this sector. Together, the 'in' agriculture investments and the investment in supportive investments are referred to as investment **'for' agriculture**.

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[26]GoI-Planning Commission, 2012.
[27]Chand, 2000; Roy and Pal, 2001; Gulati and Bathla, 2002.

For each investment head, the incremental capital output ration (ICOR) is estimated at the sub-national level to arrive at the projected investment rate required to double farmers' income from its present level in 2015-16. The ICOR estimates the additional unit of capital or investment that is needed to produce an additional unit of output for a particular period. It is taken as a measure of capital efficiency.

In all, 20 select states have been taken up for the analysis. Public expenditure data on the newly formed states, viz., Chhattisgarh, Jharkhand and Uttarakhand, is available from 2000 onwards and has been merged with the respective parent states of these new states, viz., Madhya Pradesh, Bihar and Uttar Pradesh. Separate estimates for the three new states are given from 2000 onwards. The total public investment refers to 20 select states only, as comparable time series are not available for the UTs and north eastern states. Attempts will be made to work on these regions in due course. However, the all-India data on private investment in agriculture by farm households refers to all the states and UTs.

This analysis is based on the extant literature and state-level data extracted from the National Accounts Statistics, Central Statistical Organisation (NAS–CSO) for the Gross State Domestic Product (GSDP) and national level estimates on public and private capital formation; National Sample Survey and the All India Debt Investment Survey (NSS–AIDIS) for private investment in agriculture; Finance Accounts for public expenditure (capital) under various economic heads/services; and Agricultural Statistics at a Glance, Ministry of Agriculture and Farmers Welfare for the net sown area and other indicators.

Section 2 of this chapter analyses the temporal trends in the magnitude of private and public capital formation at the all-India level, based on estimates provided by NAS–CSO and their share in national income and total investment in the economy. This is followed by spatial trends in investments and changes therein over the period 1981-82 to 2013-14 based on AIDIS and Finance Accounts. The patterns in private investment have been evaluated across various land size holdings and the contribution of institutional credit towards asset creation by each within the rural households. Section 3 highlights the factors that influence public and private capital formation in agriculture and their impact on land productivity and income. This is followed by an empirical analysis on the marginal returns from private investment as well as key public investments in rural areas in terms of income and reduction in the number of poor people. Section 4 provides estimates on the futuristic investment requirements for doubling farmers' income. Section 5 concludes the chapter and presents policy implications.

3.2   Investments in Agriculture and the Allied Sector in India

At the outset, it is important to mention that the official estimates on gross capital formation (GCF) in agriculture and allied activities (GCFA) are provided by the CSO in the NAS at the all-India level. Only a few states attempt to estimate the GCFA. The GCFA is bifurcated into gross fixed capital formation (GFCF) and change in stock (CIS), and as per the institution, viz.,the household (farmers), and the private corporate and public sectors at current and

constant prices. The CSO also provides estimates on the net fixed capital stock.[28]Statistics reveal that during 1960-61, gross capital formation in agriculture and the allied sector (GCFA) at constant prices (base year 2004-05) was Rs.120.6 billion, which increased to Rs.329.98 billion in 1980-81. It remained stagnant for many years during the two decades and then increased from the early 2000s to reach Rs.1600 billion by 2012-13 (Figure 3.1). The CIS varies each year and roughly constitutes 5 to 9 per cent in the total GCFA. As per the institution, private GCFA accounts for a major share in the total investment. The share of public GCFA, which was high at 44 per cent in the total GCFA, during the 1960s, has now fallen to an extremely low level. In 2014-15, the private GCFA accounted for an 83 per cent share, as compared to the public GCFA at 15 per cent, and private corporate investment at 2 per cent in the total. As shown in Figure 3.1, the share of public GCFA, which mainly pertains to major and medium irrigation systems and agriculture, has consistently decreased. A greater dominance in the GCFA is mainly of the private sector (that is, farm households). Although many private companies are making forays into agriculture, their share in the total investment is quite low and stagnant.

Figure 3.1 GCF in agriculture and allied activities (at 2004–05 prices) (Rs. billion)
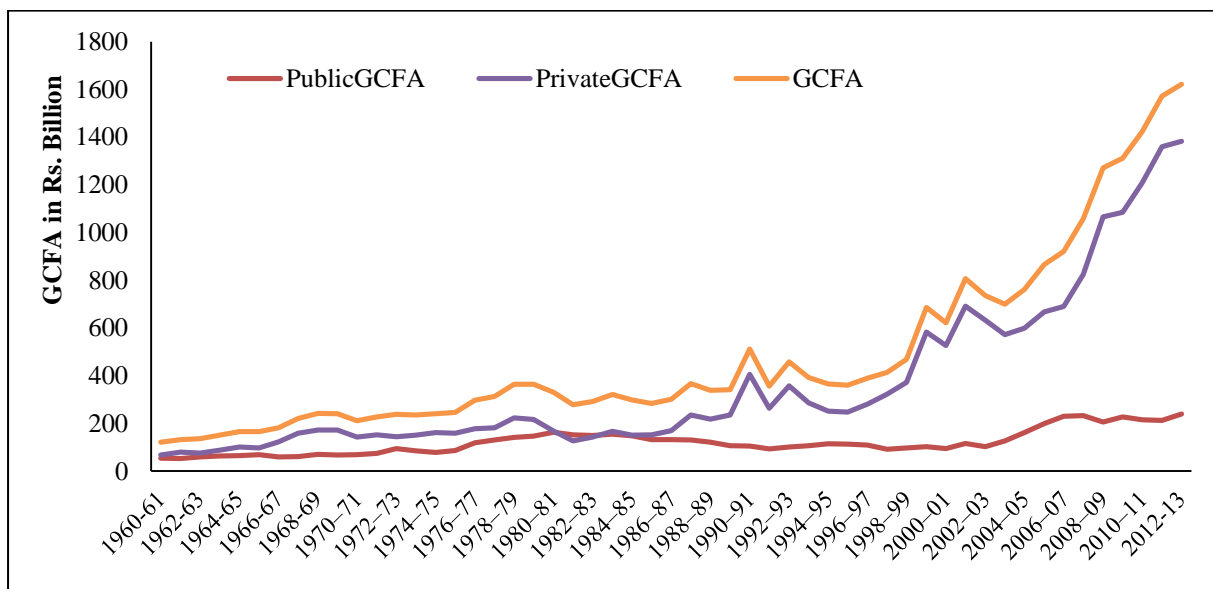
Source: National Account Statistics (NAS), CSO.

Table 3.1 presents estimates on the size of public and private GCFA over a longer period of time along with the decadal rates of growth. The relative position of GCFA is seen in terms of its share in the GDP pertaining to agriculture and allied activities (GDPA) and gross domestic capital formation (GDCF) in the economy. Stagnation in the GCFA was observed during the 1980s and 1990s, mainly due to a fall in the public GCFA.

The prevalence of lower public GCFA has been explained by the diversion of government expenditure towards the revenue account owing to an increase in the input subsidies and day-

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[28]Capital formation is slightly different from 'investment', which requires adjustment on account of consumption of fixed capital (that is, depreciation) due to accumulated capital. Investment is considered to be a flow and implies the formation of capital, that is, change in the capital stock

to-day expenses, low preference by the government for spending on agriculture, population density, and procurement of foodgrains[29]. In contrast, a slower increase in private investment has been attributed to deceleration in the rate of growth in public investment, and the inadequate flow of institutional credit. A big push in the public GCFA along with credit is visible from 2002-03, which may have induced private GCFA. The annual rate of growth in GFCA on public and private accounts has been high at 5.89 per cent and 8.84 per cent, respectively, during the 2000s.

A strong complementarity between the two at the national level has been identified in the literature. Chand and Kumar (2004),and Bathla (2014; 2016) have explained the increase in the private GCFA in terms of the growing number of farm holdings, increase in the flow of institutional credit, and diversification towards high-value crops, coupled with an increase in the demand for processed food and favourable terms of trade. Increased levels of investment, complemented with favourable weather conditions and prices, seem to have helped agriculture achieve a higher rate of growth, or close to 4 per cent during the mid-2000s.[30]

Table 3.1 Magnitude of public and private GFCA (Rs Billion) and annual rate of growth (%) at 2004-05 Prices

Average	Public GCFA	Private GCFA	GCFA	GSDPA	Public GCFA	Private GCFA	GCFA	GSDPA
1981-1989	105	232	337	3192	-2.49	1.81	0.49	2.89
1990-1999	93	330	423	4476	2.78	3.11	3.06	3.66
2000-2013	186	895	1082	6200	5.89	8.84	8.25	3.01
1981-2013	136	543	679	4857	3.04	6.43	5.64	3.12

Source: Estimates based on National Account Statistics, CSO

Notwithstanding an impressive rate of growth in the GCFA, its share in the GCF in the economy has been found to be declining, which in fact, reflects a 'relative neglect' of agriculture.[31] During 1960-61, the share of GCFA in the total GCF was 16.56 per cent, which rose further to touch the peak at 21.47 per cent in 1968-69, and then decelerated for at least two subsequent decades. Although some improvement was observed in the share of GCFA in the GCF in 2001-02, at 11.89 per cent, it again fell to 7.69 per cent in 2012-13 (Figure 3.2).

This decline in the GCFA suggests that out of the total investment share of almost 36 per cent in the GDP, investments in the industry and services sector are growing at a much faster rate as compared to that in agriculture. Similarly, while the share of GCFA in the GDPA has risen significantly from 6 per cent to 21 per cent during this period, the share of GCFA in the GDP continues to be low at 3 percent.

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[29]Mishra and Chand, 1995; Mishra and Hazel, 1996; Bathla, 2014.
[30]Chand and Parappurathu, 2012.
[31]Gulati and Bathla, 2001.

Figure 3.2 Share of GCFA in GCF and of GCFA in GDP and GDPA, respectively
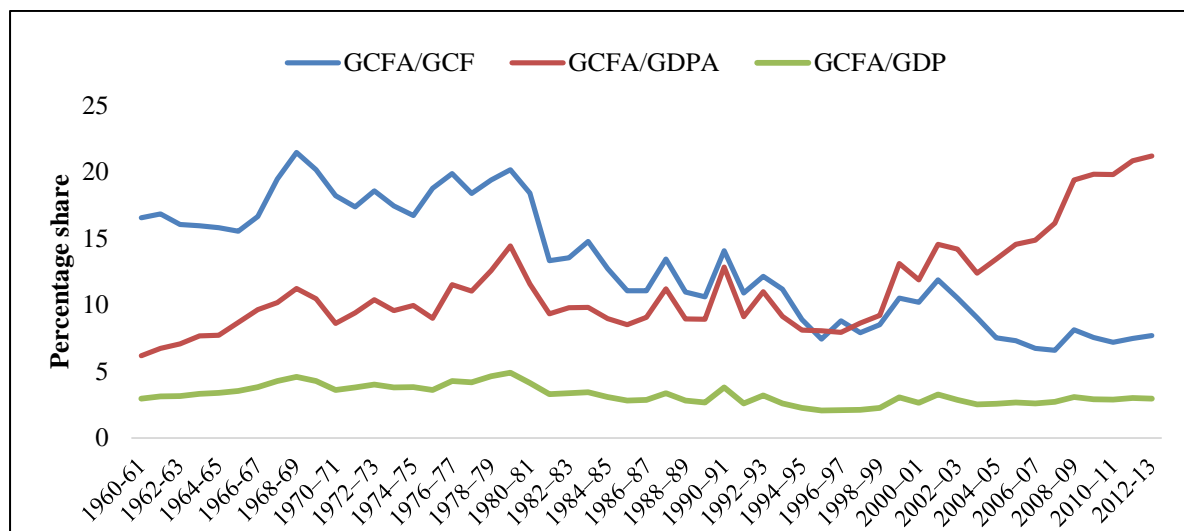
As mentioned above, official estimates on GCFA at the state level are not available. Independent researchers have widely used quinquennial surveys carried out by the NSSO (AIDIS) for analysing private (farm households) fixed capital expenditure (FCE) in the farm business (FCEFB).[32] The DFI Committee provides estimates for four rounds, viz. 1981-82, 1991-92, 2002-03 and 2012-13, along with the changes in its composition based on Schedule 18.2 for 20 select states and all India.

For the public GCFA, the Committee referred to State Finances or budget documents, using the capital expenditure heads on irrigation, and agriculture and allied activities for 20 select states and their sum.[33] In this chapter, capital expenditure under various economic services (agriculture and allied, irrigation, rural roads and transport, and rural energy from the Finance Accounts, CAG, GoI) has been used.

The bifurcation of capital expenditure on rural roads and transport has been done based on the share of rural population in the total population, and on energy based on its share of consumption in agriculture. The state-wise time series on investments/expenditures are converted into 2004-05 prices using GSDP deflators.

3.3 Private investment in agriculture

Table 3.2 furnishes the state-wise fixed capital expenditure in farm business (synonymous with private investment in agriculture and allied activities) by rural households at 2004-05 prices over the period.

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[32]The estimates are based on unit level household data collected by the NSSO in its decennial report, the All India Debt and Investment Survey (AIDIS) (Schedule 18.2) 1981-82 (37th Round) 1991-92 (48th Round), 2002-03 (59thRound), and 2012-13 (70th Round) across 17 major states. Since each round is not comparable with the other due to differences in the definition of 'farmer', the investment per rural household is analysed.

[33] Capital expenditure is gross and includes the government's investment in financial stocks. Hence, it may be an over-estimation of actual investment in the respective heads/services. This is the major data limitation.

Table 3.2 State-wise FCE in farm business (investments) per rural household (Rs.) at 2004-05 Prices

State	1981-82		1991-92		2002-03		2012-13	
	FCEFB	FCEFB/ GCE	FCEFB	FCEFB/ GCE	FCEFB	FCEFB/ GCE	FCEFB	FCEFB/ GCE
Andhra Pradesh	687	20.3	533	21.55	484	16.12	1287	17.25
Assam	248	13.84	80	6.37	119	10.65	303	14.86
Bihar	186	9.82	142	15.68	73	6.53	172	6
Gujarat	1405	39.08	781	23.37	1220	29.56	3163	38.93
Haryana	2029	27.73	1429	10.93	2646	18.75	2593	10.75
Himachal Pradesh	496	12.29	783	11.72	1228	6.63	3412	19.01
J& K	538	7.62	520	14.17	711	9.13	1475	9.69
Karnataka	1045	19.19	1902	38.67	586	17.43	2430	19.09
Kerala	686	8	658	7.73	703	5.09	2188	7.16
Madhya Pradesh	664	22.02	1589	40.1	353	18.73	3019	40.63
Maharashtra	1129	28.95	1367	31.51	1015	22.46	2674	26
Odisha	181	8.42	134	7.42	327	10.81	350	11.16
Punjab	3245	36.19	1940	29.14	2091	23.21	4720	37.49
Rajasthan	1134	23.42	1677	33.83	1605	23.25	3442	23.59
Tamil Nadu	634	20.63	791	20.51	620	11.89	626	5.21
Uttar Pradesh	769	18.86	703	17.05	831	19.63	2253	29.82
West Bengal	232	10.31	194	9.73	119	3.87	263	4.15
AP-Telangana	--	--	--	--	--	--	1150	14.66
Bihar-Jharkhand	--	--	--	--	76	6.53	300	8.59
MP-Chhattisgarh	--	--	--	--	272	12.49	1685	26.68
UP-Uttarakhand	--	--	--	--	1170	21.76	1451	23.19
All-India	753	20.17	815	22.24	669	15.56	1631	18.78

Source: AIDIS.

Note: Deflated using GDCF given in NAS, CSO; the newly created states have been merged with their respective parent states in the last rows for recent years.

The per household investment increased from Rs. 758 in 1981 to Rs. 815 in 1991, fell to Rs. 669 in 2002, and then shot up again to Rs. 1631 in 2012.

Despite an impressive increase in the FCEFB, its share in the gross capital expenditure[34] (GCE) went down from nearly 20 per cent to 15 per cent in 1991, and went up slightly by three percentage points in 2012. Three states, viz., Haryana, Bihar and Tamil Nadu, experienced a significant decline in the share of investment in agriculture in gross investment. This points to an increasing expenditure on residential land by the rural households, which is undertaken at the expense of farm investments.

Table 3.3 presents the annual rate of growth in FCEFB during the periods 1981-1991, 1991-2002 and 2002-2012. One observes a modest rate of growth in it for almost two decades, followed by a significant increase at 9.3 per cent per annum during the 2000s. With a few exceptions, most of the states recorded negative rates of growth in private investment during the 1980s and 1990s.

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[34] AIDIS estimates the gross capital expenditure (GCE), which is equal to FCE, purchase of land and normal repairs and maintenance; FCE in farm business encompasses eight components, with the major ones being land improvement, livestock, irrigation, transport, and machinery and implements.

This confirms a deceleration in its growth reported at the national level, followed by revival during the subsequent decade. The highest growth of 8-15 per cent was experienced by almost all the states with a few exceptions, viz., Haryana, Odisha, Tamil Nadu and Uttar Pradesh. As mentioned above, various factors such as massive public investments in irrigation, provision of input subsidies, favourable terms of trade, and increased flow of credit seem to have pushed private investment, especially in the less developed states.

Table 3.3 Annual rate of growth in private FCEFB/rural households at 2004-05 prices

States	1981-91	1991-2002	2002-2012
Andhra Pradesh	-2.52	-0.86	10.27
Assam	-10.74	3.67	9.83
Gujarat	-5.71	4.15	9.99
Haryana	-5.32	5.76	-0.20
Himachal Pradesh	4.67	4.18	10.76
J&K	-0.35	2.89	7.56
Karnataka	6.17	-10.15	15.29
Kerala	-0.42	0.61	12.02
Maharashtra	1.93	-2.67	10.17
Odisha	-2.98	8.48	0.66
Punjab	-5.01	0.68	8.48
Rajasthan	3.99	-0.4	7.93
Tamil Nadu	2.24	-2.2	0.10
West Bengal	-1.78	-4.38	8.29
Bihar-Jharkhand	-2.64	0.56	14.77
MP-Chhattisgarh	9.12	-9.3	20.03
UP-Uttarakhand	-0.90	11.55	2.18
All India	0.80	-1.77	9.31

Source: NSS–AIDIS (Schedule 18.2).

As regards the composition of private investment in agriculture, the 1981-82 survey shows that the bulk of the investment of rural households went into the purchase of machinery and transport (46.1 per cent), followed by expenditure on irrigation structures (25.4 per cent), and on land improvement (14.8 per cent).

Irrigation investment became more important during 1991-92 as its share in the total FCEFB went up to 31.8 per cent, and that in orchards declined. Similar trends were observed during 2012-13, whereby the largest expenditure share (more than 60 per cent) was incurred on implements and transport, and irrigation structures (Table 3.4).

This clearly indicates an unchanged preference of farmers for these assets over the years. Another important point to be noted is that households devoted a substantial share of expenditure on livestock (23.01 per cent) during 2012-13. Among all the assets, transport, machinery and implements, livestock and irrigation together account for 80 per cent of the rural household's investments.

Farmers in the hilly regions tend to spend less on irrigation structures and more on land improvement, livestock and farm buildings. In contrast, rural households in the less developed states incur a higher share of expenditure on irrigation. A positive rate of growth in each asset is visible in almost all the states.

Table 3.4 State-wise percentage share of components of FCEFB in rural households, 2012-13

State	Land Improve-ment	Orch-ards	Irrigation	Farm machinary & transport	Farm Buildings	Others	Live-stock	Total FCFA
Andhra Pradesh	10.61	0.08	9.59	27.53	4.58	0.02	47.6	100
Assam	3.35	3.19	8.9	40.3	20.38	1.92	21.96	100
Bihar	0.15	17.04	5.5	36.15	9.61	3.18	28.37	100
Gujarat	9.33	0.18	23.64	36.54	6.15	1.08	23.09	100
Haryana	3.26	0	22.99	43.61	0.74	0.11	29.29	100
Himachal Pradesh	17.02	4.42	32.56	6.07	23.28	0.09	16.56	100
J & K	3.99	16.27	0.41	13.54	2.33	0.18	63.27	100
Karnataka	10.5	0.01	46.09	17.74	1	0.31	24.35	100
Kerala	4.38	3.33	12.24	60.69	1.56	5.59	12.2	100
Madhya Pradesh	13.84	0.05	33.01	31.87	0.73	4.24	16.26	100
Maharashtra	17.39	5.17	33.73	21.09	2.68	1.3	18.65	100
Odisha	19.5	0.41	20.07	27.02	11.74	1.71	19.55	100
Punjab	3.04	0	10.2	63.86	1.21	0.82	20.87	100
Rajasthan	5.37	0.46	30.16	25.46	5.98	0.46	32.11	100
Tamil Nadu	5.54	0.8	47.78	17.94	16.8	1.03	10.11	100
Uttar Pradesh	2.31	0.15	3.26	73.37	0.84	0.28	19.8	100
West Bengal	1.06	1.91	4.99	41.85	12.32	0.46	37.41	100
AP-Telangana	8.98	0.05	33.43	21.76	2.78	0.06	32.94	100
Bihar-Jharkhand	2.96	3.55	9.34	40.47	18.24	3.26	22.18	100
MP-Chhattisgarh	2.15	1.35	3.42	70.73	1.46	0.48	20.41	100
UP-Uttarakhand	20.45	1.01	4.9	19.75	2.62	13.29	37.97	100
All India	8.29	1.46	22.55	39.69	3.59	1.34	23.08	100

Source: NSS–AIDIS.

Across various land holding sizes, the small and marginal farmers continue to have a much lower share in total investment. As shown in Table 3.5, investment by marginal farmers having less than one hectare of land accounts for a 1.9 per cent share in the total investment as compared to medium and large farmers, whose land holdings account for shares of 25.8 per cent and 47.3 per cent, respectively.

The share of marginal and small farmers together in FCEFB is less than 10 per cent as compared to that of farmers in the semi-medium and medium category, of farmers, at 43.2 per cent. Small farmers have a reasonably higher share of investment in the total investment only in the states of Gujarat, Haryana, Kerala, Rajasthan and West Bengal. The fact is that almost 62 per cent of the farmers in India cultivate less than 2 hectares of land and barely spend on asset creation.

Table 3.5 Percentage share of FCE in agriculture as per land holding size, 2012-13

State	Marginal (<=1ha)	Small (1-2ha)	Semi-Medium (2-4ha)	Medium (4-10ha)	Large (>10ha)	%
Andhra Pradesh	2.83	3.05	24.56	61.79	7.75	100
Assam	6.29	8.6	12.05	73.06	0	100
Bihar	0.48	2.39	1.1	5.74	90.29	100
Gujarat	3.93	11.96	20.44	48.06	15.61	100
Haryana	1	10.67	19.41	6.8	62.11	100
Himachal Pradesh	3.9	8.48	15.5	4.11	68.02	100
J&K	17.14	11.22	10.85	60.79	--	100
Karnataka	2.5	9.08	25.34	12.58	50.5	100
Kerala	18.64	60.37	20.99	0	0	100
Madhya Pradesh	1.27	4.46	7.1	26.13	61.05	100
Maharashtra	1.42	8.98	10.8	18.38	60.43	100
Odisha	1.22	4.6	34.75	15.53	43.89	100
Punjab	1.18	8.68	28	30.15	32	100
Rajasthan	5.8	18.01	25.96	23.95	26.28	100
Tamil Nadu	1.25	6.68	80.3	11.78	0	100
Uttar Pradesh	3.84	8.64	17.76	22.51	47.24	100
West Bengal	5.53	33.5	60.97	--	--	100
AP-Telangana	4.17	9.05	21.46	51.71	13.61	100
Bihar-Jharkhand	1.64	4.48	1.95	7.57	84.35	100
MP-Chhattisgarh	1.35	4.68	8.23	29.51	56.23	100
UP-Uttarakhand	4.07	15.35	23.02	19.59	37.96	100
All India	**1.97**	**7.49**	**17.42**	**25.8**	**47.31**	**100**

Source: AIDIS 2012-13 (Schedule 18.2).

3.4 Contribution of institutional credit to private investment in agriculture

Credit acts as an enabling and critical input in the production process. Studies reveal that loans from institutional sources, viz., commercial banks, regional rural banks and cooperatives, provide access to and usage of fertilisers, seeds and other inputs, and are also highly correlated with capital formation.[35]Seen from the demand side, this indicates that nearly 86 per cent of the farm investment in India is undertaken through borrowed money from both institutional and non-institutional sources.

The farmers' dependence on the borrowed amount for investment is more than 50 per cent across all the states, and is relatively higher in the developed states—at more than 90 per cent in Andhra Pradesh, Kerala, Tamil Nadu, Punjab, Karnataka, Maharashtra and Madhya Pradesh (Table 3.6).

However, a pertinent question is to identify how much of the total borrowings for such long-term investments are done through institutional sources. While the national average is estimated to be 63.4 per cent, the sub-national picture shows the agriculturally developed states to be reaping the benefits of financial institutions. This suggests that nearly 54 per cent of the investment is undertaken by the farmers through institutional loans. The outreach of banks for farm loans needs to be increased in Andhra Pradesh, Bihar, J&K, Rajasthan, Tamil Nadu and

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[35]Sidhu and Gill, 2006; Chavan, 2013.

Uttar Pradesh, as the share of investment from institutional sources, is relatively low in these states, varying between 41per cent and 55 per cent.

Table 3.6 Percentage of farm investment from borrowings and share of institutional credit in total borrowings in 2012-13

State	FCEFB	% of FCE from Borrowing	% Borrowing from Institutional Agencies
Andhra Pradesh	1287	98.9	44.6
Assam	303	49.9	61.4
Bihar	172	70.2	53.2
Gujarat	3163	84.4	78.8
Haryana	2593	65.7	61.1
Himachal Pradesh	3412	42.6	64.2
J &K	1475	36.9	43.8
Karnataka	2430	89.2	58.4
Kerala	2188	95.5	82.7
Madhya Pradesh	3019	90.5	79.8
Maharashtra	2674	91.7	71.3
Odisha	350	66.1	70.9
Punjab	4720	95.4	77.7
Rajasthan	3442	86.6	55.9
Tamil Nadu	626	95.5	46.6
Uttar Pradesh	2253	83.5	47.2
West Bengal	263	79.2	69.4
AP-Telangana	1150	98.8	41.8
Bihar-Jharkhand	300	65.3	47.1
Madhya Pradesh-Chhattisgarh	1685	76.9	58.3
Uttar Pradesh-Uttarakhand	1451	85.5	64.3
All India	1631	85.9	63.4

Source: AIDIS, 2012-13 (Schedule 18.2)

Further probing reveals that in most of the states, the marginal and small farmers depend more on the informal sources for investment credit. This is visible from Table 3.6a, which, as expected, shows higher investments by the medium and large farmers. Also, FCEFB is incurred more from borrowed money by each land size holder. Given the high dependence on borrowed money for making investment, the share of institutional credit is certainly higher at Rs.3543 as compared to Rs.1645. However, as shown in Table 3.6b, farmers make 13.8 per cent of their investments through their own resources, perhaps personal savings. The quantum of investment done through borrowing from formal sources is higher (more than 60 per cent) among the medium and large farmers.

The landless and marginal farmers depend more on the informal sources for credit for asset creation as compared to the medium and large-size landholders. Taking FCEFB undertaken from borrowings into account, it may be observed that all landholders prefer to make investments using credit from formal institutions. However, among the various land classes, a higher percentage of investment is carried out from the informal sources of borrowings such as moneylenders, traders and input dealers by the landless (40.6 per cent), marginal (52.1 per cent), and small farmers (30.8 per cent). While the small sized landholders have pending loans from informal financial sources, that too at exorbitant rates of interest, the medium and large

farmers get subsidised loans[36] (Kumar, et al., 2017). It is important to take these aspects into consideration while trying to ensure financial inclusion within the credit policy.

Table 3.6a FCE in farm business from borrowings (Rs./rural household) at 2004-05 prices in 2012-13

Land Class	FCEFB	FCE FB from Own Sources	FCEFB from Credit	FCEFB from institutional Sources	FCEFB from Non-institutional Sources	Difference in Mean (t test)
Landless	258	97	419	716	260	3.15*
Marginal	1295	521	1896	2174	1689	3.74*
Small	3416	1644	4129	4850	3096	2.63*
Medium	8466	3987	9858	10,142	9306	1.69***
Large	13,593	4719	16,012	17,285	12,538	0.97
All Classes	1630	519	2472	3543	1645	10.26*

Source AIDIS 2012-13. Note: - * is significant at 1%, ** is significant at 5%, and *** is significant at 10%.

Table 3.6b Percentage share of sources of credit in private investment in agriculture in 2012-13

Land Class	Distribution of Farm Expenditure as per Source (%)			Percentage Share of Investment (FCEFB) from	
	Own Source (Non-borrower)	Borrowing from Formal Sources	Borrowing from Informal Sources	Formal (Institutional) Sources	Informal (Non-institutional) Sources
Landless	18.6	48.4	33.0	59.4	40.6
Marginal	17.4	39.6	43.0	47.9	52.1
Small	13.9	59.6	26.5	69.2	30.8
Medium	10.9	60.6	28.6	67.9	32.1
Large	7.40	73.2	19.4	79.1	20.9
All Classes	13.8	53.8	32.5	63.4	36.6

Source: AIDIS, 2012-13.

In view of the large variations in private investment and institutional credit across the states and as per the size of land holdings, the empirical estimation of the relationship between the two has been examined. Besides the land holding size of the households, family size, household type, level of education, and investment preference have also been taken into account to explain variations in private investment in agriculture. The state/region, caste and religion of the household types have been taken as control variables. The analysis is based on unit level data from AIDIS 2012-13 in log linear functional form.

The results presented in Table 3.6c reveal that institutional credit bears a positive relation with FCEFB with the estimated elasticity being 0.29 each. It suggests that a 10 per cent increase in credit by institutional agencies would increase household's investment by 2.9 per cent. A growing investment preference of farmers for residential purposes, as highlighted above, has a negative and significant impact on farm investment (elasticity -0.021). It may be explained in terms of lower returns from farming along with other factors such as urbanisation and demographic changes.[37] Family size is also important in explaining the investment behaviour of farmers. The results further confirm that large farmers tend to make more investments as

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[36] Institutional sources extend loans at a 7per cent rate of interest under the interest subvention scheme, which reduces to 4per cent in a situation of early repayment.
[37] Bathla and Kumari, 2017.

compared to other categories, which is visible from the negative sign of the coefficients. Across the regions, a negative sign of coefficient of the eastern region indicates that farm investment is much lower in this region relative to the northern region. As expected, the self-employed households make more investments as compared to other types of households having negative signs of the coefficients. The level of education acquired by the head of the household is significant in making investment if it is above the secondary level.

Table 3.6c Factors explaining private investment (FCEFB) in agriculture based on the log linear model in 2012-13

Explanatory Variables	Coefficient	Standard Error
Institutional credit (Rs.)	0.299***	0.0118
Investment Preference (%Share of residential expenditure in total expenditure)	-0.0207***	0.0008
Age of household head (Years)	0.0831	0.0549
Family size (No.)	0.2961***	0.0313
Land class (Large farmer as the base)		
Landless - 1, otherwise - 0	-1.4025***	0.0790
Marginal - 1, otherwise – 0	-1.0692***	0.0613
Small - 1, otherwise - 0	-0.7296***	0.0626
Medium - 1, otherwise - 0	-0.4296***	0.0654
Region (Northern region as the base)		
Central - 1, otherwise – 0	0.3556***	0.0440
West - 1, otherwise – 0	0.7109***	0.0510
South - 1, otherwise – 0	0.2651***	0.0445
East - 1, otherwise – 0	-0.2754***	0.0443
North-East - 1, otherwise – 0	0.4217***	0.0884
Education of the Household Head (Higher Secondary and above as the Base)		
Illiterate - 1, otherwise – 0	-0.1798***	0.0505
Primary Level- 1, otherwise – 0	-0.1086**	0.0506
Middle Level - 1, otherwise – 0	-0.0650	0.0527
Secondary Level - 1, otherwise – 0	0.0525	0.0567
Household Type (Self-employment in Agriculture as theBase)		
Self-employment in non-agriculture - 1, otherwise – 0	-0.3313***	0.0564
Agricultural labour - 1, otherwise – 0	-0.4665***	0.0621
Non-agricultural labour- 1, otherwise – 0	-0.4152***	0.0623
Salaried job/regular labour - 1, otherwise – 0	-0.2050***	0.0536
Other - 1, otherwise – 0	-0.2683**	0.1356
Constant	4.3775***	0.2598
No. of observations	13,648	
Adj R-squared	0.2972	
Root MSE	1.5967	
Chi-square	166.20	
Prob Chi-square	0.0000	

Source: NSS 70th Round (Schedule 18.2).

Note: *** is significant at 1%, ** is significant at 5%, and * is significant at 10%.

These findings may imply that the credit policy needs to be changed keeping in view the regional, land size and other characteristics of the households. The agriculturally less developed states and marginal and small farmers should have higher access to institutional credit for making long-run investments.

3.5 Magnitude of public investment 'in' and 'for' agriculture: 1981-82 to 2013-14

The Government spends on many social and economic services/heads in the respective states. The public expenditure in India is highly decentralised. Since the central government routes most of its funds though the state governments, which also contribute their own share and spend the final amount, the data on revenue and capital expenditure is captured at the State level. The data is taken from finance accounts, GoI and the expenditure by the Central Government and loans/advances have not been taken to avoid double counting. Central government also spends directly on many activities in rural areas, such as on agricultural R&D and flagship programmes.

Broad statistics for 20 select states reveal that during the period 1981-82 to 2013-14, the total real public expenditure (for all sectors) increased from Rs. 1,108 billion in TE 1983-84 to Rs. 8,257 billion in TE 2013-14, growing at a rate of 6.73 per cent per year. The per capita development expenditure increased from Rs. 1,513 to Rs. 7,270 during this same period. Within economic services, the average (1981-82 to 2013-14) share of various expenditures reveals that nearly 25 per cent was allocated to irrigation and flood control, followed by agriculture and allied activities (19.2 per cent), rural development (14 per cent) and rural road and transport (11 per cent).

The expenditure on rural energy was significantly below that on road and transport, education and health.[38] It is important to mention that over the given period, the relative share of expenditure on economic services has decreased while that on social services has increased. Within that, the share of irrigation-flood control fell substantially from 35.5 per cent to 20.14 per cent and that of agriculture from 21.2 per cent to 19 per cent.

For convenience, the states have been categorised into three groups based on the average real per capita income from 2000-01 to 2012-13. Accordingly, seven states fall under the high-income category, and five each in the middle- and low-income categories. The low-income states (LIS) include Bihar, Uttar Pradesh, Assam, Jammu & Kashmir, and Madhya Pradesh; the medium-income states (MIS) include Odisha, Rajasthan, West Bengal, Andhra Pradesh, and Karnataka; and the high-income states (HIS) include Punjab, Himachal Pradesh, Tamil Nadu, Kerala, Gujarat, Haryana, and Maharashtra.

This categorisation would also help in understanding the capital requirement of the less developed states in the eastern and central regions in totality where agricultural growth has been lagging, necessitating the provision of additional resources for irrigation and R&D. In contrast, the developed states in the North and the South may have different capital requirements, perhaps for value addition or for taking their agriculture to the next level, which may require the efficient use of the existing capital. Figure 3.3 depicts the pattern of spending on agriculture and irrigation, which has significantly escalated since 2000. The state-wise scenario pertaining to spending on agriculture and irrigation has been delineated in Table 3.7,

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[38]Bathla, Thorat, Joshi and Bingxin, 2017.

which shows large variations. The spending on agriculture and irrigation has not received much priority in the less developed poorer states though a significant increase is visible in the magnitude of expenditure at a rate of 2 to 7.3 per cent. Out of the total expenditure, the amount leading to investment is high for irrigation, the national average being 63.8 per cent in the Triennium Ending (TE) 2014, which is slightly higher than that in TE 1983.

Figure 3.3 Public expenditure on agriculture and irrigation (Rs. billion)
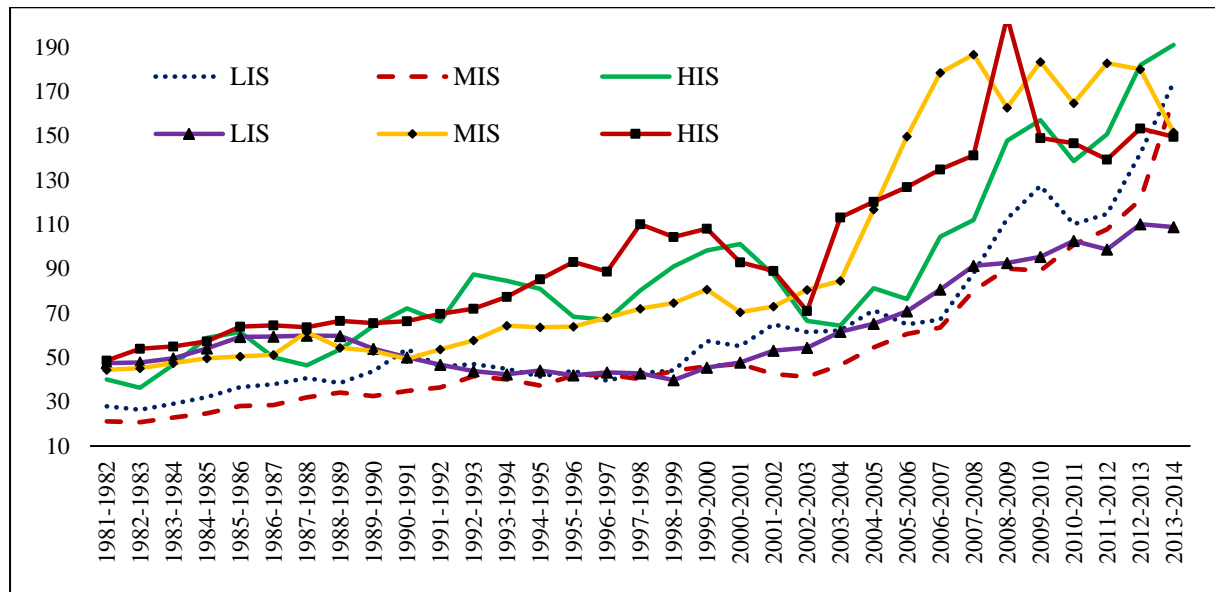
Source: Based on Finance Accounts, GoI.

Table 3.7 Public expenditure in agriculture and irrigation (Rs.billion) and percentage share of capital expenditure (2004-05 prices)

State	Agriculture		% of Capital Expenditure		Irrigation		% of Capital Expenditure		Annual Rate of Growth: 1981-2014	
	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	Agriculture	Irrigation
Andhra Pradesh	5.37	28.45	1.61	1.34	15.94	114.71	57.17	57.29	4.56	7.11
Assam	3.98	12.11	5.73	1.33	3.4	10.88	74.29	61.81	2.08	2.59
Bihar-Jharkhand	4.72	26.56	6.8	5.63	11.89	27.98	72.82	65.07	4.02	2.04
Gujarat	4.02	27.9	24.42	16.3	13.19	47.84	52.85	86.45	5.46	3.91
Haryana	2.36	14.38	2.94	26.14	6.25	10.99	56.4	40.58		1.98
Himachal Pradesh	2.58	7.98	8.61	5.02	0.48	3.35	58.39	48.59	3.28	7.45
J&K	2.03	10.31	6.4	27.04	1.8	4.6	67.43	48.96	4.88	3.68
Karnataka	4.6	48.05	2.88	2.76	9.64	34.49	56.93	88.07	7.3	4.57
Kerala	3.37	24.48	11.18	7.48	3.89	5.46	72.75	47.17	5.59	0.77
MP-Chhattisgarh	10.76	56.8	6.46	3.18	11.73	37.98	80.17	84.16	4.96	3.75
Maharashtra	18.33	54.88	3.44	17.2	20.07	66.32	62.59	73.94	3.11	4.85
Odisha	3.8	22.56	11.57	3.01	7.79	17.42	84.39	64.42	4.57	2.5
Punjab	2.43	7.56		2.25	5.13	9.02	58.37	26.93		1.64

State	Agriculture		% of Capital Expenditure		Irrigation		% of Capital Expenditure		Annual Rate of Growth: 1981-2014	
	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	Agriculture	Irrigation
Rajasthan	2.64	17.82	7.95	8.98	8.83	12.67	56.96	36.29	5.25	1.72
Tamil Nadu	7.88	37.32	12.62	13.25	4.2	14.18	39.82	62.34	4.34	4.31
UP-Uttarakhand	6.28	37.88		12.21	22.86	47.93	53.11	38.41	5.97	2.07
West Bengal	5.11	15.08	9.97	12.44	4.34	9.63	37.01	42.26	3.03	2.78
Total- 20 states	**90.38**	**454.15**	**6.45**	**9.57**	**150.99**	**477.79**	**61.04**	**63.83**	**4.59**	**4**

Source: Finance Accounts, GoI.

The composition of spending under agriculture and allied activities for TE 2014 is presented in Table 3.7a. As per the three groups of states, it shows a maximum share of crop husbandry at nearly 34 per cent in LIS and HIS, and 39.8 per cent in MIS, followed by forestry (15.3 per cent), animal husbandry (10.6 per cent) food storage (11.98 per cent) and cooperation (9.63 per cent).

The share of spending on food storage and warehousing in agricultural expenditure is relatively higher in LIS and MIS at 15 per cent and 11.6 per cent, respectively, than that in HIS at 5.5 per cent, which could be explained by the existence of a larger number of poor in LIS and MIS, hence the need for government intervention for stocking food. The share of spending on agricultural R&D is less than 10 per cent in HIS, and much lower in the other groups at 6 percent. Given a deceleration in the productivity growth rate of many crops, and also the fact that R&D activity is not undertaken by the private sector in the country, it needs to be scaled up. India spends 1 per cent of the GSDP agriculture on agricultural R&D.

Among various types of irrigation expenditures, the highest share is occupied by the medium and major irrigation systems across all the states. Bathla, Joshi and Kumar (2017) find that the LIS spend more on minor irrigation and that their share in the total expenditure on irrigation stood at 27.68 per cent during TE 2013-14 as compared to 4.81 per cent and 16.64 per cent in the MIS and HIS, respectively.

The MIS spend substantially on flood control, which is visible in their high share in the total irrigation expenditure, at 62.8 per cent. This may have also led to a cut in the spending on irrigation. The annual rate of growth in minor irrigation is much higher at 11.95 per cent, as compared to that in the major and medium irrigation systems at 5.75 per cent. An increase in investment in minor irrigation, mainly tanks and tubewells, can be explained by growing inefficiency and long gestation periods in the construction of canals and growing inefficiency. The marginal efficiency of capital is also found to be much higher in minor irrigation than in major and medium irrigation in each state.

Table 3.7a Percentage share and composition of expenditure on agriculture and irrigation

	TE 2014				Annual Growth Rate, 2000-2013			
	LIS	MIS	HIS	All	LIS	MIS	HIS	All
Agriculture (Rs.Billion)	143.65	131.95	174.5	454.15	-	-	-	-
Share in Agriculture:	100	100	100	100.26	8.77	10.64	7.82	8.93
Crop Husbandry	33.99	39.8	33.6	35.39	10.98	16.08	10.66	12.31
Soil and Water Conservation	4	2.64	6.15	4.35	2.22	2.18	8.67	5.03
Animal Husbandry	10.58	9.88	11.11	10.59	7.62	6.65	8.46	7.78
Dairy Development	1.32	2.74	3.19	2.44	15.59	9.32	-7.13	-2.02
Fisheries	1.91	2.23	3.73	2.65	8.95	6.52	11.94	9.56
Forestry and Wildlife	19.94	13.33	13.14	15.36	5.89	5	4.67	5.31
Food, Storage & Warehousing	14.06	12.43	9.15	11.98	8.42	13.69		14.14
Agricultural Research and Education	5.48	5.77	9.23	6.92	8.2	7.35	6.99	7.31
Cooperation	8.46	10.67	9.53	9.63	14.91	13.66	9.72	12.58
Others	1.11	0.52	1.18	0.94	--	10.24	7.2	9.89
Irrigation (Rs.Billion)	129.36	188.93	157.17	477.79	-	-	-	-
Share in Irrigation:	100	100	100	100	8.18	8.14	4.76	6.91
Minor	27.68	4.81	16.64	19.15	11.95	9.17	9.58	10.32
Medium and Major	56.29	31.2	76.77	71.76	5.75	8.11	3.73	5.89
Command Area Development	2.53	1.2	1.3	1.83	7.5	2.41	2.15	4.32
Flood Control	13.5	62.8	5.29	7.25	15.86	8.38	12.88	12.71

Source: Based on Finance Accounts, GoI.

Many studies have shown that public investment in irrigation has a 'crowding in' effect on irrigation investment (in electric tubewells) by farmers.[39] This discussion has also brought in another dimension, that is, the impact of public infrastructural investments which may have a direct and indirect bearing on private investment, productivity and rural poverty across many developing countries.[40] Researchers have grouped such investments under the category of 'for' agriculture (health, education, roads, rural industry and telecommunication) without pondering over where to draw the line in defining investments 'for' agriculture, and how to do a rural–urban or agriculture–non-agriculture bifurcation of such investments.[41]

Nevertheless, the impact of these investments is stated to facilitate production as the impact of infrastructural development operates in cumulative and multiple ways.

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[39]Dhawan, 1998; Gulati and Bathla, 2002.
[40]Mogues, et al., 2015; Mogues et al. 2013; Fan, 2008.
[41]Gulati and Bathla, 2002; Chand, 2000; Fan, Hazell and Thorat, 2000.

Table 3.7b Major social-economic heads of public expenditure at 2004-05 prices (Rs. Billion) in TE 2014

State	Public expenditure (revenue and capital) (Rs Billion)			Share of capital expenditure (investment) in total public expenditure (%)			Annual rate of growth of public Expenditure (revenue and capital):1981-2014 (%)		
	Rural Roads and Transport	Rural Energy	Rural Develop ment	Rural Roads and Transport	Rural Energy	Rural Develop ment	Rural Roads	Rural Energy	Rural Develop ment
Andhra Pradesh	15.04	9.72	26.17	52.79	0.92	--	6.53	11.33	3.62
Assam	9.42	0.01	5.69	57.58	74.36	--	4.11	44.11	5.62
Bihar-Jharkhand	33.75	1.04	47.85	78.13	10.61	28.54	9.31	6.65	5.78
Gujarat	21.6	8.16	16.39	40	26.98	37.77	6.28	21.05	3.58
Haryana	12.29	7.42	7.85	41.03	8.09	--	3.77	15.16	5.34
HP	10.63	0.01	2.47	37.23	52.88	0.03	6.66	--	4.54
J&K	3.2	0.92	3.28	72.04	10.36	50.73	4.91	5.09	4.72
Karnataka	21.63	13.9	14.21	69.42	10.36	5.62	8.9	27.16	3.73
Kerala	17.82	0.04	3.64	53.65	41.89	5.67	7.75	44.48	2.07
MP-Chhattis garh	22.08	7.53	39.95	62.79	31.44	18.26	6.54	15.67	7.48
Maharashtra	26.13	12.43	27.44	45.99	25.63	20.98	9.95	8.74	4.86
Odisha	12.11	0.03	13.01	67.76	93.3	0.03	6.22	0.68	4.18
Punjab	4.06	7.51	4.16	38.7	--	29.65	0.94	21.03	3.2
Rajasthan	11.82	18.33	25.27	53.44	41.31	7.81	4.07	17.39	6.49
Tamil Nadu	17.45	4.38	14.93	73.06	52.23	53.27	6.93	--	3.61
UP-Uttara khand	39.39	7.71	43.44	74.22	50.26	27.14	6.84	--	4.63
West Bengal	9.49	0.42	22.07	52.44	14.74	0.02	5.01	8.73	5.73
Total (20 States)	**289.76**	**102.95**	**323.91**	**60.4**	**24.66**	**18.32**	**6.59**	**12.37**	**4.96**

Source: Estimates based on Finance Accounts, GoI

Table 3.7b provides the quantum of public expenditure (revenue and capital) on rural roads and transport, rural energy, and rural development, and the share of capital expenditure (i.e. investment) under each head for TE 2014. Large inter-state variations may be observed in the investment pattern across the states under each head. As expected, the developed states tend to spend more on these infrastructural road and energy heads. Nearly 60 per cent of the expenditure on roads goes towards investment as compared to 24.66 per cent under rural energy. Hardly 18 per cent is spent on asset creation under rural development, which obviously shows that the government spends more on employment schemes and payment to workers on a day-to-day basis.

Given the large population in each state and variations in its size, it is important to assess the expenditure on these services on a per capita basis. Table 3.8 shows that the magnitude of rural per capita spending in development (social-economic) expenditure has shot up by four times, mainly in the developed states. Amongst the key services, spending varies across the states in a significant way. The per capita expenditure was the highest during TE 2013-14 at Rs.646.50 on rural road and transport in Kerala, Himachal Pradesh and Haryana; spending on rural energy was higher in the richer states; expenditure on agricultural R&D, which has been taken on a per hectare basis, was high in the less developed states and the developed states, at Rs. 2307.95

and Rs. 2799.90, respectively, as compared to Rs. 1540.77 in the middle income states. The HIS and MIS have spent more on irrigation as compared to LIS, which indicates a high density of population in the rural areas of LIS.

There are large inter-state differentials in spending on agricultural R&D, with the highest being Rs. 4968 per hectare in J&K, and the lowest at Rs. 531 per hectare in Rajasthan. One state, viz., Andhra Pradesh spends the maximum amount on irrigation (Rs. 10105/hectare) while Rajasthan, a state with scant rainfall, spends the least at Rs.713 per ha. It may be found that the developed states have spent more on roads, rural energy, education and health, which is obviously due to the higher economic growth in these states and hence their better spending power.

Table 3.8 Public expenditure per hectare and per rural capita (Rs.) at 2004-05 prices

State	Agricultural R&D/ha		Irrigation/ha		Per rural resident					
					Rural Roads		Rural Energy		Total Expenditure	
	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014
Andhra Pradesh	164	1838	1376	10106	73.4	266.1	18.1	172	2666	12467
Assam	573.7	2183	686	2128	152.1	342.6	0.01	0.5	2094	7682.6
Bihar-Jharkhand	239.9	2432	1347	3071	37.5	276.2	1.5	8.5	1197	4816.4
Gujarat	191.2	1620	1332	4561	137.2	613.4	1	231.7	2774	15928
Haryana	285.5	1281	1481	2910	388.4	730	20	442.4	3235	14570
Himachal Pradesh	2043	5351	803	5626	399.3	1688	-1.7	1.8	3862	17358
J&K	780	4969	1959	4646	228.9	343.8	36.7	97.2	4789	18380
Karnataka	160.6	1770	920	3646	71.7	568.5	0.4	365.8	2276	13362
Kerala	705.7	4398	1600	2193	89.3	646.5	0	1.4	2384	13391
MP-Chhattisgarh	137.6	762	615	1891	89.5	296.4	3.6	101.5	1812	8164.9
Maharashtra	210.8	1560	1093	3790	48.3	417.2	21.8	198.8	3403	16126
Odisha	259.9	2301	1222	3719	64.9	338.4	0.03	0.8	1872	7325.8
Punjab	317.6	1049	1082	1868	280.1	231.3	19.3	427.4	3243	13687
Rajasthan	61.4	532	553	713.8	109.8	222	9.6	343.6	1903	7329.9
Tamil Nadu	571.6	4341	729	2150	96.6	463.8	11.3	116.9	2608	18514
UP-Uttarakhand	182	1195	1265	2537	66.7	236.3	0.4	46.2	1462	6368.4
West Bengal	297.3	1264	596	1037	59.1	150.4	0.4	6.7	1600	7470.5
Total (20 States)	**222.4**	**1532**	**1012**	**3206**	**89.2**	**340.6**	**6**	**121.1**	**2107**	**9710**

Source: based on Finance Accounts and Bathla, Joshi and Kumar (2017).

Note: Irrigation excludes expenditure on flood control.

Table 3.1 in Annex 3 provides the state-wise estimates on public investment 'in' and 'for' agriculture on a per hectare basis at the 2004-05 price.

While public investment 'in' agriculture includes agriculture and irrigation (excluding flood control), public investment 'for' includes agriculture per se, irrigation (excluding flood control), plus rural energy, rural roads for transport and rural development. The caveat is that the state-wise estimates on public accounts are on the higher side as compared to the official NAS statistics available at the all-India level as the former are gross figures and also include investments in financial assets.[42] Similarly, estimates on private investment are culled out from

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[42] As per NAS, public GCFA in agriculture–irrigation in 2012-13 at 2004-05 prices was nearly Rs. 240 billion, which is lower than estimates on capital expenditure, at nearly Rs. 360 billion (excluding expenditure on flood

AIDIS for the respective survey year based on a representative household sample and are again not comparable with the official statistics. NAS data includes broader areas of investment such as in tea and coffee plantations, livestock (from the livestock Census), forestry, and fishery sectors. However, in this report investments by rural households in agriculture and allied activities only are taken as available in AIDIS at the State level.

The analysis shows a sizeable increase in public investment in each state towards the end of the 2000s, with the 20 states average being Rs. 653/hectare to Rs. 2328/hectare. Similarly, private investment also increased from Rs.471/hectare to Rs. 687/hectare and then to Rs.1645/hectare in 2012-13.

The states that have registered a per hectare public investment below the national average in the recent period include Assam, Kerala, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Tamil Nadu, Rajasthan, Punjab and Odisha. In the case of private investment, the states of Gujarat, Haryana, Himachal Pradesh, J&K, Karnataka, Kerala, Maharashtra and Punjab have made significant strides, perhaps due to better banking infrastructure and opportunities. The less developed states continue to lag behind, which indicates a strong need to increase the flow of credit in these states.

It is also important to study the size of the total expenditure (revenue + capital) on key heads in the rural areas and the relative status of agriculture and irrigation. As shown in Table 3.9, the spending on agriculture and irrigation, and for that matter, on rural roads and energy, is miniscule (upto 1 per cent of GSDP) at the national level.

If taken together, the share of agriculture and irrigation is hardly 2 per cent and is lower than the fraction of GSDP on education at almost 3 percent. Even if agriculture expenditure is seen as a percentage of agricultural GSDP, the share is almost 5 per cent in the less developed states compared to 7 per cent in the developed states. The share of capital expenditure i.e. investment in GSDP income would have a much lower size.

The respective state governments have accorded less priority to spending in rural areas though the share of spending on economic and social services remains at 65 per cent. There has been an improvement in the rate of growth in agricultural spending during the 2000s at 8.9 per cent across the states. Among the states, Andhra Pradesh, Assam and Gujarat have accorded high priority to agriculture, where expenditure exceeds 1 per cent of GDP. Andhra Pradesh gives high importance to irrigation as its spending share in GSDP is the highest at 2.65 per cent. Among rural roads, health and other services, the states have completely ignored development of the rural areas.

Table 3.9 Size of public spending (Expenditure/GSDP) (%)

	Agriculture and Allied	Irrigation	Rural Roads	Rural Energy	Rural Development

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control) from Finance Accounts. The former are finer estimates based on actual expenditure after making allowance for depreciation of assets.

State	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014
Andhra Pradesh	0.7	0.66	2.07	2.65	0.4	0.34	0.1	0.22	0.95	0.6
Assam	1.51	1.44	1.3	1.29	0.96	1.12	0	0	0.35	0.68
Bihar-Jharkhand	1.41	1.01	3.54	1.07	0.7	1.3	0.03	0.04	1.65	1.81
Gujarat	0.75	0.65	2.44	1.11	0.61	0.5	0	0.19	0.81	0.38
Haryana	0.94	0.77	2.51	0.59	1.6	0.65	0.08	0.4	0.45	0.42
HP	3.74	1.79	0.7	0.76	2.34	2.39	-0.01	0	0.66	0.55
J&K	1.93	2.89	1.72	1.29	1.09	0.92	0.18	0.26	0.51	0.92
Karnataka	0.89	1.51	1.86	1.1	0.37	0.69	0	0.44	0.53	0.45
Kerala	0.91	1.1	1.05	0.24	0.5	0.8	0	0	0.64	0.16
MP-Chhattisgarh	2.53	1.85	2.77	1.24	0.9	0.72	0.04	0.25	0.86	1.31
Maharashtra	1.72	0.66	1.88	0.8	0.19	0.31	0.09	0.15	0.52	0.33
Odisha	1.28	1.61	2.65	1.25	0.52	0.85	0	0	0.73	0.93
Punjab	0.69	0.45	1.46	0.55	0.98	0.25	0.07	0.45	0.28	0.25
Rajasthan	0.72	0.76	2.4	0.54	0.83	0.5	0.07	0.78	0.61	1.08
Tamil Nadu	1.23	0.82	0.65	0.31	0.5	0.38	0.06	0.1	0.96	0.33
UP-Uttarakhand	0.6	0.74	2.19	0.94	0.59	0.78	0	0.15	0.88	0.86
West Bengal	0.85	0.43	0.73	0.27	0.41	0.27	0	0.01	0.42	0.63
All States	**1.14**	**0.9**	**1.91**	**0.95**	**0.59**	**0.58**	**0.04**	**0.21**	**0.72**	**0.64**

Source: based on Finance Accounts and NAS.

3.6 Investments for Increased Productivity and Agriculture Income

Given the magnitude and composition of private and public investments in agriculture across the states, it is important to examine the extent to which these have impacted agricultural growth and productivity. As mentioned above, while private investments on irrigation, implements and machinery, and livestock would directly contribute to growth, infrastructural investments and agricultural R&D, undertaken primarily by the government, impact agricultural growth through multiple pathways. Table 3.10 provides descriptive statistics on irrigation intensity, foodgrain production, land productivity (GSDPA/ha) and GSDPA to gauge the impact of investment on agriculture.

There has been a significant growth in each economic head in almost every state over the period. The average land productivity during TE 1982 was Rs. 17,329, which rose to Rs. 39,807 during TE 2014. The HIS have achieved more than the national average at nearly Rs.63,000, and in some states like Himachal Pradesh, J&K and West Bengal, the corresponding figures are more than Rs.1,00,000.Land productivity grew between 3 and 4 per cent per annum during the 2000s. The less developed states have experienced higher rates of growth in recent years, which has been possible due to a marked improvement in irrigation investment and foodgrain production. An improvement in the rate of growth in GSDPA is also visible in the agriculturally less developed states such as Bihar, Jharkhand, and Chhattisgarh. A somewhat higher response in LIS could perhaps be explained by unfavourable initial conditions and higher magnitude of poverty in most of the states.[43]

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[43]Bathla, Joshi and Kumar, 2017.

Table 3.10 Irrigation intensity, farm production and productivity (2004-05 prices) and annual rate of growth during 1981-2014

	Irrigation Intensity 2013	Foodgrain Production (thousand tons)		Land Productivity (Rs.)		GSDPA Rs. Billion		Foodgrain Production (% Growth)	GSDPA
	NIA/ NSA	TE 1984	TE 2014	TE 1984	TE 2014	TE 1984	TE 2014		
Andhra Pradesh	46.84	11,489	19,053	29,036	73,554	327	819	2	3.3
Assam	5.66	2634	4803	39,650	64,126	107	180	1.7	1.4
Bihar-Jharkhand	29.5	8477	18,660	24,879	77,697	196	514	1.8	2.7
Gujarat	41.09	5076	8113	22,181	46,279	214	477	2.3	3.3
Haryana	99.4	6525	17,053	29,855	84,905	109	298	3.2	3.2
HP	19.05	1026	1447	52,546	1,46,581	30	79	0.8	3.2
J&K	40.62	1216	1490	55,462	1,00,751	41	77	0.7	2.5
Karnataka	37.66	6861	11,743	19,083	44,632	199	419	2.1	2.4
Kerala	16.46	1309	532	51,187	99,014	111	199	-3.1	2.1
MP-Chhattisgarh	38.89	13,718	29,886	9329	37,312	178	747	1.9	4.5
Maharashtra	18.7	10,246	12,403	11,219	38,100	205	662	0.9	4.2
Odisha	31.28	5672	7590	25,778	55,511	157	228	0.7	1
Punjab	99.3	14,084	27,597	36,762	87,533	155	360	2.2	2.7
Rajasthan	46.74	8521	18,543	10,327	27,969	164	496	2.9	3.7
Tamil Nadu	60.8	6139	7907	25,486	69,263	143	348	0.1	2.7
UP-Uttarakhand	38.95	26,652	52,236	27,043	61,590	467	1069	2	2.7
West Bengal	59.3	7191	16,530	34,956	1,09,749	191	595	2.4	3.7
Total (20 States)	**56**	**1,36,834**	**2,70,301**	**20,956**	**54,827**	**2954**	**7578**	**2**	**3.1**

The statistics also show a continuous increase in the irrigation intensity over the years, albeit slowly. Haryana and Punjab were nearly 100 per cent irrigated states in 2013 whereas Assam, Kerala and Maharashtra are rainfed states characterised by low irrigation intensity. While an increase in area under irrigation in each state is visible, the percentage area irrigated by canals (owing to public investment) has remained unchanged and is less than 40 percent. This is despite an enormous increase in resources towards development of canal irrigation during the 2000s. In some states, viz., Odisha, Rajasthan, Andhra Pradesh, Gujarat, and Karnataka, improved investment has led to an increase in the area irrigated by canals, but it appears trivial in view of a sizeable spending on irrigation ranging from Rs.104 billion to Rs. 340 billion between 2000-01 and 2013-14.

This situation points to inefficiency in the use of public resources. Also, the irrigation intensity of public canals is much lower than that of tubewells owned by farmers.[44]Clearly, farmers depend more on micro irrigation (bore wells, tanks) as compared to public canals.

The empirical analysis also verifies a positive impact of private and public capital formation on agriculture productivity and income, though in varying proportions. It is difficult to say which public investment would yield higher returns to agriculture as the impact of many would be indirect through an increase in production and marketable surplus, and a reduction in prices. One may argue that while investment 'in' agriculture directly influences agriculture through increase in land productivity that 'for' agriculture may have an indirect impact through improvement in

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[44]Bathla, Joshi and Kumar 2017.

infrastructure and higher wage rates. Table 3.11 provides elasticity estimates based on a quantification of the relationship between investment (both public and private) and farm income (GSDPA) at the state level, worked out using a three stage least squares (3SLS) model by Bathla and Kumari (2017). It shows that private investment in agriculture is influenced by public investment in irrigation, institutional credit, terms of trade and infrastructural variables, viz., road density and electricity consumption. Public investment bears a complementary relationship with private investment (elasticity 0.48).

Table 3.11 Private and public investments and agricultural income during 1981-2013, based on 3SLS

Dependent Variable/Explanatory variables	Coefficient	Dependent Variable/ Explanatory variables	Coefficient
Private GCFA:		**Public GCFA (Irrigation):**	
Institutional Credit	0.31*	Size of Public Spending	0.27*
Public GCFA (Irrigation)	0.48*	Per Capita Income	1.2*
Investment Preference (%Share of residential expenditure in total expenditure)	-1.2*	Input Subsidy	-0.098*
TOT (3 years moving average)	0.83*	Growth Deficit	-0.03
Road Density	0.26*	Trend	-0.02*
Electricity Consumption Agriculture	-0.13*		
Rural Literacy	-0.03		
Constant	-0.65	Constant	38.2
Adj R-squared	0.90	Adj R-squared	0.81
Agriculture Income (GSDPA):		**Terms of Trade:**	
Private GCFA	0.083*	Agriculture Income	-0.30*
Public GCFA (Irrigation)	0.49*	World Price Index	0.20*
Public Investment in R&D	0.10*	Growth in Non-agriculture Income	0.19*
GCA	0.19*	Dummy (reforms)	0.08*
Labour	0.17*	Trend	0.013*
Road Density	0.04		
Electricity Consumption Agriculture	0.11*		
Rainfall	0.08*		
Constant	1.17	Constant	9.14*
Adj R-squared	0.91	Adj R-squared	0.61

Source : Bathla and Kumari (2017).

Notes: No. of observations 527 (17 states; time period: 1981 to 2013). Variables are specified on a per hectare basis in double log form. Variables converted into 2004-05 prices using GDCF and SDP deflators.
* and ** denote level of significance at 1 and 5 percent, respectively.

A positive relationship between investment and institutional credit in the literature (Kumar, Mishra, Saroj and Joshi, 2017) is reconfirmed through a positive elasticity at 0.31. The terms of trade, which has also been taken as an endogenous variable, is negatively influenced by agricultural income and positively influenced by non-farm income and the world price index. As compared to private investment, public investment is determined by the size of public spending, and income of the respective state. Spending on input subsidies negatively affects investment in agriculture, as shown by the elasticity value of 0.098. However, the results might differ in the case of the poorer states.

The impact of both investments on agriculture income turns out to be positive and statistically significant. The elasticity is the highest for public irrigation at 0.49, followed by that for land, labour and private investment. Public spending on agricultural R&D (including soil conservation and crop-animal husbandry) is also important for raising productivity, showing elasticity to be 0.10. Infrastructure and rainfall also impact agriculture income.

The findings validate earlier studies on the vital role of institutional credit, terms of trade, and investments in impacting income.[45] Across land holding size, Bisaliah, Dev and Saifullah (2013) found that land, credit availability and literacy had a positive impact on the capital formation of marginal, small and large farmers during the period 1994-95 to 2007-08. In contrast, investments by semi-medium and medium farmers were influenced by land and credit. Farmers investing in the Kangra district in Himachal Pradesh received financial assistance, which helped increase investment by 277 per cent in machinery and implements, 26 per cent in livestock, and nearly 3 per cent in farm buildings, with the overall average increment being 28 percent.[46]

3.7   Marginal returns in terms of agriculture income from key investments

Private investment and the selected heads of public spending positively impact agricultural income. However, not all public expenditures have a similar marginal impact. The impact has been seen to differ quite significantly among the social and economic heads of expenditure, and also across the states. Table 3.12 furnishes estimates on the differential effects of such investments on welfare (both direct and indirect) across the states. The estimates have been obtained from Bathla, Joshi and Kumar (2017), derived from a structural equation model based on 13 equations each for the three groups of states.

The marginal effects of various expenditures have been estimated by using the estimated elasticities and expressed as: (a) increase in agricultural GDP (Rupees per unit of spending averaged during the period 2011-12 to 2013-14), and (b) reduction in poverty headcount (number of rural poor brought out of poverty per unit of spending). It enables us to compare the relative benefits of an additional unit of expenditure across different types of investment items in each state and to prioritise the spending heads.

The all-India picture shows the highest returns accruing from private investment in irrigation and public investment in agricultural R&D, followed by education, health and energy. Returns on the first four heads of spending, namely, private investment, public education, R&D and health, were as high as 9.72, 2.47, 2.39 and 1.84, respectively, indicating returns of 972, 247, 239 and 184 percent, respectively, from additional public spending on these services. However, cross-state analysis shows a better ranking of R&D, education, and health, more so in the agriculturally less developed states. Irrigation investment ranks the lowest in the MIS.

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[45]Dhawan, 1998; Gandhi 1990; Mishra and Hazell, 1996; Gulati and Bathla, 2001; Chand and Kumar, 2004; Bathla, 2014.
[46]Chandel and Swarup, 2015.

Table 3.12 Marginal effects of additional investments and subsidies on agricultural income and rural poverty: 1981-2014

Investment area	Income (Rs.per Rs.Spent)				Ranking			
	All States	HIS	MIS	LIS	All States	HIS	MIS	LIS
Rural Development	0.14	0.01	0.02	0.01	8	8	7	8
Irrigation Investment (Canals)	0.15	0.19	0.01	0.64	7	6	8	6
Road Investment	0.42	0.06	1.42	0.21	6	7	4	7
Energy Investment	1.73	1.57	1.18	1.01	5	4	5	5
Health Investment	1.83	1.55	0.84	1.74	4	5	6	3
Education Investment	2.39	1.74	2.27	1.5	3	2	3	4
Agricultural R&D Investment	2.47	3.23	4.44	9.92	2	1	1	2
Private Investment (Tubewell Irrigation)	9.72	1.66	2.87	19.8	1	3	2	1
Poverty: Decrease in No. of Rural People Per Rs.Millions of Spending								
	All States	HIS	MIS	LIS	All States	HIS	MIS	LIS
Irrigation (Canals) Investment	3	5	21	43	8	8	7	5
Road Investment	35	18	55	28	7	7	4	8
Agriculture R&D Investment	45	85	136	1231	6	4	1	2
Education Investment	88	214	88	31	5	2	3	6
Energy Investment	97	68	30	66	4	5	6	4
Health Investment	109	115	43	30	3	3	5	7
Private Investment (Tubewells)	166	55	88	1286	2	6	3	1
Rural Development	605	253	92	124	1	1	2	3

Source: Bathla, Joshi and Kumar (2017).

Note: Based on averages from 2011-12 to 2013-14,derived through
      direct and indirect effects, using the Structural Equation Model.

Rural development has not had much impact on agricultural income but is important in poverty alleviation across the states. Clearly, the ranking of the marginal impacts of various types of spending on rural poverty is different from that on agricultural GDP. Spending on rural development ranks first, which could be due to a big push in employment programmes during the 2000s. This is followed by private irrigation investment, health, energy and education, in that order.

The common themes in the rankings of farm income growth and poverty reduction include spending on private investment, and public spending on agricultural R&D, which is ranked high for both poverty and income. One possible explanation is that spending on R&D helps to facilitate growth while at the same time cutting down poverty through private investment, income, productivity and other pathways (Fan, 2008). The returns differ across the states, suggesting a location-specific policy for the agricultural sector.[47]

3.8 Futuristic Investment Requirements for Doubling Farm Income

This section provides estimates on the projected investment requirements in agriculture on private and public accounts, which can contribute towards doubling of income in this sector in the next seven years. The quantification is based on a standard methodology that is used in the literature, viz., Incremental Capital Output Ratio (ICOR). The ICOR estimates additional unit

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[47]A high ranking of private investment in irrigation in accelerating income should not be taken to mean that such investment is encouraged it without considering its environmental impacts. A cautious approach is required in each state in view of the level of water tables and soil health.

of capital or investment that is needed to produce an additional unit of output for a particular period. It is taken as a measure of capital efficiency, estimated as: i/g

where i = investment (GFCF) and g is GSDPA growth.

It is also an indicator of the efficiency of capital use. The marginal efficiency of capital is estimated as 1/ICOR. Since the official GFCF in agriculture is not estimated at the state level, the ICOR is computed using GCF on private account (rural farm households) from AIDIS at four points of time (1981-82 to 2012-13). The same on public account is estimated based on the capital expenditure incurred by the respective state governments on: (a) agriculture and allied activities, (b) major, medium and minor irrigation and command area development (excluding flood control), (c) rural energy, and (d) rural road and transport.

The estimates have been worked out for seven time periods, starting from 1981-82 to 2013-14, approximately corresponding to the five-year plan periods. Public investment in agriculture, which also includes expenditure on agriculture and irrigation, has been extended to include rural roads and transport and energy with an aim to make it "for" agriculture.

In order to address large variations in the series, three yearly moving averages of investments and GSDPA (at factor cost), centred at the mid-point of the triennia, have been worked out. The ICOR is then estimated by taking the ratio of the annual averages for a five-year period of capital expenditure and incremental GSDPA, derived from three yearly moving averages.

The exercise has been carried out at 2004-05 prices for each of the selected states without accounting for changes in the stocks and depreciation of assets under the respective investment heads. The ICOR on public investment, is estimated for each of the selected states, and together for all 20 states. This ICOR estimate is not for all-India and hence may not be comparable with the estimates made in other studies. The ICOR on private investment is estimated separately for 20 select states and for all States/UTs of India.

The average ICORs for the period 2007-08 to 2011-12 and 2012-13 to 2013-14 on each of the public and private heads have been applied to find the required investment rate under an unchanged growth scenario of annual growth in farm income for each state till 2022-23. At first, investments are estimated for the base year (2015-16), using the annual real rate of growth in private investment from 2002-03 to 2012-13, and in public investments from 2000-01 to 2013-14. The respective ICORs have been multiplied with the targeted real annual rate of growth in farm income to get the required real annual investment rate.

The quantum of investment required by 2022-23 has been calculated presuming that farmers' income from agriculture and livestock activities would grow at the same rate each year with no change in the level of efficiency. As shown in chapter 6, the annual real rate of targeted growth in farm income for contribuitng to doubling farmers' income is estimated at 9.23 per cent.

Going by the extant literature and standard assumptions in the traditional Harrod–Domar framework, the ICOR has been calculated on the assumptions that: (a) the farm economy is on

a steady path, (b) investments translate into productive capacity without much lag, (c) full capacity utilisation exists, and (d) there is an unchanging production structure and no technological change (GoI 2012). It is reasonable to assume that the output from some public investment will have some lag period. Lag is not considered because the investments required for enhancing farm income may be directed into the ongoing projects and possibly have some immediate and intermediate impacts.

One may observe a definite pattern in the behaviour of ICORs over the five-year plan periods from 1981-82 to 2013-14. On private investment, ICOR was at a level of 0.79 during the Sixth Five Year Plan, 1981-82 1984-85, which increased to 1.33 during the Ninth Plan (1997-98 to 2001-02) and then to almost 0.71 during the successive period..

As compared to private investment, ratios on public account show wide fluctuations, mainly due to investments in major and medium irrigation systems. Taking the weighted average of public investments together on various heads, ICOR turned out to be 0.50 during the early 1980s, and doubled by the period 1997-98 to 2000, decreased to 1.02, and again went up to 0.83 during the period 2007-08 to 2011-12. It shows some improvement in the efficiency of investment during the Tenth Five Year Plan (2002-03 to 2006-07).

Table 3.13 provides estimates on average ICORs from 2007-12 to 2012-14 across the selected individual states and the select 20 states. The ICOR is found to be much higher in public investment as compared to that in private investment. The ICORs vary from nearly 2 in Punjab and HP to as low as 0.10 each in Bihar, Chhattisgarh and Jharkhand on private account. In case of public investment, no pattern as such is visible on any economic head. A higher ICOR on public account may explain the existence of a large unutilised capacity.

The analysis indicates that relatively higher capital intensity may be required on public irrigation at almost 1.04, followed by roads-transport at 0.57, and agriculture and energy at 0.15 and 0.09, for select states together. Taking public investment 'for' agriculture weighted by the share of each expenditure head in GSDP, the average ICOR turns out to be the highest at 4.3 in J&K; 3.7 in Andhra Pradesh, 3.4 in Gujarat, and lowest in West Bengal at 0.05; Punjab at 0.09 and Rajasthan at 0.15. Among all the states, a higher ratio on public account is found for Andhra Pradesh, Gujarat, Himachal Pradesh, J&K, Maharashtra, Odisha and Uttarakhand. For select states together, the ICOR on public account is estimated at 0.75.

The lowest is found in Punjab, WB, Rajasthan and Haryana. Taking all the LIS together, the ICOR is higher at 1.95 as compared to 1.32 in the MIS, and 0.98 in the HIS, indicating considerable public investment requirements in low productivity and the agriculturally less developed states.. Another important finding is that the LIS show a consistent pattern in the ICOR from 1997 onwards. The ratios on every head of Investment have decreased, indicating an improvement in the efficiency of investment (MEI) from the Ninth Plan onwards (1997-02 to 2012-13).

Table 3.13 Estimated ICOR on public & private accounts (averaged 2007-12 & 2012-14) **at 2004-05 prices**

State	Private Investment		Public Investment				Public Investment 'for' Agriculture(weighted)	Private & Public Investments
	Agriculture & Allied	Irrigation	Agriculture & Allied	Irrigation (excluding. flood control)	Rural Energy	Rural Roads & transport		
Andhra Pradesh	0.36	0.11	0.01	2.04	0.00	0.18	3.73	4.09
Assam	0.19	0.02	0.01	0.45	0.00	0.69	0.61	0.80
Bihar	0.09	0.012	0.03	0.33	0.02	1.20	1.44	1.52
Gujarat	1.03	0.48	0.46	4.47	0.24	0.90	3.36	4.36
Haryana	0.64	0.18	0.40	0.46	0.16	0.43	0.29	0.93
Himachal Pradesh	1.82	0.196	0.23	0.89	0.00	1.94	1.89	3.71
J&K	0.82	0.017	2.51	1.72	0.30	4.00	4.55	5.10
Karnataka	0.46	0.196	0.02	1.36	0.11	0.49	1.51	1.96
Kerala	1.43	0.144	0.29	0.19	0.00	1.52	0.68	2.10
Madhya Pradesh	0.44	0.14	0.02	0.59	0.09	0.30	0.72	1.17
Maharashtra	1.20	0.44	0.41	2.57	0.12	0.47	1.51	2.71
Odisha	0.47	0.06	0.12	1.92	0.00	1.27	2.03	2.50
Punjab	2.28	0.28	0.03	0.50	0.01	0.41	0.09	2.37
Rajasthan	0.89	0.30	0.05	0.24	0.22	0.17	0.15	1.04
Tamil Nadu	0.77	0.39	0.81	0.69	0.28	1.65	0.62	1.39
Uttar Pradesh	1.22	0.05	0.24	0.45	0.17	0.83	0.60	1.82
West Bengal	0.24	0.01	0.10	0.10	0.01	0.28	0.05	0.29
Chhattisgarh	0.11	0.014	0.06	0.78	0.02	0.54	1.01	1.12
Jharkhand	0.10	0.01	0.01	0.30	0.00	0.34	0.37	0.46
Uttarakhand	0.59	0.002	0.39	1.33	0.05	2.47	2.27	2.86
Bihar-Jharkhand	0.09	0.01	0.02	0.31	0.01	0.84	0.92	1.01
MP-Chhattisgarh	0.36	0.11	0.03	0.62	0.06	0.35	0.76	1.12
Uttar Pradesh-Uttarakhand	1.18	0.049	0.25	0.50	0.16	0.92	0.68	1.87
Total 20 states	0.72	0.18	0.15	1.04	0.09	0.57	0.75	1.47

Note: Private investment in agriculture and allied activities is for all India and includes irrigation also. Separate estimates for irrigation are given to gauge their importance across the states. Karnataka ICOR relates to 2007-12; weighted average is based on the share of the respective public expenditure in GSDP; ICOR for 20 select states is estimated separately.

The estimates on Marginal Efficiency of Investments (MEI) are presented in Table 3.2 for all select states together and for three groups. It shows positive and high capital intensity, which is different from the earlier decades when erratic trends were noticed in many states.

In the following sections, estimates on the annual growth in investment needed (from the base year 2015-16) to enable an increase in the income levels of farmers from 'farm income' in each state, have been provided. It has been found that an annual increase of 9.23 per cent in farm income (cultivation and livestock) is required to contribute to doubling of farmers' income by 2022-23. As shown in Table 3.14, for achieving this rate of growth, the required annual growth in gross public investment 'for agriculture' is 6.92 per cent for all the 20 select states put together. The private growth rate in investment is estimated to be 6.62 per cent at all India level. The total annual investment (public and private) required for enhancing the farm income is 13.54 per cent.

A bifurcation of investment into private and public accounts reveals a slightly higher investment requirement on the latter, which may further go up if required public investments in the north eastern states and UTs are also considered. The investment required on public account is reasonably higher on irrigation systems, followed by rural roads-transport across many states. The annual rate of growth in investment for the creation of such infrastructure is much higher in the less developed states, which have been lagging behind the other states for long. On private account, the macro national picture entails an increase of 6.62 per cent in investment per year, varying from 19.8 per cent in Punjab to nearly 1 per cent in Bihar, Jharkhand and Chhattisgarh. It implies a strong need for an adequate flow of credit to the agriculturally less developed states for accelerating agricultural growth.

Table 3.14 Annual % increase in investment required to facilitate 9.23% rate of growth in farm income

State	Private Investment		Public Investment				Public Investment 'for' Agriculture (weighted)	Private & Public Investments
	Agriculture & Allied	Irrigation	Agriculture & Allied	Irrigation (excluding. flood control)	Rural Energy	Rural Roads & transport		
Andhra Pradesh	3.17	0.94	0.06	17.71	0.01	1.55	32.37	35.54
Assam	1.79	0.14	0.11	4.27	0.02	6.57	5.82	7.61
Bihar	0.75	0.10	0.24	2.83	0.18	10.38	12.46	13.20
Gujarat	9.60	4.57	4.38	42.92	2.28	8.64	32.26	41.86
Haryana	5.92	1.66	3.70	4.23	1.46	3.95	2.70	8.61
HP	16.99	1.83	2.15	8.33	0.03	18.13	17.67	34.66
J&K	7.87	0.16	24.70	16.88	2.97	39.36	42.31	50.18
Karnataka	4.50	1.92	0.23	13.32	1.11	4.81	14.78	19.29
Kerala	12.49	1.26	2.53	1.68	0.03	13.29	5.93	18.42
Madhya Pradesh	4.84	1.58	0.26	6.50	1.04	3.32	7.94	12.77
Maharashtra	10.79	3.94	3.64	23.06	1.09	4.18	13.55	24.34
Odisha	5.07	0.65	1.27	20.68	0.03	13.63	21.87	26.94
Punjab	19.80	2.44	0.25	4.31	0.08	3.54	0.77	20.57
Rajasthan	8.33	2.82	0.50	2.20	2.05	1.61	1.42	9.75
Tamil Nadu	8.06	4.07	8.41	7.24	2.90	17.17	6.43	14.50
Uttar Pradesh	10.13	0.43	2.03	3.74	1.44	6.89	4.99	15.12
West Bengal	1.97	0.08	0.81	0.86	0.12	2.35	0.40	2.37
Chattisgarh	1.21	0.16	0.63	8.49	0.26	5.83	10.95	12.17
Jharkhand	0.93	0.08	0.13	2.94	0.00	3.29	3.59	4.52
Uttarakhand	4.89	0.02	3.24	11.08	0.41	20.69	19.00	23.89
Bihar-Jharkhand	0.83	0.09	0.20	2.90	0.07	7.76	8.44	9.27
MP- Chattisgarh	3.98	1.23	0.34	6.74	0.66	3.77	8.27	12.25
UP &Uttrakhand	9.86	0.41	2.08	4.18	1.31	7.64	5.70	15.56
Total 20 states	**6.62**	**1.62**	**1.41**	**9.57**	**0.82**	**5.25**	**6.92**	**13.54**

Source: Finance Accounts, AIDIS, GoI.

Note: Targeted real annual growth in farm income is taken from chapter 6; Investment rate on private account is at all India. Public investment rate relates to select 20 states. Based on gross estimates, that is, inclusive of expenditure on inventory (stock) and depreciation of assets, each roughly estimated between 5-10%.

One may find a lower rate of growth in investment on account of irrigation (mainly tubewells) in UP and Haryana, and the hilly states. The rate of growth in irrigation investment is found to be negative and low during the period 2002-12 in most of the states, and high and positive in transport and machinery, thereby indicating the changing preferences of farmers in the

developed states. These investment rates have been multiplied with the base year (2015-16) investment on each head to calculate the absolute amount required in the successive seven years for achieving the targeted rate of growth in farm income with an aim to double farmers' income.

Table 3.15 lists the estimates and shows that farmers would need a cumulative capital investment of Rs. 463 billion over the 7 years period of 2016-17 to 2022-23, increasing at an annual rate of 6.62 per cent from the base year (2015-16) investment of Rs. 296 billion. For the same on public account, presuming that the marginal efficiency of investment (MEI) on each economic head would remain unchanged, the gross cumulative investment required would be Rs.58.5 billion for agriculture and allied activities, Rs. 626.4 billion for minor, medium and major irrigation systems, Rs.32.3 billion for rural energy, and Rs. 323.6 billion for rural roads for transport infrastructure. The base year investment (2015-16) for agriculture stands at Rs. 640.2 billion which needs to scale up to a total of Rs. 1023 billion over the period of 7 years (by 2022-23), growing at a rate of 6.92 per cent per annum.

Table 3.15 Investment requirements over a 7 years period of 2016-17 to 2022-23 (Rs. billion) at 2004-05 prices

State	Private Investment: Agriculture & Allied	Irrigation	Public Investment: Agriculture & Allied	Irrigation (exc. Flood control)	Rural Energy	Rural Road-Transport	Investment 'for' Agriculture (Weighted)
Andhra Pradesh	21.71	4.28	0.36	270.47	0.08	9.50	679
Assam	2.26	0.22	0.25	5.74	0.01	10.32	17
Bihar	3.42	0.08	2.75	8.60	0.37	75.06	109
Gujarat	45.46	7.95	7.38	646.37	9.89	19.34	551
Haryana	7.62	1.05	11.42	5.16	0.69	8.69	24
HP	17.54	1.55	0.55	2.90	0.01	14.58	21
J&K	3.84	0.00	26.72	6.30	0.11	27.39	125
Karnataka	28.19	11.40	1.70	79.61	14.99	29.40	183
Kerala	35.47	1.70	2.89	2.02	0.04	31.78	26
Madhya Pradesh	56.97	15.27	1.51	44.40	2.16	14.46	74
Maharashtra	88.77	16.77	14.96	248.93	3.98	19.63	215
Odisha	3.33	1.68	0.72	41.44	0.06	23.72	86
Punjab	49.93	1.23	0.22	2.21	0.00	2.42	3.97
Rajasthan	48.85	8.66	2.21	5.26	13.37	8.80	29
Tamil Nadu	9.32	2.94	11.40	11.21	8.15	50.32	57
Uttar Pradesh	124.62	1.57	1.38	18.15	5.32	55.10	77
West Bengal	4.72	0.34	3.29	1.49	0.05	6.46	10
Chattisgarh	1.38	0.08	0.62	17.17	2.11	9.48	39
Jharkhand	2.96	0.63	0.65	8.19	0.00	11.41	21
Uttarakhand	1.16	0.00	6.10	8.50	0.21	20.71	50
Bihar-Jharkhand	6.76	0.26	3.74	16.73	0.14	76.86	111
MP- Chattisgarh	54.02	14.04	2.21	61.90	2.66	24.76	110
UP &Uttrakhand	122.46	1.61	2.82	23.60	5.03	66.99	95
Total 20 states	**463**	**66.53**	**58.54**	**626.42**	**32.26**	**323.55**	**1023**

Sources: AIDIS and Finance Accounts.

Note: Targeted rates are estimated on ICOR for both at individual state level and group level. Public investment is in reference to the 20 select states, whereas private investment estimates signifies all India. Public investment 'for' agriculture is based on the weighted average of each investment. Total investment for each individual state

may not sum up to the total investment estimated for the select 20 states as ICOR is estimated separately for individual state and at group level.

Table 3.16 Futuristic Public and Private Investments during 2015-16 and 2022-23 at 2004-05 Prices

Private* Investment in Agriculture		Public# Investment 'for' Agriculture	
2015-16 (Base year)	2016-17 to 2022-23 (7 years)	2015-16 (Base year)	2016-17 to 2022-23 (7 years)
Rs. 296 billion (Rs. 29,559 crore)	Rs. 463 billion (Rs 46,298 crore)	Rs. 640 billion (Rs. 64,022 crore)	Rs. 1023 billion (Rs. 1,02,269 crore)

Note: * Private investment by farmers, estimated at all India level, growing @ 6.62 per cent per annum.
         # Public investment estimated for 20 select states, growing @ 6.92 per cent per annum.

The futuristic total public investment 'for' agriculture would be Rs. 1023 billion at 2004-05 prices, for the select 20 states taken together. Across the states, Gujarat, Maharashtra, Punjab, Rajasthan, Madhya Pradesh and Uttar Pradesh may require relatively higher amounts of private capital at Rs. 45.46 billion, Rs.88.7 billion, Rs.49.93 billion, Rs.48.85 billion, Rs.56.97 billion, and Rs. 124.62 billion, respectively. Similarly, capital requirements on public account are found to be much higher in Andhra Pradesh, Gujarat, Maharashtra and the poorer and agriculture-dominant states, viz., J&K, Bihar, Uttar Pradesh, and Madhya Pradesh, at close to Rs. 100 billion in each. Some of the developed states may require much higher resources due to an increased spending on public irrigation systems in recent years. The estimated requirements on a per hectare basis have been provided in Table 3.17.

The private investment in agriculture and allied activities that would be required in 2022-23 is Rs.3366 at 2004-05 prices. Irrigation requirements (Rs.484/hectare) are considerably lower, indicating the farmers' increasing requirements for implements and machinery, and transport. The per hectare investment requirements on public irrigation and road transport turn out to be much higher, at Rs.4554 and Rs.2352. If public investments 'for' agriculture are taken into account, India would require an amount of Rs.7435 per hectare to double farm income by 2022-23. The requirements in AP, J&K and Uttarakhand are relatively higher than in most of the other states.

Apparently, the projected capital requirements on public accounts are much higher as compared to those on private accounts, which in a way, highlights the key role of the government in the agricultural sector, especially in the less developed states. However, it is heartening to learn from the data that the public investments have been rising substantively, and in 2015-16 the growth rate was already touching 10.9 per cent per annum, based on the investments for the period 2000-01 to 2013-14.

It would therefore be imperative to maintain the desired growth rate in public investment of 6.92 per cent per annum, at least. It would also be useful to know that this quantum of public investment can be further reduced: i) by improving the efficiency of use of funds in various projects; and ii) by promoting private corporate investments (other than through farmers).

Table 3.17 Per hectare investment requirement in 2022-23 (Rs.) at 2004-05 prices

State	Private Investment Agriculture	Private Investment Irrigation	Public Investment Agriculture	Public Inv. Irrigation (Excluding Flood)	Public Investment Energy	Public Investment Road-Transport	Public Inv.'for' Agriculture
Andhra Pradesh	1954	386	32	24347	6.91	856	61136
Assam	805	77	90	2040	5.31	3670	5898
Bihar	601	13	484	1514	65	13212	19111
Gujarat	4413	772	716	62742	960	1877	53468
Haryana	2174	299	3261	1473	197	2482	6868
Himachal Pradesh	32599	2873	1025	5394	19	27095	38813
Jammu & Kashmir	4953	4.42	34448	8126	140	35316	161331
Karnataka	3177	1285	192	8973	1690	3314	20682
Kerala	17936	860	1462	1019	22	16071	13270
Madhya Pradesh	3681	987	97	2869	139	934	4803
Maharashtra	5118	967	862	14351	229	1132	12391
Odisha	861	433	186	10707	14	6129	22207
Punjab	12220	301	53	542	0.00	592	970
Rajasthan	2804	497	127	302	767	505	1655
Tamil Nadu	1845	581	2256	2220	1613	9964	11219
Uttar Pradesh	7470	94	83	1088	319	3303	4603
West Bengal	836	60	583	264	9.02	1146	1834
Chhattisgarh	299	18	135	3704	455	2044	8371
Jharkhand	2727	584	602	7552	0.00	10518	19395
Uttarakhand	1672	0.00	8755	12206	306	29747	71399
Bihar-Jharkhand	1000	39	553	2473	21	11362	16447
MP- Chattisgarh	2686	698	110	3078	132	1231	5466
UP &Uttrakhand	7046	93	163	1358	289	3855	5493
Total 20 states	3366	484	426	4554	235	2352	7435

Source: AIDIS and Agricultural Statistics at a Glance, GOI.

Note: Net sown area (NSA) is used. Public investment irrigation excludes flood control.

Farmers' income can also be enhanced through re-allocation of the existing resources into most productive uses. Evidence shows that crop diversification from cereals to high-value crops such as in horticulture generates greater income for farmers. Further, reduction of post-harvest losses and value addition help the farmers in augmenting their incomes. Chapter 4 discusses issues related to crop diversification, post-harvest management and processing.

3.9 Conclusions and Policy Implications

The government's aim to double farmers' income by 2022-23 requires estimates on the magnitude and size of private as well as public investments "in" and "for" agriculture in the past so that futuristic capital requirements may be worked out. This chapter has analysed the temporal and spatial trends in public and private capital formation, and their composition and size across major states from 1981-82 to 2013-14, based on capital expenditure series. It has also evaluated the investments as per the size of landholdings, contribution of institutional credit in increasing private investment, and its impact along with that of key public investments

on agricultural income. This is followed by an estimation of the state-wise incremental capital output ratios, separately for private and public investment heads for assessing the quantum of capital required by 2022-23 that would double farmers' income.

The analysis is undertaken for major states based on the extant literature and published data set from 1981-82 to 2013-14 from the NAS-CSO, AIDIS-NSS and Agricultural Statistics at a Glance, MoA. The temporal and spatial trends in public and private investments as well as estimation of ICOR have been undertaken at 2004-05 prices using GSDP deflators.

The state-wise annual investment rates required on private accounts and on key public services have been estimated from 2015-16 to 2022-23 using the ICORs and the targeted annual real rate of growth in farm income estimated in this report. Following are the broad findings for drawing policy prescriptions:

i.   Private investment in agriculture by rural households has increased manifold from 1981-82 to 2012-13. The highest growth ranging between 8 and 15 per cent was experienced by almost all the states with a few exceptions, viz. Haryana, Odisha, Tamil Nadu and Uttar Pradesh. Farmers belonging to the states falling in the eastern regions have much lower investment relative to those in the northern region.

ii.   A growing preference of households to invest in land improvements (residential land-buildings) has been identified, especially in the relatively developed states. Such investments that have been undertaken at the expense of investment in agriculture, may be due to lower returns from farming, demographic factors and growing urbanisation.

iii. Within the sector, investment preference continues to be in farm implements-machinery, transport, livestock and irrigation which together attract 80 per cent of a rural household's investment. However, the investment preference of farmers towards non-farm business remains unchanged.

iv.   The share of marginal and small farmers in total investment is less than 10 per cent as compared to that of the semi-medium and medium category of farmers, who have a corresponding share of 43.2 per cent share. Small farmers account for a reasonably higher share of investment in agriculture in the total investment only in Gujarat, Haryana, Kerala, Rajasthan and West Bengal.

v.   The composition of private investment in agriculture has not changed much over the period. Among all the assets, transport, machinery and implements, livestock and irrigation together attract 80 per cent of a rural household's investments. Small farmers invest more in livestock. Households in Punjab and Haryana have shown negative rate of growth in irrigation structures and positive growth in expenditure on transport and machinery.

vi.   Large inter-state disparities in both private and public investments in agriculture have been apparent with a sizeable increase witnessed in both during the 2000s. Although public and private investments are not strictly comparable, the former have increased four times from Rs. 653/ha in TE 1983-84 to Rs. 2328/ha in TE 2013-14 at 2004-05 prices. The latter also stepped up from Rs.471/ha in 1981-82 to Rs. 687/ha in 2002-03 and then to Rs.1645/ha in 2012-13.

vii.   The states having a per hectare public investment below the national average include Assam, Kerala, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Tamil Nadu, Rajasthan, Punjab and Odisha. In case of private investment, the developed states, viz. Gujarat, Haryana, Himachal Pradesh, J&K, Karnataka, Kerala, Maharashtra and Punjab, have taken significant strides, perhaps due to better banking infrastructure and growth opportunities. The less developed states continue to lag behind, which suggests an urgent need for intervention.

viii.   The national average shows that 63.4 per cent of the private investment in agriculture has been met through institutional credit. However, a relatively higher dependence of marginal and small farmers on informal sources of credit in almost all the states raises questions about the outreach of banks and financial inclusion in the credit policy.

ix.   The percentage of investment credit that is met from informal sources 40.6 per cent, 52.1 per cent, and 30.8 per cent, for the landless, marginal farmers, and small farmers, respectively.

x.   While the small-sized landholders have pending loans from informal financial sources, that too at exorbitant rates of interest, the medium and large farmers get subsidised loans. This may imply that the credit policy needs to be changed, keeping in view the regional, land and socio-economic status of the households. The Committee feels that the less developed states and marginal and small farmers should have higher access to institutional credit for making investments of a long-run nature.

xi.   Public expenditures on both revenue and capital accounts have increased phenomenally, but expenditure on almost each economic head has got reduced in relative terms. The brunt of reduction in expenditure is borne by agriculture, irrigation and rural development services/heads. A relative decline in expenditure may suggest that less priority has been accorded to the rural areas by the respective state governments. The momentum of accelerated pace of public investments over the period from 2001-13 at 10.9 per cent may be maintained over the period till 2022-23. In order to increase the efficiency of this investment and generate accelerated growth, it is suggested that closer monitoring and supervision of the investment at the field level may be ensured with respect to the outcomes. Enhanced investment use efficiency will help achieve lower rates of investment.

xii. Returns from additional spending tend to be higher in the less developed states as compared to the high-income states for most of the economic services. The developed states tend to show diminishing marginal returns from additional public investments, thereby suggesting the need to step up investments in the less developed and rainfed regions to meet the future growth challenges in agriculture. Owing to higher marginal returns from additional public spending in the less developed and rainfed states, the Committee suggests a relatively higher increase in the capital intensity of investments in irrigation and infrastructure in such regions to meet the future growth challenges.

xiii. The marginal efficiency of capital is much higher in minor irrigation than that in the major and medium irrigation systems, implying the usefulness of allocation of more resources towards the former by the respective state governments.

xiv. Based on the average ICORs from 2007-08 to 2011-12 and 2012-13 to 2013-14 and the targeted 9.23 per cent annual increase in real farm income, the required rate of investment on private account is at 6.62 per cent. In case of public investment ('for' agriculture) the targeted investment rate is assessed at 6.92 per cent per year.

xv. The already achieved rates of investment in both private and public accounts being higher, at nearly 10 per cent per annum, it is certain that the targeted investments will be achieved. Such positive signals come from additional mobilisation undertaken by government through non-budgetary sources, like creation of a corpus funds of Rs. 40,000 crore to complete long pending AIBP projects, Rs 5,000 crore for accelerating micro-irrigation coverage, and Rs 8,000 crore for DIDF during the years 2016-17 to 2017-18.

xvi. In absolute terms, in order to enable the doubling of farmers' real income by generating higher farm incomes, the private investment in India should increase from Rs. 296 billion (Rs 29,559 crore) in 2015-16 to cumulative Rs. 463 billion (Rs 46,299 crore) in 2022-23, at 2004-05 prices.

xvii. The private investments here, refer to investments made by farmers themselves, inclusive of own savings and borrowings from institutional and non-institutional sources. It is recommended that institutional credit be stepped up substantively so as to cover as many farmers as possible. It is encouraging that the institutional credit made available by the government, is seeing a robust increase from Rs 8 lakh crore in 2014-15 to Rs. 10 lakh crore (about Rs one thousand billion) in 2017-18. Of the Rs. 10 lakh crore, a sum of Rs. 3.15 lakh crore is meant for capital investment, while the balance is towards crop loans.

xviii. The projected capital requirements on public accounts (Rs 1023 billion), with no change in efficiency use, in the 20 select states, are Rs.59 billion in agriculture and allied activities, Rs. 626 billion in minor, medium and major irrigation systems, Rs.32 billion in rural energy, and Rs. 324 billion in rural roads-transport infrastructure, on a

cumulative basis. The results would be better if the investments are be guided into optimal areas for higher efficiency through appropriate reforms and policy changes.

Key Extracts

- As seen from the analysis and explanations in preceding sections, capital investments in and 'for' agriculture are vital to achieve the desired growth rate of 9.23 per cent per annum in farm income. This will help in increasing the share of farm income as a ratio of farmer income and thereby improve the viability of agriculture.

- It is a happy situation, that in respect of both private and public investments, the rates of growth by 2015-16 are already higher than the now desired growth rates of 6.62 and 6.92 per cents per annum respectively. It indicates, that it is easy to meet the capital investment requirements over the 7 year period of 2016-17 to 2022-23. But, what is more important is to improve capital use efficiency, by investing in area-specific and domain specific needs, so as to maximise dividends.

- There is also scope to further accelerate the investment by drawing up policies to attract private sector investments from the formal and organised stakeholders (other than farmers)

- The Committee observes that a disaggregated state and district level estimation of capital formation in agriculture on public and private accounts is the need of the hour to ensure location-specific investment decisions and effective planning for this sector in the future.

Chapter 4
Crop Diversification and Post-production Management

In the context of food security, the focus of Indian policymakers and agricultural scientists has remained on building production and stocks of staple cereals. The ensuring of nutrition security of the population, and the need to enhance the net income of farmers have not received enough attention by policymakers.

4.1 Backdrop

Food security concerns, have hitherto, brought specific focus on raising production and productivity, mainly of cereals. The critical aspect of ensuring nutrition security for Indian population, in general, and how it correlates to enhance the net income of farmer households, in particular, are two aspects that have not received equal attention by policymakers. However, during the last decade, researchers have begun to pay considerable attention to the following:

- Augmenting the growth of agriculture through the diversification towards high-value crops (HVC), particularly horticulture (mainly fruits and vegetables);[48] and

- Assessing whether the small holders have benefited from the diversification towards HVC.[49]

These studies have contributed significantly to our understanding of how diversification has led to the growth of the agriculture sector in the wake of the shifting consumption pattern of Indian households towards high value products like fruits, vegetables, milk, fish, and meat.

During the discussion on doubling of farmers' income, it has been argued that expanding the area under HVC will help increase farm income, as it has been found that expanding HVC by one hectare at the expense of staple crops, yields an additional "gross returns up to Rs. 1,01,608 per hectare"[50]. However, it is important to determine the extent to which expanding the area under HVC would help in increasing the net income.

Another important issue to be considered pertains to a high degree of harvest and post-harvest losses, particularly in fruits and vegetables, which account for significant economic losses.[51] The existing marketing system of agricultural produce is also reportedly fragmented and entails high transaction costs.[52] Since there is a wide variation in the estimates of harvest and post-harvest losses given by different agencies, this issue needs to be examined from the perspective of enhancing farmers' income. The other associated issues that need to be addressed include the role of private traders in regulated markets, and evolution of an appropriate marketing system to increase farmers' income and reduce market fragmentation.

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[48] Birthal, et al., 2012; Birthal, et al., 2008; Joshi, et al., 2006; Chand, 2017; Chand and Parappurathu, 2012; Dalwai, 2012; IFPRI, 2007.

[49] Joshi, et al., 2006; Roy and Thorat, 2008; Birthal, et al., 2012; Minot, et al., 2006; Weinberger and Lumpkin, 2007.

[50] Chand, 2017b.

[51] ICAR-CIPHET, 2015; Small Farmers' Agri-Business Consortium (SFAC), 2015; National Centre for Cold-chain Development (NCCD), 2016; NCCD and Amity University, 2015; ISB and NCCD, 2016.

[52] IFPRI, 2007.

It is also pertinent to examine the level of gains that can flow to farmers through improved post-harvest management and development of the agro-processing industry. An efficient post-harvest management, comprising aggregation, preparatory activities and pre-conditioning, refrigerated transportation and other cold-chain/agri-logistics, not only reduces the proportion of agricultural produce, especially perishables that are otherwise discarded, but also aids in expanding the size of the market.

Apart from optimising the efficiency of post-harvest operations/activities and increasing the size of the market, farmers' income can also be increased by promoting linkages between agriculture and the food processing industry, which can be an assured market for specific crops and increases other income opportunities.

Farmer households may or may not directly benefit from the promotion of the food processing industry, but if some of the post-harvest activities, as part of agri-logistics, are located close to the farm gate, as in the case of pack houses, pre-cooling chambers, transport hubs and cold storages, it could result in direct income gains to the farmer households. This is seen in similar developments in the milk supply chain where each pooling centre provides jobs and connects the produce to onwards market linkages.

This chapter is organised as follows. Section 4.2 assesses the net gains accruing to farmer households from diversification into fruits and vegetables. Section 4.3 examines the magnitude of harvest and post-harvest losses and their links with the marketing channels concerned. Section 4.4 analyses the role of private traders in horticulture while Section 4.5 explores the nature and composition of the Indian food processing industry in terms of linkages between small and large enterprises and their role in employment creation. The main findings and the policy implications are discussed in Section 4.6.

Sections 4.2, 4.3, and 4.4 are based on unit level data of farmer households using the 70th Round of NSSO. An attempt has been made to present the farmer level findings at the state level for the benefit of policy makers. Section 4.5 draws from the studies conducted by different researchers.

4.2   Crop Diversification to Increase Farmers' Income

4.2.1   Nature of diversification-led growth

Recent research on the sources of growth in India's crop sector has shown that crop diversification in favour of HVC has consistently made a significant contribution to the overall growth of the crop sector over the last three decades.[53] Birthal et al. (2013) have decomposed the growth of the crop sector, attributing it to various factors including area, yield, price, diversification and the interaction term.[54] They argue that the role of technology (via yield increase) was dominant in the 1980s, declined in the 1990s, and regained prominence in the

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[53] Birthal, et al., 2013.
[54] Birthal, et al. (2013) have followed the methodology adopted in Minot, et al. (2006)

first decade of the twenty-first century.[55] The contribution of crop diversification to the growth of the crop sector over these periods has been to the extent of 26.3 per cent, 33.3 per cent and 31.2 per cent, respectively (Table 4.1). Birthal et al. (2013) have also presented the results by region. It may be observed that crop diversification has contributed the most to the growth of the crop sector during the period 2000-01 to 2009-10 in the southern region (48.6 per cent), followed by the eastern (42.1 per cent), western (37.9 per cent) and northern (26.2 per cent) regions, in that order.

Table 4.1 Contribution of Different Sources of Growth of the Crop Sector at the National Level (%)

Sources of Growth	1980s	1990s	2000-01 to 2009-10
Area	16.5	8.7	21.2
Yield	51.5	32.3	39.4
Price	5.2	24.3	7.2
Diversification	26.3	33.3	31.2
Interaction	0.5	1.3	1.0
Total	100	100	100

Source: Figure 3.3, Birthal, et al., 2013.

Birthal, et al. (2013) have also noted that diversification into production of fruits and vegetables, in general, and vegetables, in particular, is likely to benefit the small and marginal farmers more than the medium and large farmers for the following reasons:

i.   Marginal and small farmers tend to allocate a large proportion of their holdings (7.5 per cent and 6.3 per cent, respectively) than the medium and large farmers (3 per cent and 4.8 per cent, respectively).

ii. Small farms enjoy a greater comparative advantage in the cultivation of vegetables than medium and large farms as vegetable cultivation is more labour-intensive than fruit cultivation. The cultivation of vegetables also needs much less capital than fruit cultivation.[56]

iii. The cultivators of HVC (including horticultural crops) within farm size groups tend to exhibit a lower incidence of poverty than cultivators of other crops.[57]

4.2.2 Relative profitability of horticultural crops

Since the mere shifting of the area under horticulture may not necessarily help augment farmers' income, it is also imperative to assess the relative profitability of horticultural crops vis-à-vis the competing crops in the context of the interplay of several relevant factors such as yield, prices of competing crops, and climatic conditions, among others.

This study presents evidence of the net profitability of horticultural crops vis-à-vis competing crops by using the unit level data of NSSO, 70th Round (2012-13) for each state. The NSSO provides information for two visits, viz., Visit 1 (during the Kharif season) and Visit 2 (during

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[55] Chand, 2014.
[56] Birthal, et al., 2012.
[57] Joshi, Birthal and Minot, 2006.

the Rabi season). Different staple crops compete with horticultural crops in each state and during each season, as shown in Annex Table 4.1.

The NSSO's unit level data permits the computation of net income (gross income minus paid out cost) for each crop. This information is used to compute the excess (deficit) of net income per hectare of horticultural crops over the competing crop in each visit. If there is more than one competing crop, the mean level of excess (deficit) of net income of horticultural crops over competing crops is computed. The annual net profitability of horticultural crops over competing crops is obtained by adding the net profitability per hectare for the two seasons.[58]

The net additional income per hectare due to replacement of staple crops such as cereals, coarse/nutri-cereals and oilseeds[59] by horticultural crops for the year 2012-13 (the reference year of NSSO 70th Round) is given in column 1 of Table 4.2. This is then converted into 2015-16 prices, the benchmark year for the DFI.

From the policy perspective, it is important to address the following question: What is the additional income to the farmer in a given state if one hectare of staple crop(s) is replaced by a horticultural crop? It must be noted that using some of the staple crops (say, paddy) may only marginally impact the farmer's food security as the area under staple crops is huge in comparison to the area under horticulture.

Given that a marginal shift from staple crops to horticulture does not adversely affect food security at the household or even the national level, it may be useful to determine the elasticity of income accruing from horticultural cultivation from a policy perspective (see Table 4.2 for information on each state under consideration).

In the table, the highest elasticity is observed for Mizoram (1.33), followed by Himachal Pradesh (0.91), J & K (0.84), Kerala (0.69), Maharashtra (0.62), and Goa (0.47). Comparatively lower elasticity is observed for Haryana (0.03), Punjab (0.040), Uttar Pradesh (0.09), Rajasthan (0.11), and Madhya Pradesh (0.07).

The following observations may be made on the basis of the above analysis:

- All the three states of the northern region, viz., Haryana, Punjab and Uttar Pradesh, exhibit low elasticity. This region has been at the centre of the Green Revolution and also has the advantage of an assured price (MSP) and almost assured

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[58] The details of computation/ results are not presented here to save space. The relevant information can be furnished on demand.
[59] Only staple crops (not pulses) have been considered for substitution by horticultural crops. Since pulses are a major source of protein in India, their replacement by horticultural crops may have adverse effects on nutrition of the population.

procurement of wheat and paddy by the Food Corporation of India (FCI).[60] This is also true of UP, especially the western part of the state.

- Rajasthan has shown progress in crop diversification in the past six years and significantly increased its area under fruits and vegetables. However, low elasticity because of arid conditions and slow progress in the adoption of micro irrigation (MI), this case of low elasticity is not a surprising one.[61]

- Among the hill states, Himachal Pradesh and J&K have high elasticity. Uttarakhand is lagging behind in crop diversification, probably because of lack of rigorous efforts to promote cultivation of high value fruits. [62].

- Andhra Pradesh, Gujarat and Maharashtra are quite receptive to the idea of crop diversification in favour of fruits and vegetables.

- Madhya Pradesh and Chhattisgarh have relatively low elasticity in spite of expanding the area under horticulture. The low elasticity may be an indication of famers' limited access to the market outside the local catchment area, whereas the relatively low level of development of infrastructure may be hindering diversification in these states.[63]

- All the North-Eastern states, except Manipur, show relatively low elasticity, which may be attributed o, the lack of proper infrastructure and poor market connectivity.[64]

However, a caveat may be mentioned here regarding the interpretation of the value of elasticity of income from cultivation with respect to shifting of the area under horticultural crops. A low value of elasticity need not necessarily imply a concomitant low potential to increase the income of farmers. For example, Uttarakhand, despite having agro-climatic conditions that are similar to those of J & K and Himachal Pradesh, has a much smaller elasticity than these states.

It is also expected, that with associated development of cold-chain logistics and supply chain, the enhanced market connectivity will give a far greater impetus to the expected income gains from shifting cropping area into horticulture.

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[60] Of the total procurement of rice in 2015-16, 70.2 per cent and 22.4 per cent were procured from Punjab and Haryana respectively. In case of wheat, 36.8 per cent, 24.1 per cent, 26.0 and 8.1 per cent were procured from Punjab, Haryana, Madhya Pradesh and Uttar Pradesh, respectively. DES (2015), Table 9.1a

[61] Although, the penetration of MI in Rajasthan (9.3 per cent) is much higher than the national average penetration (5.5 per cent), it is low in view of the arid conditions in the state (Thornton and FICCI, 2016)

[62] In Uttrakhand, the cultivation of high value fruits such as apple has not been promoted with special efforts, resulting in relatively lower net additional income over staple crops (paddy and maize), in spite of Uttarakhand having better infrastructure than Jammu and Kashmir. (Bhandari , 2012)

[63] Madhya Pradesh and Chhattisgarh are ranked at 19 and 13, respectively, in the infrastructure index (Bhandari, 2012).

[64] The North-Eastern states lag behind in terms of market reforms (Chand and Singh, 2016). The index of infrastructure is available only for Assam (index =19), which points to the low status of infrastructure in the state (Bhandari, 2012).

Table 4.2 Elasticity of income from cultivation with respect to shifting of area under horticulture by replacing staple crops

Zone	State	Additional income due to replacement of staple crops by horticulture crop at 2012-2013 prices) (Rs. per hectare)	Ratio of state net crop income of 2015-16 to 2012-13 at current prices[1])	Additional income due to replacement of staple crops by horticulture crop at 2015-16 prices col. 1 x col.2 (Rs./ha)	Area under horticulture crops in 2015-16 ('000 ha) [2]	1% of area under horticulture 2015-16 (ha)	Additional income due to replacement of staple crops by 1% increase in area under horticulture in 2015-16 col. 5 x col. 3 (Rs. crores)	Income from cultivation at 2015-16 prices. (Rs. crores) [3]	Elasticity of cultivation income w.r.t. Shifting of area under horticulture [col. 6/col. 7] x 100
		1	2	3	4	5	6	7	8
Hill Zone	Himachal Pradesh	173888	1.11	193550.75	324.81	3248.11	62.87	6922.98	0.908
	Jammu & Kashmir	171750	1.16	198568.58	406.66	6922.98	0.908	9645.25	0.837
	Uttarakhand	35364	0.95	33673.99	281.25	4066.59	80.75	7384.50	0.128
North Zone	Haryana	21393	1.05	22543.74	493.65	4936.49	11.13	43066.12	0.026
	Punjab	58617	1.05	61470.11	345.14	3451.44	21.22	52546.14	0.040
	Uttar Pradesh	58033	1.06	61508.60	2057.50	20575.02	126.55	145090.28	0.087
South Zone	Andhra Pradesh	82137	1.16	95525.17	1998.17	19981.70	190.88	55760.50	0.342
	Karnataka	107403	1.23	131668.15	2027.16	20271.56	266.91	62170.63	0.429
	Kerala	79548	1.07	85101.75	1540.92	15409.22	131.14	18975.08	0.691
	Tamil Nadu	83240	1.33	110861.76	1340.80	13408.04	148.64	57095.18	0.260
	Telangana 4)	102600	0.88	90671.93	569.45	5694.50	51.63	32982.95	0.157
East Zone	Bihar	45317	0.90	41007.55	1176.66	11766.61	48.25	43910.07	0.110
	Odisha	100231	0.92	91938.78	1358.45	13584.52	124.89	31354.94	0.398
	Jharkhand	50091	1.14	57207.31	375.90	3758.96	21.50	16897.01	0.127
	West Bengal 5)	49970	1.59	79452.30	1836.91	18369.13	145.95	50162.88	0.291
West Zone	Goa	40053	1.15	46074.39	103.97	1039.70	4.79	1021.00	0.469
	Gujarat	56423	1.26	71298.70	1646.63	16466.33	117.40	79255.09	0.148
	Maharashtra	324442	1.11	359735.61	1807.86	18078.61	650.35	105593.49	0.616
	Rajasthan	49755	0.98	48525.45	1621.49	16214.93	78.68	74709.42	0.105
Central Zone	Chhattisgarh	65039	1.15	75075.69	732.35	7323.54	54.98	22661.58	0.243
	Madhya Pradesh	47105	1.47	69463.21	1491.13	14911.29	103.58	146271.54	0.071
North-East Zone	Arunachal Pradesh	19251	1.51	28980.21	83.23	832.27	2.41	4870.44	0.050
	Assam	79842	1.08	86057.25	671.68	6716.76	57.80	24775.93	0.233
	Manipur	22973	1.09	24933.09	97.02	970.21	2.42	1470.42	0.165
	Meghalaya	58522	1.28	75161.19	127.89	1278.87	9.61	2289.05	0.420
	Mizoram	75929	1.16	88397.26	137.44	1374.43	12.15	915.98	1.326
	Nagaland	0	1.30	0.00	96.98	969.77	0.00	2707.63	0.000
	Sikkim 6)	35561	1.34	47635.34	67.48	674.83	3.21	1108.62	0.290
	Tripura 6)	48612	1.09	53099.78	144.07	1440.66	7.65	3561.93	0.215
All India		**69129**	**1.15**	**79231.80**	**24471.67**	**244716.75**	**1938.93**	**1105176.60**	**0.175**

Notes on next page   *Source: Computation by DFI Committee; based on NSSO, 70th Round*

Table 4.2 Notes

1)   Based on Net State Domestic Product from crops (source: India Stat as accessed on 8.6.17).

2) Source: National Horticulture Board.

3) NSDP from crops

4) Area under horticulture is the third estimate of 2015-16 : (Source: National Horticulture Board)

5) For West Bengal, the available data has two limitations: (i) The NSDP (Agr. & Allied) at current prices is available till 2014-15 only for 2004-05 series. Information for 2015-16 is not available. (ii) The NSDP(crop) is not available directly, however, NSDP (agr.) is available which includes livestock and poultry also along with crops. In order to obtain NSDP (agr. & allied) for 2015-16, the Y-O-Y growth rate of GSDP (agr. & allied) is applied for the period 2014-15, which is 15.36% as per Economic Survey (2016-17), Government of West Bengal. Assuming the same growth is applicable to NSDP (agr. & allied), the value obtained for NSDP (agr. & allied) for 2015-16 comes to Rs. 20600773 lakhs. The next problem is to obtain NSDP (crop) at 2015-16 prices. It is taken to be 24.35% of NSDP (agr. & allied) on the basis of the ratio of crop income to total farm income for West Bengal as per NSSO, 70th Round, the he implicit assumption being that this ratio has not changed between 2012-13 and 2015-16.

6) For Sikkim and Tripura, the NSDP is not available. Therefore, Net State Value added (crop) at current prices is taken as a proxy.

7) Column 2: Geometric mean of ratios of states.

8) Column 7: As data for NSDP(crop) for all India is not directly available, it is taken as the summation of state values, excluding UTs

The sustained promotion of cultivation of high value fruits and other horticulture crops in the state along with improvement in infrastructure can help enhance farmers' income in Uttarakhand. Low elasticity of cultivation is also observed in some of the relatively high productivity areas such as Haryana and Punjab. This also does not necessarily mean that these states should not reduce the area under wheat–paddy rotation in favour of horticulture. In fact, it has been observed that wheat–paddy rotation has led to environmental degradation in the form of soil erosion, deficiency of soil nutrients, and lowering of the ground water table in these states.

It is, therefore, imperative to ensure diversification into horticulture in these states by offering suitable incentives to farmers.

4.2.3 Prospect of raising farmers' income through diversification

A simple analysis is undertaken on the basis of an assumed rate of growth of area under horticultural crops during the period 2015-16 to 2022-23. The following two scenarios have been generated to present a contrast between an ambitious plan and a pragmatic approach:

Case I: An ambitious plan: Shifting of area into horticulture at 4 per cent per annum for seven years for all states, irrespective of the magnitude of the elasticity of income from cultivation with respect to the shifting of area under horticulture from staple crops.

Case II: A pragmatic plan: Shifting of area in favour of horticulture by replacing staple crops at 2 per cent per annum for the first three years and thereafter shifting at the rate of 4 per cent per annum for the next four years for all states.

The logic behind Case II (pragmatic plan) with an initial lower rate of growth of 2 per cent per annum of area under horticulture, for is that most of the states have shown a considerable deceleration of growth in the area under horticulture during the period 2011-12 to 2016-17 due to a combination of various factors such as price/weather shocks, limited market access, and lack of cold-chain and other similar agri-logistics facilities.

There is considerable fluctuation in the value of production and price of the horticultural produce (Annex Table 4.2). The fluctuation (coefficient of variation) in the implicit price (value of production divided by the quantity of production) varies from a relatively low 12.5 per cent in Karnataka and 19.0 per cent in Chhattisgarh to a relatively high 38.2 per cent in Rajasthan and 36.0 per cent in Uttar Pradesh. Even the growth rate (mean y-o-y) of production varies a lot over time. The growth of production of fruits and vegetables at the national level has been impressive at 4.43 per cent per annum for the period 2004-05 to 2016-17. However, the growth trajectory was not consistently smooth. The growth in the production of fruits and vegetables declined sharply to 2.14 per cent per annum during the period 2011-12 to 2016-17 from 6.72 per cent per annum during the period 2004-05 to 2011-12 (Annex Table 4.3).

The same pattern has been observed for several high-performing states such as Andhra Pradesh, Assam, Chhattisgarh, Karnataka, Tamil Nadu, and West Bengal. In the case of Tamil Nadu and West Bengal, negative growth rates of -3.7 per cent and -1.3 per cent, respectively, were recorded for the production of fruits and vegetables during the period 2011-12 to 2016-17. In Karnataka, on the other hand, the corresponding production rate nosedived to a low of 0.34 per cent during the same period. These developments thus foster uncertainty among farmers in terms of the allocation of the cultivated area to horticultural crops.

As regards the growth of the area under horticulture, it has been observed that at the national level, this area has grown at the rate of 1.62 per cent per annum during the period 2004-05 to 2016-17.[65] However, this growth rate has shown considerable variation over the sub-periods of this period. The main issue that needs to be considered for assessing the growth rate of the area under horticulture in the two scenarios delineated above is whether there is a statistical evidence of either acceleration or deceleration in the growth of area under horticulture. If yes, one need not necessarily assume a constant rate of growth of area under horticulture for the seven-year period in which farmers' income has to be doubled or significantly enhanced. Simultaneously, one also needs to decide the cut-off year for getting at least two sub-periods with a reasonable number of observations. The committee thought of the two series of sub-periods on the basis of the cut-off year (with normal weather conditions) for checking the acceleration or deceleration in the area under horticulture as follows:

Series A: 2004-05 to 2009-10 and 2010-11 to 2016-17   *(cut- off year 2009-10)*
Series B: 2004-05 to 2010-11 and 2011-12 to 2016-17   *(cut- off year 2010-11)*

The results for both the series are presented in Annex Table 4.4. It has been observed that since 2009-10 was the year that saw a 'below normal' rainfall, the production and area under horticulture remained comparatively depressed. Hence, the period after post 2009-10, that is, 2010-11 to 2016-17, is likely to show an over-estimation of the growth of the area under horticulture. Thus, the DFI Committee prefers to focus on Series B for assessing the growth of the area under horticulture during the following sub-periods: 2004-05 to 2010-11 (period I)

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[65] Growth rate of the area refers to the mean of the y-o-y change over time (Annex Table 4.4).

and 2011-12 to 2016-17 (period II) as it avoids the overestimation of growth of area under horticulture (Refer to Columns 4, 5 and 6 in Annex Table 4.4).

Figure 4.1 Mean Growth Rate of Area under Horticulture
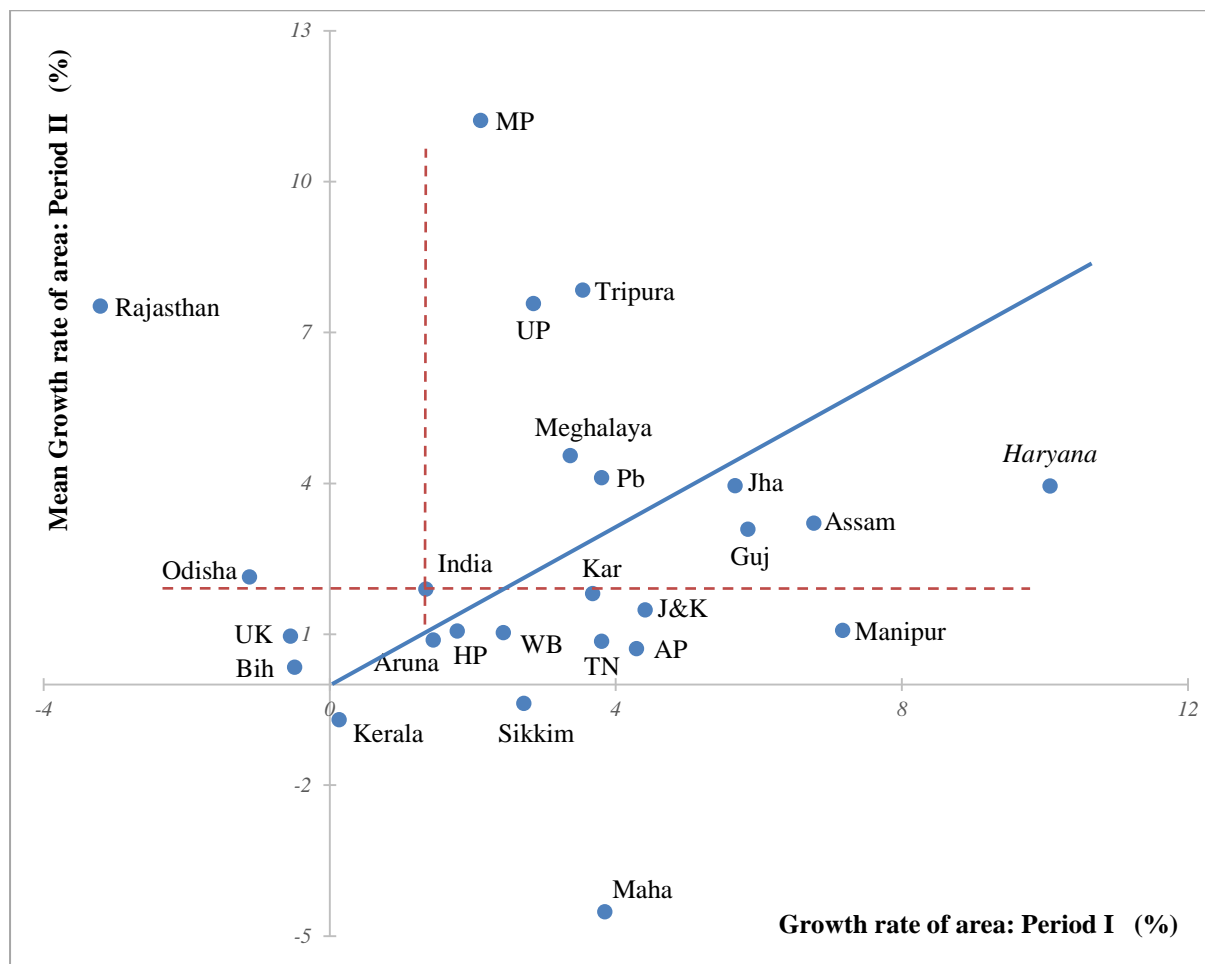
Source: Annex Table 4.4

[Cut-off point: Year 2010-11]

Notes:
1. Period I: 2005-06 to 2010-11; Period II: 2011-12 to 2016-17.
2. Mean growth rate of area under horticulture is mean of y-o-y growth rate (%)
3. Blue line is the 45 degree line through the origin.
4. The outlier states (with very high values) are not shown in the figure. These states are: Nagaland, Mizoram and Chhattisgarh. (Annex Table 4.4).

Although at the national level, the mean growth rate of the area under horticulture is higher in period II than in period I, most of the states show a deceleration in the concomitant growth rate, with three states, viz., Kerala, Maharashtra and Sikkim, showing a negative growth rate (Odisha: -1.12 per cent; Rajasthan: -3.21 per cent) during the period 2011-12 to 2016-17. Odisha and Rajasthan show an impressive acceleration in the growth of area under horticulture during 2011-12 to 2015-16 as both of them started with negative growth during the period 2005-06 to 2010-11. The phenomenon of acceleration is clearly noticed in the following states: Punjab and Uttar Pradesh in the North; Madhya Pradesh in Central India; and Meghalaya, Nagaland and Tripura in the North-Eastern region. The phenomenon of deceleration in the growth of area of horticulture is depicted in Figure 4.1 for the states falling below the 45 degree

line are (blue line). For example, Haryana's growth of area in period I was much higher than that observed in period II. Similarly, Uttar Pradesh exhibits an acceleration in area under horticulture as it lies above the 45 degree line.

It is observed that some of the states in the Central, North-Eastern and Western zones do not have a good record in respect of infrastructure/market connectivity and implementation of marketing and farmer-friendly reform.[66]

It may not be easy for these states to sustain re-allocation of more area for horticulture for high growth, without risking a significant decline in the realised price and/or incurring a huge waste of perishable produce. Even states like Karnataka and Maharashtra, which have performed very well in horticulture, have significantly reduced the growth under horticulture. Thus, it seems plausible for the states to shift the area to horticulture at a relatively slow pace of 2 per cent per annum for the first three years, and thereafter accelerate it at 4 per cent per annum in the next four years. The first three years may be utilised to develop the essential infrastructure in terms of markets, cold-chains, other agri-logistics including road/rail connectivity and to implement farmer-friendly reforms.

The increase in the area under horticulture at the national level after seven years (by 2022-23) will be 31 per cent in Case I, and 24 per cent in Case II (over the base period of 2015-16) [column 3, Table 4.3]. The area under horticulture will increase by 6.1 per cent in Case II at the end of three years, and by 17.9 per cent in the following four years (2019-20 to 2022-23). The states will have a chance to review their preparations before the launch of phase II of DFI.

The important question is: What will be the increase in income from cultivation by the end of 2022-23 in Case I and Case II? Given the elasticity of cultivation income with respect to expansion of the area under horticulture (see column 1, Table 4.3), the increase in (net) income for Case I and Case II is given in columns 5 and 6 of Table 4.3, respectively. There is a substantial difference in increase in income at the state level between Case I and Case II. In general, the higher the elasticity, the larger is the difference in increase in income between the two cases at the state level (for example, J&K and Mizoram). However, at the all-India level, the difference in increase in income in Case I (5.54 per cent) and Case II (4.21 per cent) is not large in the terminal year (2022-23). Figure 4.2 depicts the increase in income in Case I and Case II in different states, with the states being arranged in the ascending order of percentage increase in income by 2022-23. Note that in some of the agriculturally backward states like Bihar, Jharkhand, Madhya Pradesh, Rajasthan and Uttar Pradesh, the percentage increase in income from cultivation is less than that observed on an all-India basis.[67]

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[66] In the western zone, Rajasthan ranks low at 15 in terms of infrastructure, while some states in the North-Eastern Zone lag behind in terms of both infrastructure as well as the implementation of marketing and farmer-friendly reforms (Chand and Singh 2016).

[67] Please note that the examples cited in the form of Case I and Case II basically denote an illustrated exercise. Another variant of this exercise could also be used to check the difference in outcomes.

It may be emphasis that Case II is being suggested as a matter of pragmatic step in the wake of no major breakthrough in productivity/yield of horticultural crop in the short run. A similar phenomenon is expected in respect of the perishable livestock product in which case a mere increase in the number of livestock is not likely to increased farmers' net income. An efficient solution to raise farmers' income through livestock sources must come from productivity gains accompanied by development of cold-chains and other agri-logistics.

Figure 4.2 Increase in Income from Cultivation by Crop Diversification [1] (%)
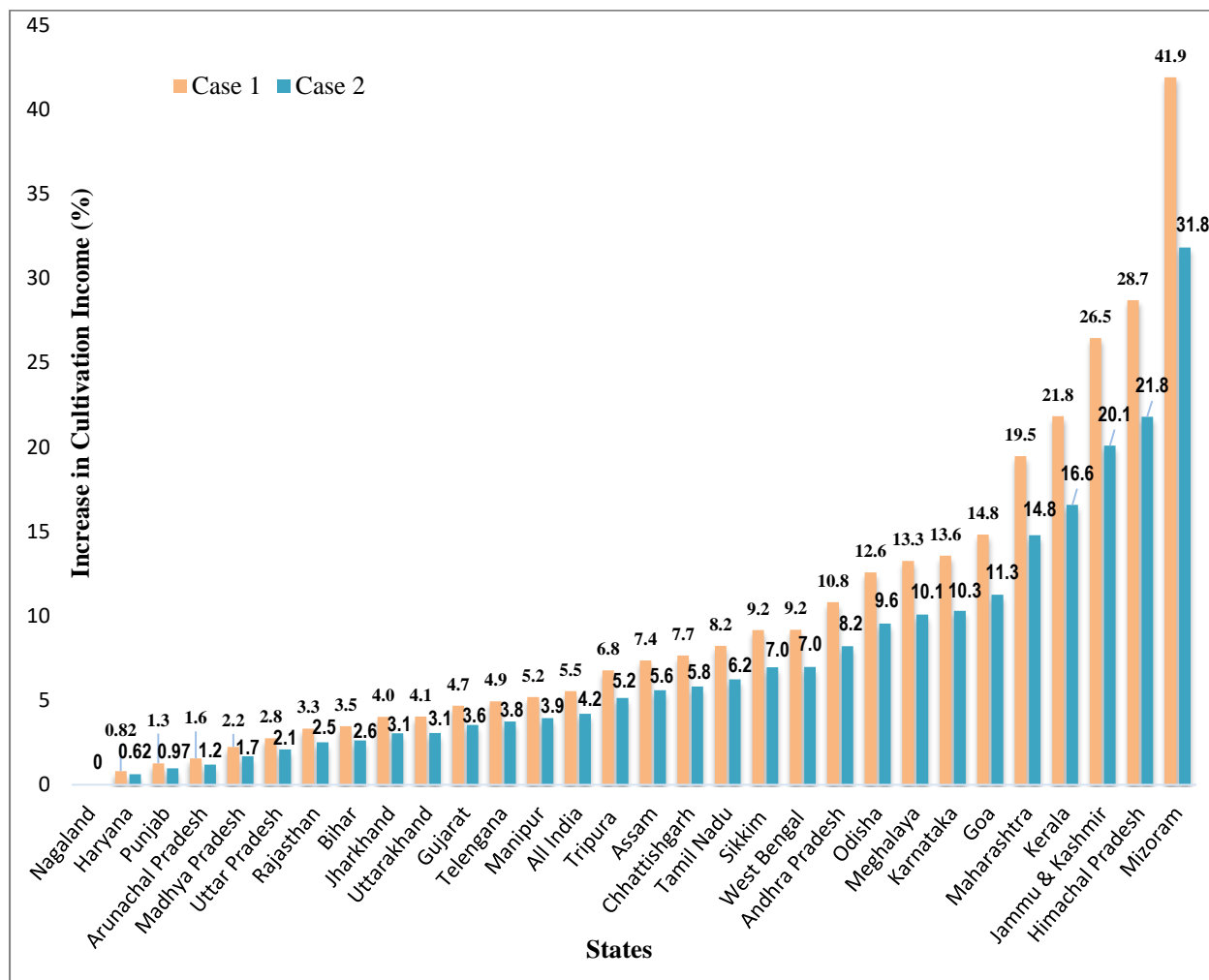
Source: Table 4.3

[1] Crop diversification through shift in area in favour of horticulture (by reducing equal area under staple crops). States are arranged in the ascending order of percentage increase in income from cultivation in Case 1.

Case 1: Shift of area in favour of horticulture at 4 per cent per annum for 7 years, that is, till 2022-23.
Case 2: Shift of area in favour of horticulture at 2 per cent per annum for the first three years and thereafter at 4 per cent per annum for the next four years (2018-19 to 2022-23) (Table 4.3).

Table 4.3 Increase in income from farms through replacement of staple crops by horticultural crops

Zones	States	Elasticity of cultivation income w.r.t. shift of area in favour of horticulture (from Table 4.2)	Shift of Area in favour of Horticulture by 2022-23 (base 2015-16) (%)		Area Shift in favour of Horticulture over base year 2015-16 ('000 ha)	Increase in Income from Cultivation over 7 year i.e. by 2022-23 (at 2015-16 prices)	
			Case 1	Case 2		Case 1	Case 2
			Shift in area in @ 4% p.a. for 7	Shift in area @ 2% p.a. for the first three years		Col 1 x Col 2 (%)	Col 1 x Col 3 (%)

			years for all states.	and thereafter @ 4% for the next 4 years			
		1	2	3	4	5	6
Hill Zone	Himachal Pradesh	0.908	31.6	24	7795.46	28.70	21.79
	Jammu & Kashmir	0.837	31.6	24	9759.82	26.46	20.09
	Uttarakhand	0.128	31.6	24	6749.98	4.05	3.08
North Zone	Haryana	0.026	31.6	24	11,847.58	0.82	0.62
	Punjab	0.040	31.6	24	8283.46	1.28	0.97
	Uttar Pradesh	0.087	31.6	24	49,380.05	2.76	2.09
South Zone	Andhra Pradesh	0.342	31.6	24	47,956.08	10.82	8.22
	Karnataka	0.429	31.6	24	48,651.74	13.57	10.30
	Kerala	0.691	31.6	24	36,982.13	21.84	16.59
	Tamil Nadu	0.260	31.6	24	32,179.30	8.23	6.25
	Telangana	0.157	31.6	24	13,666.80	4.95	3.76
East Zone	Bihar	0.110	31.6	24	28,239.86	3.47	2.64
	Odisha	0.398	31.6	24	32,602.85	12.59	9.56
	Jharkhand	0.127	31.6	24	9021.50	4.02	3.05
	West Bengal	0.291	31.6	24	44,085.91	9.19	6.98
West Zone	Goa	0.469	31.6	24	2495.28	14.83	11.26
	Gujarat	0.148	31.6	24	39,519.19	4.68	3.56
	Maharashtra	0.616	31.6	24	43,388.66	19.46	14.78
	Rajasthan	0.105	31.6	24	38,915.83	3.33	2.53
Central Zone	Chhattisgarh	0.243	31.6	24	17,576.50	7.67	5.82
	Madhya Pradesh	0.071	31.6	24	35,787.01	2.24	1.70
North-East Zone	Arunachal Pradesh	0.050	31.6	24	1997.45	1.56	1.19
	Assam	0.233	31.6	24	16,120.22	7.37	5.60
	Manipur	0.165	31.6	24	2328.50	5.20	3.95
	Meghalaya	0.420	31.6	24	3069.28	13.27	10.08
	Mizoram	1.326	31.6	24	3298.63	41.91	31.83
	Nagaland	0.000	31.6	24	2327.44	0.00	0.00
	Sikkim	0.290	31.6	24	1619.56	9.16	6.96
	Tripura	0.215	31.6	24	3457.58	6.79	5.15
All India		**0.175**	**31.6**	**24**	**5,99,103.79**	**5.54**	**4.21**

Source: Table 4.2 and computation by DFI committee

Note:

1) UTs are not included in this exercise.

2) In case II, the increase in area under horticulture is @ 2% p.a. for the first three years and thereafter @ 4% p.a. for the next four years.. To get all India figure (in col. 3) the following exercise is done: Area under horticultural crops in 2015-16 (col.4 in Table 4.2) is multiplied by the percentage increase in area under horticulture (col. 3 of Table 4.3). The all India figure in column 4, 599103.79 ('000 ha) is obtained by the summation of all the state values and represents the increase in area under horticulture over 7 years i.e.by 2022-23

4.2.4 Productivity enhancement & resource conservation through micro irrigation (MI)

The advantage of crop diversification in favour of horticulture can bring further benefit to the farmer through the adoption of micro irrigation (MI), that is, the use of sprinklers and drip irrigation. Several studies have shown that the adoption of MI increases productivity and also

helps resource-saving, particularly in rain-fed areas.[68] The impact of MI on the productivity of fruits varies from a low of 32.5 per cent in Uttarakhand to a high level of 73.4 per cent in Gujarat. In the case of vegetables, the productivity increase varies from 28.7 per cent in Maharashtra to 98.8 per cent in Chhattisgarh (Table 4.4). The resource conservation (saving in input costs to the farmer) is estimated in the range of 20 to 40 per cent.[69]

Table 4.4 Impact of MI on productivity increase of fruits and vegetables in rain-fed/arid areas

State	Fruits (%)	Vegetables (%)
Chhattisgarh	66.7	98.8
Gujarat	73.4	68.7
Maharashtra	49.2	28.7
Rajasthan	70.4	39.4
Uttarakhand	32.5	49.8

Source: Thornton, IAI and FICCI (2016).

In addition to productivity increase and resource conservation, a major advantage of MI in the rain-fed areas is to help reduce fluctuations in output under deficit rainfall conditions and hence reduce vulnerability. The following caveats are cited with regard to the quantum of gains cited above:[70]

- Farmers need to master the MI technology. Dismantling of the MI structure after every crop can damage the equipment. However, in the case of crops lasting over several seasons/years such as grapes, there may not be a need for frequent change in the fixing of the structure.

- The provision of after-sales services such as the removal of clogging in the pipes is crucial for farmers. It is thus imperative for the dealers of MI to take care of maintenance issues for minimising the troubles of farmers.

- Banks have so far not played a major role in the financing of MI equipment. Although farmers rely on government subsidy for fulfilling many of their needs, it is important to devise a suitable business model for financing MI across states. Hence, there is need to focus more on innovation in the business model rather than on fostering technological improvement.[71]

- There is evidence of improvement in the ground water table whenever MI has been adopted on a large scale, say at the village level. Hence, while promoting the adoption of MI, it is important to focus attention on its adoption at either the village level or the cluster level. In fact, cluster-level adoption is important in view of the crop-specific

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[68] The most often quoted study in this context is NMMI- GOI (2014), based on a survey of beneficiaries across 13 states.

[69] The saving in Input costs due to MI in water, fertilizer, energy, and irrigation are 20-40 percent, 28.5 per cent, 30.5 per cent, and 31.9 per cent, respectively

[70] Bhamoriya and Mathew, 2014.

[71] Ibid.

benefits of MI..[72] The exercise undertaken in the earlier sub-section (Tables 4.2 and 4.3) can be further refined and extended to show that the enhancement of farmers' income can be achieved, especially in the arid zones, even if the productivity increase in fruits and vegetables is modest (say, 2 per cent per annum) along with resource conservation at 2 per cent per annum. A major part of the subsidy on MI can be directed towards the rain-fed areas which are characterised by a high incidence of poverty and greater vulnerability of farmers to low/ deficit rainfall. As mentioned above, this would necessitate innovative methods of financing as well as organising the farmers at the village/ cluster level.

MI can also contribute significantly to the sustainability of agriculture and augmentation of natural resources (land and water) in terms of: (a) utilisation of saline ground water for irrigation in conjunction with other agro-techniques; and (b) use of public wastelands for horticulture crops.[73]

4.3 Harvest and Post-Harvest Losses

This section focuses mainly on:

- The harvest and Post-Harvest Losses (PHL) of horticultural produce that is of a perishable nature; and

- The relative roles of different agencies to which the farmer sells his horticultural produce.

Special attention is paid to the losses incurred on certain products that are deemed as sensitive products because of their mass consumption, such as onion, potato and tomato. These products are considered sensitive in the sense that even a mild rise in their prices adversely affects their consumption by a large section of the population, particularly the poor.

A large number of studies have been conducted on the measurement of harvest and post-harvest losses in different regions of the world, covering a wide variety of agricultural crops and seasons. A meta-analysis of PHL has been done by Kitinoja and Kader (2015), offering a critical review of various studies. These authors argue that the estimates of PHL from these studies cannot be easily compared as the research has been done "without much explanation of what is being measured, when or how". Even the studies on PHL in India (say, on horticulture) are not easily comparable due to the varying coverage and concepts of PHL used by different authors. Some of the recent important studies on PHL have been summarised in Annex Table 4.5. The estimates of PHL by different studies vary by wide margins. For example, in the study by the Indian Council for Agricultural Research- Central Institute of Post-Harvest Engineering and Technology (ICAR-CIPHET), the cumulative PHL of fruits and vegetables is in the range of 4.5–15.88 per cent only.[74] The studies sponsored by NCCD show that the PHL varies from

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[72] For example, both grapes and cotton are grown in black soil and the benefits of MI flow to the cluster of farmers under such soil conditions. However, the quantum of benefit of MI is much larger in the case of grapes than cotton as the MI structure can last up to 12 years without being disassembled in grape cultivation (Bhamoriya and Mathew, 2014).

[73] See Task Force on Micro-irrigation, 2004, p. 19.

[74] GoI, Press Information Bureau, 2016 and ICAR-CIPHET, 2015

a low of 7-11 per cent in watermelon to a high of 24-55 per cent in bottle gourd, and was recorded to be as high as 44 per cent in the case of pears.[75] The research by Small Farmers' Agri-business Consortium 2015) in the North-Eastern region for fruits and vegetable shows that the food loss varies from 9 per cent in potato to 32 per cent in peas (Annex Table 4.6), leading to two interesting cases as delineated below:

- "In the case of pineapple, due to lack of an assured market in NR, about 20-30 per cent of the produce gets wasted and during the period of glut, when abundant produce is being taken to the market, the farmers are not even able to recover the logistics cost and are forced to distress sell as they do not have any other option" (p. 115).

- "From the value chain analysis, it seems that the farmers are getting around 50 per cent of the consumer price but in reality they get this price only for the high quality produce which fetches premium price in the market and the produce which reaches the market; so although farmers are getting good returns per unit produce, the actual returns per unit area are very low. About 20-30 per cent of the produce gets wasted at the farm level for which the farmers get nothing" (p. 115).

Although the study of SFAC (2015) is confined to the North-Eastern region, which faces special problems not only of agro-ecology but also of poor infrastructure and poor connectivity with markets, it is still quite relevant to many parts of India that are not well connected with markets. The following lessons can be drawn from the SFAC study:

- A significant proportion of the produce (20-30 per cent) gets wasted during periods of glut in the absence of an assured market.
- In such cases, the farmers are sometimes not able to recover even the logistics cost due to resorting to a distress sale.
- Even if the farmers get a high price on a portion of the high quality produce, the actual return per unit land is low due to a substantial proportion (20-30 per cent) of the produce getting wasted at just the farm level.[76]

One significant lesson from these studies is that while measuring PHL, an important dimension of the problem, as reflected in the following question, is usually missed by the researchers: How much of the produce is actually sold by the farmer? In other words, what proportion of the produce that is not monetised remains unsold? The produce that gets wasted in the field due to glut and/or a crash of the price or simply thrown away by the farmer in disgust is part of the produce that is 'not sold' and does not get monetised, that is, for which the farmer does not get any financial returns.

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[75] National Centre for Cold-Chain Development (NCCD), 2016.
[76] Such cases are not unusual for fruits and vegetables when the farmers do not even harvest a part of their crop or they are forced to abandon their produce in the field or throw it away at the road side.

4.3.1 An alternative view on the measurement of PHL

The studies referred to above measure PHL in harvest and post-harvest operations. However, an alternative view of PHL should also include the unsold produce of the farmer that is, pertaining to the proportion of the produce that does not get monetised or marketed at all. Even if part of this unsold produce is used by the farmer for self-consumption and for use as seeds, the remaining unsold produce should be treated as post-harvest losses.

The DFI Committee estimates the proportion of unsold produce using the NSSO, 70th Round (2012-13) data. The unit level information is available on the quantity disposed of and the quantity produced of each component (type) of fruits and vegetables. The ratio of disposal to production is computed for all types of fruits and vegetables at the state level. The geometric mean of the disposal–production ratio of the components of fruits represents the disposal–production ratio for fruits for a given state. The same exercise is repeated for vegetables and also for the combined group of fruits and vegetables and presented in Table 4.5. At the all-India level, the proportions of production that farmers are not able to sell in the market and thus do not get a monetary return for are 34 per cent, 44.6 per cent, and about 40 per cent for fruits, vegetables, and fruits and vegetables combined, respectively.

Assuming that 3 to 4 per cent of the production is retained by the farmer for self-consumption and seed, the unsold production would be around 36 per cent for fruits and vegetables. This estimate is much higher than the upper limit of PHL at 15.88 per cent found in the ICAR–CIPHET study. However, the studies conducted by Amity University (undertaken with NCCD) also show that in the case of some fruits and vegetables, the PHL goes up to 35 per cent for bottle gourd and to 44 per cent for pears.[77]

The evidence on 'food loss' presented in a study by SFAC shows that the total food loss in vegetables at different stages, that is, at the level of the farmers, and wholesale and retail distribution, is as high as 32 per cent in peas and as low as 9 per cent in potatoes in the North-Eastern region (Annex Table 4.6).[78] These estimates of 'food loss' are much higher than those quoted in the ICAR–CIPHET study. Although the SFAC study also does not consider 'food loss' in terms of the unsold component of production, it does give an indication that harvest and post-harvest losses are likely to be much higher than those obtained in the ICAR–CIPHET study, especially in the states/regions that have poor connectivity, and an inadequate marketing and transport infrastructure.

As regards the state or zone level scenario of unsold production, only a few states seem to be performing well in marketing their produce. For example, Maharashtra's performance is far better than that of other states in terms of the minimum unsold produce of 5 per cent in fruits and 14 per cent in vegetables. Gujarat has also recorded a good performance. The hill states do well mainly in the marketing of fruits but not vegetables. In the South, the farmers of Andhra Pradesh and Karnataka do well in selling their fruit produce but not so well in selling

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[77] Table s1-3, Vol. III-A, DFI Report.
[78] SFAC, 2015.

vegetables. The North-Eastern states do not perform well in comparison to the all-India scenario. However, the performance of farmers in Manipur, Mizoram and Sikkim in disposing of their fruit and vegetable produce is close to that of the all-India level. A critical issue in disposing of the fruit and vegetable produce is the availability of certain basic infrastructure facilities such as pack houses, cooling chambers, and reefer trucks of a certain minimum capacity to facilitate the transport of perishable items out of the local markets/mandis and beyond the local/districts markets across various regions[79].

The Proportion of Unsold Production (PUP) of fruits and vegetables has been arranged in descending order by states in Figure 4.3. The PUP is the highest in Goa (83.7 per cent), followed by J & K (80 per cent), Kerala (75.6 per cent), and others. The states that account for high share in the production of fruits and vegetable such as Karnataka and Maharashtra have much lower PUPs, at 27.7 per cent and 11.2 per cent, respectively (Table 4).

Andhra Pradesh, a state playing a prominent role in horticulture production in the country, also has a high PUP of 39.5 per cent. Uttar Pradesh, a major producer of fruits and vegetable in absolute terms, also has a high PUP of 34.9 per cent. The issue of huge losses suffered by the farmers in terms of their unsold production is a matter of concern. It represents a significant missed opportunity of raising farmers' income.

Table 4.5 Disposal–production ratio and the unsold component of fruits and vegetables

Zone	State	Fruits		Vegetables		Fruits and Vegetables	
		Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)	Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)	Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)
Hill Zone	Himachal Pradesh	74.3	25.7	36.6	63.4	47.5	52.5
	Jammu & Kashmir	91.1	8.9	10.6	89.4	19.9	80.1
	Uttarakhand	90.8	9.2	57.2	42.8	60.6	39.4
North Zone	Haryana	97.9	2.1	51.3	48.7	55.6	44.4
	Punjab	-	-	63.9	36.1	63.9	36.1
	Uttar Pradesh	55.8	44.2	68.4	31.6	65.1	34.9
South Zone	Andhra Pradesh	65.7	34.3	58.4	41.6	60.5	39.5
	Karnataka	67.5	32.5	94.2	5.8	84.3	15.7
	Kerala	28.1	71.9	22.7	77.3	24.4	75.6
	Tamil Nadu	24.9	75.1	65.9	34.1	49.5	50.5
	Telangana	-	-	89.7	10.3	89.7	10.3
East Zone	Bihar	59.8	40.2	29.1	70.9	34.8	65.2
	Jharkhand	33.1	66.9	43.2	56.8	39.5	60.5
	Odisha	47.9	52.1	42.1	57.9	43.3	56.7
	West Bengal	36.3	63.7	53.2	46.8	44.5	55.5
West Zone	Goa	-	-	16.3	83.7	16.3	83.7
	Gujarat	86.4	13.6	68.9	31.1	72.3	27.7
	Maharashtra	95.0	5.0	86.1	13.9	88.8	11.2
	Rajasthan	100.0	0.0	67.4	32.6	72.0	28.0
	Chhattisgarh	-	-	55.9	44.1	55.9	44.1

[79] NCCD,2015 Guidelines and minimum system standards for implementation in cold chain.

Zone	State	Fruits		Vegetables		Fruits and Vegetables	
		Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)	Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)	Disposal Production Ratio (%)	Proportion of unsold Produce to Production (%)
Central Zone	Madhya Pradesh	81.6	18.4	62.5	37.5	65.0	35.0
North East Zone	Arunachal Pradesh	9.2	90.8	39.1	60.9	31.3	68.7
	Assam	44.9	55.1	40.9	59.1	42.1	57.9
	Nagaland	69.3	30.7	38.9	61.1	48.3	51.7
	Manipur	99.5	0.5	59.0	41.0	61.0	39.0
	Meghalaya	60.3	39.7	25.5	74.5	31.9	68.1
	Mizoram	82.7	17.3	52.6	47.4	60.1	39.9
	Sikkim	78.6	21.4	63.3	36.7	64.0	36.0
	Tripura	20.4	79.6	61.1	38.9	54.8	45.2
All India		**66.0**	**34.0**	**55.4**	**44.6**	**60.1**	**39.9**

Source: Computation by DFI Committee from unit level of NSSO,70th Round

Figure 4.3 Proportion of unsold production of fruits and vegetables (%)
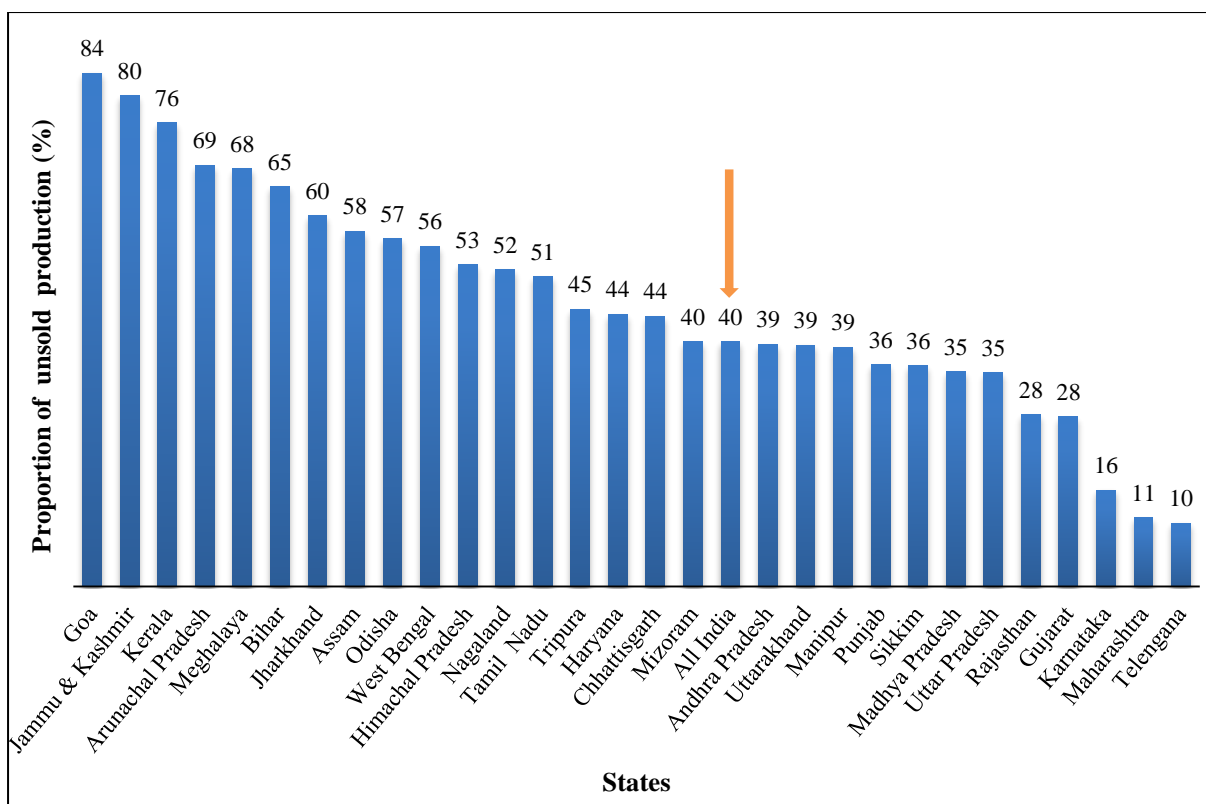
. Source: Table 4.5

4.3.2 PHL in sensitive commodities of mass consumption

Sensitive commodities like potato and onion have received special attention in our study of post-harvest losses. The results on tomato, which is also part of sensitive commodities, are not presented in Table 4.6. The unit level data of disposal of tomato needs more rigorous consistency checks

As mentioned earlier, the concept and definition of PHL are understood in a different manner by different author/agencies. Sometimes, the understanding of PHL is also contextual. It is suggested that there is strong need to harmonise the concept and definition of PHL and reconcile the empirical findings, especially in the context of rising farmer income. The losses at the all-India level are of the magnitude of 39 per cent and 14.4 per cent for potato and onion, respectively (Table 4.6).

Table 4.6 Disposal production ratio and the unsold production of sensitive horticultural commodities.

Zone	State	Potato		Onion	
		Disposal Production Ratio (%)	Unsold Produce as a proportion of the Production (%)	Disposal Production Ratio (%)	Unsold Produce as a proportion of the Production (%)
Hill Zone	Himachal Pradesh	88.3	11.7	1.9	98.1
	Jammu & Kashmir	37.8	62.2	5.6	94.4
	Uttarakhand	82.7	17.3	--	--
North Zone	Haryana	--	--	1	99
	Punjab	--	--	--	--
	Uttar Pradesh	--	--	--	--
South Zone	Andhra Pradesh			100	0
	Karnataka	97.6	2.4	93.1	6.9
	Kerala	--	--	--	--
	Tamil Nadu	--	--	93.1	6.9
	Telangana	--	--	--	--
East Zone	Bihar	47.7	52.3	55.7	44.3
	Odisha	97.2	2.8	46.8	53.2
	Jharkhand	25.3	74.7	--	--
	West Bengal	--	--	--	--
West Zone	Goa	--	--	--	--
	Gujarat	100	0	99.8	0.2
	Maharashtra	80.5	19.5	90.7	9.3
	Rajasthan			89.2	10.8
Central Zone	Chhattisgarh	25.3	74.7	--	--
	Madhya Pradesh	--	--	--	--
North East Zone	Arunachal Pradesh	--	--	--	--
	Assam			77.8	22.2
	Manipur	52.6	47.4	43.9	56.1
	Meghalaya	79.1	20.9	66.7	33.3
	Mizoram	77.6	22.4	--	--
	Nagaland	61.8	38.2	39.3	60.7
	Sikkim	66.9	33.1	--	--
	Tripura	38	62	--	--
All India		**60.9**	**39.1**	**85.6**	**14.4**

Source: Computation by DFI Committee from unit level data of NSSO, 70th Round (2012-13)

Some states with low shares in production show a high proportion of unsold production but states like Gujarat have almost a zero proportion of unsold production in onion. Maharashtra, which is an important state for production, accounts for a 9.3 per cent unsold production of onion. Bihar and Odisha have exceptionally high unsold proportions of production in onion, at 44.3 per cent and 53.2 per cent, respectively. This could be resulting in the relatively higher

price of onion in some of these poor states. The situation in the case of potato is worse than that of onion. The unsold proportion of potato is as high as 74.7 per cent in Jharkhand, 62.2 per cent in J & K, and 52.3 per cent in Bihar. Such a high proportion of unsold production of sensitive horticulture commodities not only directly hurts the interests of the farmer but also adversely impacts the poor population, in general, which ends up paying high prices for these commodities partly due to their diminished Supply caused by the high PHL.

4.3.3 Economic value of PHL and a paradigm shift in investment strategy

The economic value of PHL in fruits and vegetables in 2012-13, as estimated by the ICAR–CIPHET study, comes to Rs. 31,486 crores at 2014 prices. As a crude estimate, even if one takes the PHL in fruits and vegetables to be 30 per cent, the economic value of this loss would be Rs. 63,000 crores at 2014 price. The value of PHL of just one year amounts to 70 per cent of the investment required for specialised infrastructure for cold-chain integration.[80] This implies that a significant reduction in the PHL of fruits and vegetables alone for 2 to 3 years can finance the gap in specialised infrastructure and enhance the income of farmers. Hence, a paradigm shift in strategy of investment is imperative. Priority may be given to investment to bridge the shortfall in post-harvest specialised infrastructure needed for complete integration of cold chains. This would incentivize the farmers to undertake crop diversification, and enhance their income.

4.4 Role of the Private Trader in Perishables

It is interesting to note that despite the APMC being in operation, the largest single agency at the national level to which the farmers sell their horticulture produce is the private trader. The mandi (regulated market) is, in fact, second in order of importance as a purchaser of the farmers' produce. About 48 per cent of the horticultural produce is sold to the private traders and 38 per cent to the mandis. Input dealers (7.7 per cent) and the cooperative society and the government agency (4.6 per cent) play a relatively a smaller role in buying directly from the farmer (Table 4.7).[81] However, a major proportion of the sensitive commodities of horticulture, that is, potato, at 53.7 per cent, and onion, at 51 per cent, is sold in the regulated market.

Table 4.7 Distribution of value of produce of horticulture in its first disposal by agency: All India

SN	Major Commodities	Private	Mandi	Input Dealer	Cooperative and Govt Agency	Processors	Others	Total
1	Flowers	51.85	32.43	12.56	0.00	0.16	3.00	100
2	Fruits	45.92	43.63	8.26	1.08	0.05	1.07	100
3	Vegetables	51.89	40.99	1.84	1.96	0.48	2.84	100
4	'Others'	45.43	28.84	12.44	11.55	0.24	1.51	100
5	Horticulture (total)	47.78	37.93	7.72	4.58	0.24	1.75	100
	Sensitive Commodities							
1	Potato	40.41	53.65	3.97	0.59	0.51	0.86	100
2	Onion	42.85	50.97	3.65	2.16	0	0.38	100

Source: Computation by the DFI Committee from unit level data of NSSO,70th Round(2012-2013)

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[80] As per the estimate of NCCD (2016), the capital expenditure to meet the shortfall in cold-chain logistics, according to current norms, is Rs. 89,375 crores (Annex table 4.7).

[81] Most of the perishable produce is sold by the farmer as the first disposal.

A major part of the produce of tomato, that is, 58 per cent, is sold to private traders. The farmers do not sell directly to the processor who is a minor player in most produce, accounting for a purchase of just 6.24 per cent of the horticultural produce. The processor may be purchasing his raw material from suppliers other than farmers or is not ready to process certain horticultural crops grown, like onion, table tomato, mango, okra, spinach, etc. Cooperatives and government agencies also play a very small role, accounting for less than 5 per cent of the purchase of the horticultural produce. Their role is mainly confined to the purchase of items grouped in the 'Others' category, such as spices and plantation crops, among others.

The licensed private trader is supposed to pay a fee (a certain percentage of the value of the produce bought) to the mandi. Since they are dominant players in the market of horticulture produce, the fee liable to be paid to the authority of the mandi could be a huge amount, which varies from state to state. The resources generated by the APMC through private traders may not account for a large dimension of the overall resources.

The difference between the fee,[82] which the private trader is liable to pay, and the actual amount paid would indicate the magnitude of 'leakage' of public resources. This is a strong reason for initiating reforms in the marketing of agricultural produce by diluting the role of mandis/regulated markets, allowing for the free movement of agricultural produce, and giving farmers the freedom to sell to the best buyer.

The gross value of horticultural produce disposed of by the farmers in 2012-13 is estimated to be Rs. 26,445 crores, of which about 48 per cent is sold to the private trader,[83] that is, the farmers sold horticultural produce worth Rs.12, 693.6 crores only.

The private trader's liability in terms of the fee to be paid to the APMC authorities comes to about Rs. 127 crore at 1.0 per cent of the value of the horticultural produce alone. Given the fact that the approximate fee collected by the mandis from the private traders is only of the order of Rs. 300 crores on all agricultural produce, it can be inferred that a huge amount of the public resources were leaked through the marketing system. This underlines the urgent need for a drastic reform in the marketing system of agriculture produce.

The private trader is the dominant agency to whom the farmer sells his produce. The existing APMC system of marketing is not only forcing the farmers to forgo some income due to the lack of competition in the market but also leads to a huge leakage of public resources through the private trader who is not paying his full liability in terms of the market fee to the regulatory authority.

Thus, both the farmers and the state are losers because of the inefficient system of marketing of agricultural produce. The leaked resources could have been invested in developing the required infrastructure.

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[82] This can be precisely worked out at the state level and added up to arrive at the all-India figure.
[83] Computed from the unit level data of NSSO, 70th Round (2012–13).

4.4.1 Increasing the size of and access to the market

In the context of perishable commodities, it is important to ensure their quick disposal after harvesting unless the farmer has appropriate arrangements to hold the produce and store it at the required temperature to avoid wastage/damage to the produce before taking it to the market. This can be accomplished only if adequate infrastructure is available for packing (pack houses), cooling and transporting (through reefer trucks) to the market. Should the farmer aim at getting a better price than what is being offered in the local mandi, he needs to have access to markets beyond the local and nearby wholesale/regulated market.

However, strengthening the post-harvest logistics does increase the demand for farmers' produce and benefits them in a less direct manner. The main advantage of strengthening the post-harvest logistics goes to those engaged in this business. No doubt, this does increase the non-farm income component in the rest of the economy. However, where farmers get involved in the post-production operations a more direct benefit is extended.

The most critical point in the entire chain of farm harvest to post-harvest logistics is the extent to which the farmer is directly involved as a partner in the post-harvest logistics. Unless the farmer is part of an FPO and/or a cooperative society, his benefit is going to be rather small in terms of the remunerative price and/or enhanced sale of his produce.

Nevertheless, expanding the market size through direct connectivity from farms to markets, provides a vital advantage of linking the produce with real demand, rather than undertaking forced selling into localised markets, where the immediate demand may be lower than the supply. The latter subdues the local price discovery and leaves no options for the farmer to realise optimal value for the produce.

Figure 4.4 shows that while the development of agri-logistics benefits the economy, in general, the extent of gain to the farmer depends upon whether he is a partner of this cold-chain/other agri-logistics. In the situation depicted by the portion below the line F-M-UC in the figure, the major benefits of the development of agri-logistics go to the economy and the farmer, in general, and to the private entrepreneur, in particular.

It may be noted that in this situation, the farmer is not directly linked with the larger idea of the market. In the other situation, that is, in the portion above the line F-M-UC, the major gain of expanding the size of the market, in terms of both the reduction in PHL and better price realisation, accrues to the farmer, in particular, and to the private entrepreneur, in general. Therefore, the creation of institutions such as FPO/cooperative society is crucial to help the farmer build scale (aggregation) and participate in post-harvest logistics.

Figure 4.4 Marketing channels with and without farmers' involvement
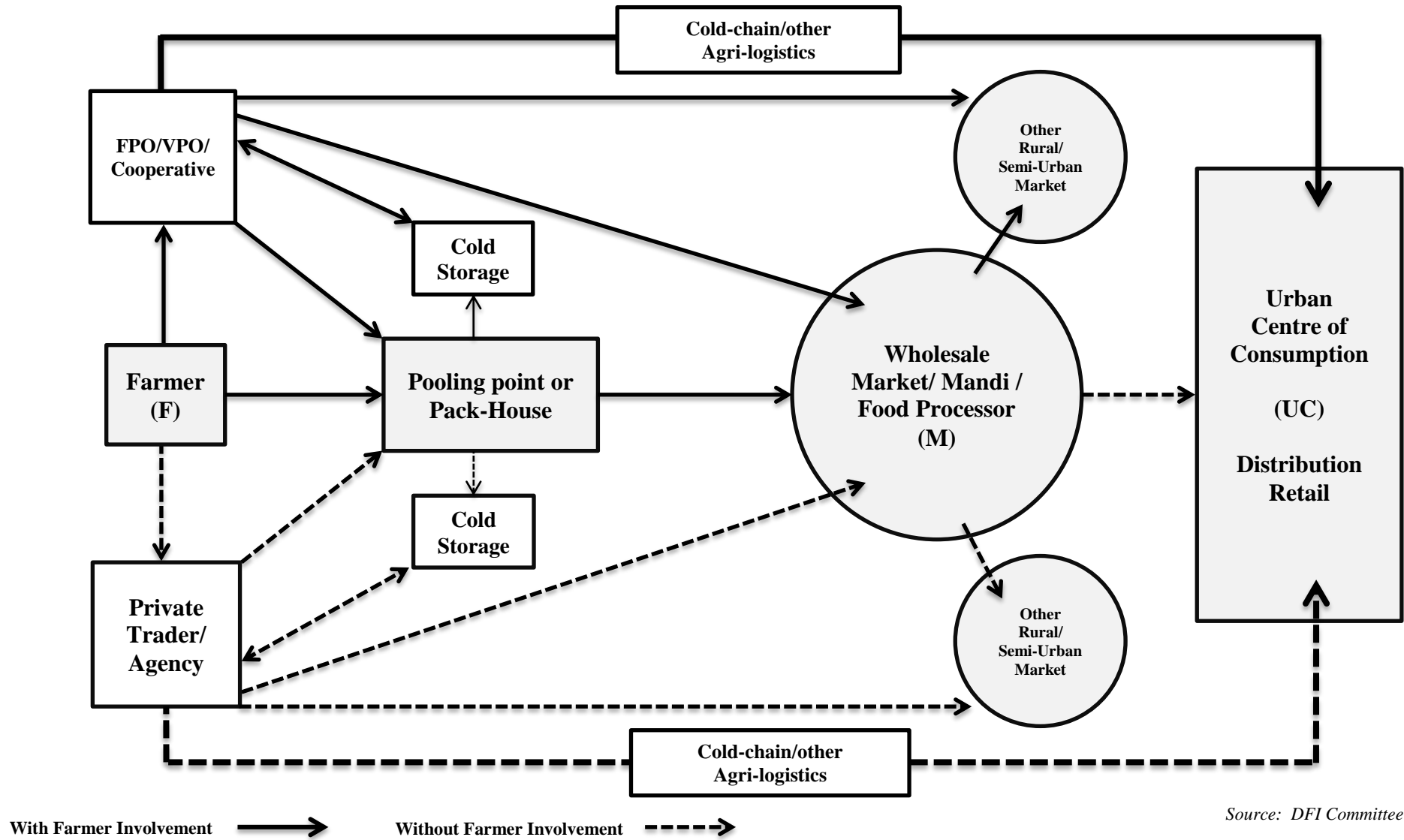
Source: DFI Committee

4.5   Nature and Composition of the Indian Food Processing Industry (FPI)

It is important to understand the nature of the food processing industry for at least three reasons: (i) employment and income generation opportunities in the non-farm sector increase if a greater proportion of the agricultural produce is processed; (ii) the relatively low skilled labour gets employment in view of the significant role played by the unregistered sector or informal sector in food processing, although this may not provide a decent (high wage) level of employment; and (iii) since an increasing Total Factor Productivity (TFP) in the food processing industry is an indication of the sustainable linkage between agriculture and industry, a sustained growth of the former would further enhance the prospects of raising non-farm income. However, the extent to which it would benefit the farmer households directly is difficult to quantify.

4.5.1   Main features of FPI

Some of the main features of the Indian food processing industry are highlighted below.

(i)   *The processing of perishable agricultural produce is low, except in some cases such as milk and fish.*

Studies that have attempted to measure the Extent of Processing of Agricultural Products (EPA) differ in terms of the methodology adopted to measure the EPA.[84]

- The share of foodgrains alone in the EPA is 70 per cent. The extent of processing of other food items is quite low in India. It is only in the fisheries (26 per cent) and milk (35 per cent) sectors that the processing level is more than one-fifth of the net value produced. It is followed by the processing of buffalo meat, at 20 per cent, and of poultry, at 6 per cent. The processing of fruits and vegetables is very low at 2.2 per cent) (Table 4.8). For all the major crops grown in India, the average weighted processing in organised manufacturing turns out to be 11.01 per cent, which is quite low as compared to that in other countries.

- The EPA in the case of milk is much higher than that for other products. The EPA for milk is reported to be as high as 35 per cent in the KPMG–MOFPI–FICCI study and 49.5 per cent in the FAOSTAT study. Ghosh's (2014) results show a much lower EPA of milk (11.6 per cent) as compared to that in other studies.

- A notable feature of the EPA for the perishable horticulture produce (fruits and vegetables) is that it is not more than 2.2 per cent. It is depicted as low as 1.1 per cent in the study by Ghosh (2014). Since horticulture offers a good opportunity to directly raise the income of farmers through the sale of fresh produce, it would have been extremely useful if horticulture could provide further value addition through processing. However, not all horticulture is readily processed and the demand for fresh produce is more on the rise.

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[84] Ghosh, 2014, for a review of the approaches used to measure EPA, which is defined as the value (or quantity) of the net proportion that is processed.

- The significant differences in estimates of EPA for different agricultural commodities in different studies can be attributed to the definition aspect and the measurement methods of processing per se.

Table 4.8 EPA estimates in different studies

Year	2007	2009-10	2003-04 to 2009-10 (avg)	
Category/Source	KPMG-MoFPI-FICCI	FAOSTAT	Ghosh (2014)	MoFPI
Fruits & Vegetables	2.2	0.19	1.1	
Milk	35	49.49	11.64	
Meat	21	0.14	5.67	
Poultry Products	6	not reported	2.05	
Milled cereals	-	0.246	4.24	
Buffalo meat				20
Fisheries				26

Source: The EPA as a percentage of the previous year's net production is adapted from Ghosh (2014)

(ii) *Although it is much smaller than the formal sector, the informal sector plays an important role in the food processing industry by contributing about 29 per cent of the Gross Value Added (GVA) of the Food Processing Industry (FPI).*

Here, it is important to delineate the sources of data with regard to the contribution of the formal and informal sectors. Biswas et al. (2015) use mainly two sources of data: ASI and NSSO. While data on the formal sector has been sourced from the factory level data of the Annual Survey of Industries (ASI), data on the informal component of the FPI has been obtained from NSSO's enterprise level data.

Table 4.9 shows that within the category of Micro Small, and Medium Enterprises (MSMEs), the informal sector plays an important role in contributing to the GVA of FPI. It is basically the manufacturing of dairy products in which the formal sector plays a larger role than the informal MSME sector in the manufacturing of dairy products, wherein it accounts for 63.3 per cent of the total produce.

This could be attributed to the significant role of cooperatives in the dairy sector. The informal sector, on the other hand, contributes a large percentage (42.3 per cent) of the GVA of FPI in the manufacturing of grain mill products, starches and starch products, and prepared animal feeds.

In general, the food processing sector has a dualistic structure. "The unorganised segment dominates in the numbers of "small enterprises and workers, but the organised segment dominates in terms of the value of output and investment".[85]

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[85] World Bank, 2014, Chapter 13

Table 4.9 Relative contribution of formal and informal sectors in gross value added of FPI

3-Digit Code	FPI Manufacturing Activity Covered	Contribution of Informal Sector to GVA of FPI (%), 2010	Relative Contribution of MSME in Total GVA (%) 2009-11	
			Formal	Informal
151	Production, processing and preservation of meat, fish, fruits, vegetables, oils and fats	35.39	27.6	72.4
15.2	Manufacture of dairy products	12.55	63.3	36.7
15.3	Manufacture of grain mill products, starches and starch products and prepared animal feeds	42.26	32.4	67.6
15.4	Manufacturing food products	21.87	43.0	57.0
	Overall	29		

Source: Compilation by DFI Committee from Biswas, et al. (2015).

(iii)   There is a strong linkage between large enterprises and MSMEs in FPI.

When micro and small enterprises contract-in work from other medium and large enterprises, they may be performing certain operations which they manage at a relatively lower cost by engaging skilled or semi-skilled labour force. The large enterprises normally contract-in raw material, etc. from MSMEs, which leads to the creation of a strong linkage between the two.

In spite of the evidence of linkage between large enterprises and SMEs, the latter are reported to face challenges in the following areas: (i) lack of adequate infrastructure; (ii) inadequate provision for skilled manpower, and (iii) lack of investable resources for holding an inventory necessitated by the seasonal nature of agriculture and raw material.[86] [87] The overall growth of the food processing sector is constrained by the nature of the fragmented market leading to "lower processing level and value addition". But this also offers opportunities to tap the growth potential.[88] For the farmers, the FPI are an alternate market provided they are suitably linked.

Biswas et al. (2015) have produced empirical evidence about a strong business linkage between the large enterprises and MSMEs. They have used ASI data at both the 3-digit and 4-digit levels, but this section briefly highlights the point of linkage by using the evidence on only the 3-digit level enterprises. The authors point to four kinds of linkages, of which the first one, ''contracting-in but not contracting-out''[89] is highlighted in terms of empirical evidence in Table 4.10. The table shows that a major proportion of the enterprises falling in the category of "contracting-in but not contracting-out'' take work from other enterprises but do not outsource their work to others.

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[86] ONICRA (undated).

[87] Market demand status and shortfall of suitable processable variety of raw produce are also factors

[88] Thornton and ASSOCHAM, 2017.

[89] The other categories of linkages are: ''contracting-out but not contracting-in''; "both contracting-in and contracting-out"; and "neither contracting-in nor contracting-out". Biswas, et al. (2015).

Table 4.10 Number of MSMEs having linkage of the type "contracting-in but not contracting-out"

Product/ Size of Enterprise (Product at the 3-digit Level) *	Total No. of Enterprises	No. in the Contracting-in Category	Proportion Column ½ (%)
Micro			
151	1350	758	56.1
152	216	152	70.4
153	6149	3918	63.7
154	2309	1505	65.2
Small			
151	725	499	68.8
152	394	184	46.7
153	2389	1513	63.3
154	1571	1127	71.7
Medium			
151	107	63	58.9
152	29	8	27.6
153	40	17	42.5
154	107	77	72.0
D. Large			
151	144	97	54.8
152	52	26	50.0
153	96	67	69.8
154	376	244	64.9

Source: Compilation by DFI Committee from Appendix Table 2.1 of Biswas, et al. (2015).

Note: *For the details of product category titles, see Table 4.2.3 of Biswas, et al. (2015).

(iv) *As regards employment generation in the food processing industry, employment growth in organised food manufacturing shows signs of slowdown in states with a high share in national level employment in the industry. Only a few states defy this pattern, but not without experiencing a decline in labour productivity.*

States such as Karnataka, Kerala, Maharashtra and Uttar Pradesh with a relatively high share in employment have observed slow growth of employment during the period 2000-2012. The only exceptions in this category are Andhra Pradesh and Tamil Nadu, which have managed higher employment growth, even though the labour productivity has declined. The other states that have made a significant contribution to employment in the food industry and have also maintained reasonable growth of labour productivity are Gujarat and West Bengal (Table 4.11). In Punjab, the growth of labour productivity in food manufacturing has turned negative. This kind of decline of labour productivity in Punjab raises a major concern about the poor prospects of labour absorption in the food processing industry, which needs to be revived.

(v) *There is a complex linkage between the agriculture and food processing sectors. Some poor states show negative Total Factor Productivity (TFP) in food processing, indicating a missing link between agriculture and industry. These states represent a case of lost opportunity of giving a push to non-farm income and increasing productive off-farm employment in the economy. This characteristic is observed in the case of both the poor as well as relatively non-poor states through*

the degree of correlation between the growth of GVA and employment, and the nature of TFP. Thus, in the food processing industry, no uniform pattern is seen across states showing sustainable growth in the GVA per factory and employment.

Among the agricultural backward states, Madhya Pradesh, Odisha, Rajasthan and West Bengal exhibit positive growth of TFP. These states have also recorded higher growth in employment than that observed at the all-India level (Table 4.11). Among the agriculturally developed, Gujarat, Himachal Pradesh and J & K show a strong positive TFP, indicating the sustainable growth in GVA of food processing. Relatively weaker but positive signal of growth of GVA in food processing is also seen in Haryana and Karnataka.

Among the relatively agricultural backward states that show negative growth of TFP are Assam, Bihar and Uttar Pradesh. These findings show how different states have been able to exploit the opportunity of strengthening linkage between agriculture and food processing, while others have missed this opportunity. The analysis indicates that states can be characterised by the nature of linkage between agriculture and food processing to generate employment and can be broadly classified into five groups, including two for the relatively poorer states, and three for the relatively non-poor states as below (for details, see Annex Table 4.7).

It has been observed that the relatively agricultural backward states with considerable dependence on agriculture have attracted private investment in processed food.[90] These states initiated fiscal and other measures to exploit their comparative advantage in offering lower transaction and transport costs (for raw materials), better economies of scale, and cheap labour. It is maintained that a rapid expansion of this relatively more labour-intensive industry in states with low per capita income, high dependence on agriculture, and high incidence of poverty, would help absorb more people from agriculture.

These arguments are even more relevant with respect to the unorganized segment of the industry, which is more spatially widespread, and has a higher potential to absorb labour, but has low productivity. Public policy thus needs to focus on promoting growth in agricultural productivity, along with investments in supportive infrastructure. More importantly, the infrastructure at aggregation level, also serves the larger purpose of connecting farmers with a wider market, besides the food processing industry, giving them a choice in markets and crop types.

For a better understanding of the underlying reasons for the vast differences across states in the performance of food processing industry, one needs to examine the role of the creation of the necessary infrastructure, investment in food processing technology, the overall business environment, and policy orientation to promote this industry.

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[90] Bathla and Madhur, 2016.

Table 4.11 Growth rate in employment, GVA, capital intensity and total factor productivity across states in organised food- manufacturing: average 2000-2012

State	Annual Growth Rate					% Share in Employment	% Share in GVA
	Employment	GVA/ Factory	Capital/ Factory	TFP	Labour Productivity		
AP*	4.43	3.64	5.7	-0.24	2.79	13.62	9.35
Assam	1.50	1.98	1.33	-3.94	3.69	5.1	2.32
Bihar	4.18	-8.52	-1.29	-3.61	-4.21	0.92	0.69
Gujarat	4.65	5.88	3.72	1.72	5.70	5.42	6.68
Haryana	0.14	10.34	12.92	0.66	10.27	2.84	3.79
HP	12.26	6.38	8.43	2.73	1.63	0.42	0.92
J&K	5.11	6.97	0.51	6.23	8.07	0.36	0.24
Karnataka	2.89	5.73	7.54	0.01	6.43	10.82	2.65
Kerala	2.03	-2.47	2.53	-	-0.98	10.82	2.65
Madhya Pradesh	4.62	5.75	5.69	2.59	4.21	2.13	4.0
Maharashtra	1.53	0.16	4.52	-1.42	1.48	12.75	14.39
Odisha	3.2	10.45	4.72	6.69	12.95	1.54	1.12
Punjab	1.89	-5.66	0.32	-9.84	-0.90	6.5	6.68
Rajasthan	7.21	9.12	5.72	2.22	5.42	1.75	2.99
Tamil Nadu	3.23	1.99	5.82	-2.14	2.24	10.45	7.36
Uttar Pradesh	0.89	2.29	9.80	-4.06	2.16	10.75	9.67
West Bengal	4.08	10.41	7.32	4.34	9.62	4.51	3.00
India	2.87	4.96	5.37	0.76	5.78	100	100

Source: Computation by DFI Committee from Bathla, 2017.

4.6   Findings and Policy Implications

4.6.1   Key issues
This chapter examined the following key issues:

- Impact of crop diversification on income from cultivation;
- Magnitude of harvest and post-harvest losses (PHL) in horticultural produce;
- Role of private traders in the purchase of fruits and vegetables; and
- Nature and composition of the food and agro-processing industry.

The first three of the above issues have been examined on the basis of the evidence generated from the NSSO, 70th Round, and 2012-13. The fourth question has been addressed on the basis of the evidence derived from the research conducted by various authors. For each question, the state level scenario/evidence has been produced, wherever possible.

4.6.2   Findings
Crop Diversification
- The past evidence shows that there is high instability in the price, area and production of horticultural commodities.

- An analysis of the prospects of raising farmers' income through diversification indicates that the relative profitability varies widely across states and so does the elasticity of income from cultivation with respect to the expansion of the area under horticulture (by substituting horticultural crops for staple crops, excluding pulses).

- It has been observed that in general, the higher the elasticity, the larger is the increase in net income due to increase in the area under horticulture. In some of the relatively poor states with low elasticity, such as Bihar, Jharkhand, Madhya Pradesh, Rajasthan and Uttar Pradesh, the percentage increase in income from cultivation is less than the corresponding all-India figure.

- The elasticity of income with respect to the increase in area under horticulture is quite low (ranging from 0.026 to 0.087) in the northern states of the Green Revolution, such as Haryana, Punjab and Uttar Pradesh. These states have little incentive to diversify as they get an assured price (MSP) for paddy and wheat through procurement by FCI. They thus continue to practise paddy–wheat rotation even at the cost of damage to the environment. All the North-Eastern states, except Manipur, exhibit low elasticity and moderate increase in income from cultivation, the main reasons for which could be the lack of market reforms and non-availability of proper market connectivity.

- The adoption of micro irrigation (MI) would help in adding to income gain and resource conservation, particularly in the rain-fed areas. There is thus need for prioritising the MI judiciously to focus primarily on the rain-fed areas for pushing diversification.

- As regards harvest and post-harvest losses, Kitinoja and Kader (2015) find that researchers have used different definitions of PHL. Most of these studies are not comparable. Studies on India too, give widely different results on PHL.

This study follows an unconventional measure of the PHL as a proportion of the produce that remains unsold net of use for seed, self-consumption, etc.

At the all-India level, the proportions of the production of fruits, vegetables, and fruits and vegetables combined, that farmers are not able to sell, are 34 per cent, 44.6 per cent, and 40 per cent, respectively. Assuming that 3 to 4 per cent of the production is retained by the farmer for seed and self-consumption, the unsold production would be around 36 per cent for fruits and vegetables. This estimate is much higher than the upper limit of PHL (15.88 per cent) reported in the ICAR–CIPHET study.[91]

- In the case of sensitive commodities, potato and onion, the losses at the national level are of the order of 39 per cent and 14.4 per cent, respectively.

- The loss of PHL in fruits and vegetables has been assessed by ICAR–CIPHET (2015) to be worth Rs. 31,486 crores at 2014 prices. Even if the PHL of fruits and vegetables is taken to be just two times of that estimated by ICAR–CIPHET (a maximum of 32 per cent), its economic value would amount to Rs. 62,972 crores, which is more than 70 per cent of the investment required for specialised infrastructure for the integration of cold-chains.[92]

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[91] The 36 per cent estimate of the PHL is not on the higher side as is being highlighted in the print media, (*Eastern Mirror*, 2017; and *The Hindu*, 2017).
[92] Refer to Annex Table 4.7.

The Role of the Private Traders

- About 48 per cent of the horticultural produce is sold to the private traders and 38 per cent to the *mandi*s. Input dealers (7.7 per cent) and the cooperative society and government agencies (4.6 per cent) play a relatively smaller role in terms of buying directly from the farmer.

- The existing APMC system of marketing compels farmers to forgo some income due to lack of competition in the market but it also leads to a huge leakage of public resources as private traders do not pay their full liability of the market fee to the regulatory authority.

The Indian Food and Agro-Processing Industry (FPI)

- The processing of perishable agricultural products is low (around 2 per cent), except in some cases such as milk and fish.

- The informal sector, though much smaller than the formal sector, plays an important role in the food processing industry by contributing about 29 per cent of the GVA of the FPI (Biswas, et al., 2015).

4.6.3 Policy implications

- The plan of diversification through expansion of the area under horticulture at a slow rate (2.0 per cent per annum) in the initial first three years and then expediting it at the rate of 4 per cent annum is based on a pragmatic choice so that some states do not feel being pushed hard to diversify. Case II stipulates a period of three years to develop/improve the necessary infrastructure and educate the farmer on the benefit of diversification and the adoption of micro irrigation. It also gives leverage to agriculture experts at the state level to undertake a detailed exercise on crop diversification at the district level.

- Since diversification-led growth is more pro-poor, there is need to prioritise incentivisation of small and marginal farmers in the rain-fed areas to adopt micro irrigation. This would help in raising productivity and also in the conservation of inputs like water and fertilisers in the less endowed regions. The recent modifications made in the Prime Minster Krishi Sinchai Yojana (PMKSY) and the National Horticulture Mission strongly support the initiative required on MI.

- Reducing PHL in fruits and vegetables in agri-logistics can help generate income/resources and empower farmers to finance more than one half of the capital expenditure required to bridge the shortfall in post-harvest specialised infrastructure needed for complete integration of cold-chain facilities.

- In order to increase the income gains to farmers, they should be involved in post-harvest logistics as partners through the Farmer Producer Organisation (FPO)/Village Producer Organisation (VPO)/cooperative society. This would directly benefit the farmers by providing them access to bigger markets (beyond the local market) and more

remunerative prices. In this context, the launch of the New Model act APLM, 2017, is a step in the right direction.

- The food processing industry in India shows linkages between the larger enterprises and MSMEs, but these linkages do not show a consistent pattern across states. A detailed study is required to quantify the role of infrastructure, technology and investment policies at the state level.

- An increase in the area under horticulture at 4 per cent per annum at the national level would lead to a net increase in income from cultivation by 5.54 per cent by 2022-23 (base year 2015-16).

- On pragmatic considerations, the states showing a deceleration in growth in the area under horticulture after 2010-11 and/or with poor infrastructure (poor market connectivity) may target for growth of area under horticulture at 2 per cent per annum for the first three years and then raise it at the rate of 4 per cent annum for the next four years. In this scenario, the increase in income from cultivation at the national level is 4.21 per cent per annum by 2022-23. Although the difference in increase in income from cultivation in this scenario and the scenario stated above is not large at the national level, the state level differences are quite significant.

- The proportion of the produce that remains unsold net of use for seed and self-consumption is taken as the measure of the post-harvest losses (PHL). The PHL of fruits and vegetables is 36 per cent. This estimate is much higher than the maximum PHL (15.88 per cent) reported in the ICAR–CIPHET study.

- The private trader still dominates the market of fruits and vegetables. About 48 per cent of the horticultural produce is sold to the private trader, 38 per cent to the mandis/regulated markets and the remaining to input dealers and processors.

- Although the overall processing of horticultural produce is very low (less than 2 per cent), the informal sector contributes about 29 per cent of the gross value added (GVA) of the food processing industry (FPI). The MSMEs have linkages with the large enterprises. Overall, the employment growth in the food and agro-processing industry has been quite low.

- Since diversification-led growth is more pro-poor, priority should be given to incentivize the small and marginal farmers in the rain-fed areas to adopt micro irrigation (MI). This would help in increasing productivity and also in the conservation of inputs like water and fertilisers in the less endowed regions. The recent modifications made in the Prime Minster Krishi Sinchai Yojana (PMKSY) and the National Horticulture Mission strongly support the initiative required for MI.

- The focus should be on reducing the PHL in fruits and vegetables. Farmers should be made partners in the cold-chain/agri-logistics to enable them to benefit from access to bigger markets (beyond the local market) and realisation of remunerative prices.

- This should be accompanied by market reforms to allow farmers' produce to move beyond the local and/or wholesale mandis. The launching of the new Model Act APLM,

2017 is a step in the right direction, and it is desirable for all states to implement reforms on the pattern of this Act.

- The development of integrated a cold-chain/agri-logistics infrastructure would be instrumental in strengthening the linkage between MSMEs and large enterprises and incentivize entrepreneurs in FPI to be located close to the village/semi urban centers. This would create considerable off-farm/non-farm employment for the rural youth.

- The creation of institutions such as FPOs/VPOs/cooperative societies in which farmers are partners is extremely crucial for scaling up post-harvest operations and directly linking them with markets beyond the local mandi/market. This would reduce post-harvest losses in perishables and also help farmers realise higher prices for their produce.

Key Extracts

- Diversifying into high value agriculture like horticulture brings me enhancement to farmers of high levels, without impacting their immediate food security.

- Increasing the area cover under horticulture should be planned so as to replace and release area under other crops which are less paying.

- Expansion into horticulture cultivation should be done carefully as it may not result in income enhancement unless it is met with equal development of suitable logistics to connect the perishables with markets.

- Shortfall in market connectivity will add to post-harvest food losses. Using NSSO data, the current levels of unsold production of fruits and vegetables is assessed to be as high as 36 per cent.

- This chapter shows example of horticulture but the same can be applied to other high value agricultural items such as fisheries, livestock, etc.

Chapter 5
Analysis of Changes on Input Costs and Crop Income

The Indian agricultural sector has undergone considerable changes since the advent of Green Revolution technology during the mid-1960s. The Green Revolution technology, which was initially focused on wheat and rice and the regions endowed with irrigation facilities, has spread to other food and non-food crops and other regions during the later decades. Despite claims that the technological breakthrough in crops other than wheat, rice and recently cotton, and its geographical adoption has happened in a limited way, there can be no denying the fact that it has tremendously increased crop output and farmers' income.

5.1   Background

The agricultural sector had registered impressive growth during the 1980s, which was followed by a slump in growth during the 1990s and early 2000s. Various studies have shown that the total factor productivity (TFP) growth in major crops decelerated in the 1990s. Despite the revival of growth since the mid-2000s, concerns have been expressed by researchers and policy planners about various issues including the decline in crop incomes; the fact that agriculture is turning out to be non-remunerative; and causes economic distress among farmers.

With the improvement in production, India's position has changed from being a net importer of agricultural products to an exporter of certain commodities. At the farm household level, the Green Revolution technology has helped improve the livelihood pattern, nutrition and education of children (Hazell and Ramasamy, 1991; Foster and Rosenzweig, 1996; Baker and Jewitt, 2007).

According to the findings of the Government of India's National Sample Survey conducted in 2003, 27 per cent of the farmers did not find farming profitable, and 40 per cent said that if they were given the choice to pursue some other occupation, they would quit. There were also concerns about slowdown in the yield of major crops. Despite the occurrence of some degree of diversification from field crops to horticulture, the amount of income generated from field crops still matters for improving the income of farmers' households.

In this context, it is important to analyse the changes in farm profitability and examine the underlying factors responsible for varying farm incomes. This chapter analyses the trends in real income of major crops in the select states of India.

The chapter is organised as follows. The next section discusses the method of estimation of crop income based on the CACP cost accounting procedure. The third section discusses changes in agricultural income and costs at the national level. Trends in income and cost for 23 crops are presented in the fourth section. The fifth section provides a summary of the major findings.

5.2 Estimation of Crop Income

For the estimation of agricultural income, secondary data were compiled from the National Accounts Statistics and the Cost of Cultivation of Principal Crops in India. While data from the National Accounts Statistics are used to analyse the changes in agricultural income at the macro level, the cost of cultivation surveys are used for the state level analysis. The 'cost of cultivation' surveys are conducted annually by the Ministry of Agriculture to collect farm level data on inputs, output and prices.

The Commission for Agricultural Costs and Prices (CACP) mainly uses the cost of cultivation data for fixing crop-specific minimum support prices. Eight types of cost concepts are used for working out the alternative incomes from crop production based on the cost of cultivation survey data. Among these costs, Cost A2 is the paid out cost and is widely used for analytical purposes to track changes in the welfare of farmers. Cost A2 includes all actual expenses in cash and kind incurred by cultivators, and the rent paid for leased-in land. However, the CACP uses the total (full) cost given in the form of Cost C2 for fixing of the minimum support price. The Cost C2 includes the rental value of owned land and interest on fixed capital. These cost components have been estimated through the method of imputation, which is considered to be defective as it does not reflect the actual prevalent rates.[93] Nevertheless, Cost C2 is also used to analyse the changes in crop income.

The present study estimates the farm business income as the difference between the paid out cost and gross value of output (main and by-product). In order to compute the per hectare farm business income, both inputs and output data were deflated by the relevant price deflators with 2011-12 as the base year. The inputs considered include human labour, bullock labour, seeds, fertilisers, insecticides, irrigation, interest on working capital, rent paid for leased-in land, land revenue, cesses and taxes, and depreciation on implements and farm buildings. While agricultural labour wages were deflated by the consumer price index for agricultural labourers, material inputs and other items were deflated by the respective wholesale price indices. Crop outputs were deflated by using the respective wholesale price indices. Two types of crop incomes have been derived; farm business income (gross value of output minus paid out cost) and net income (gross value of output minus total cost). Farm business income represents payments to own factors of production, while net income shows profitability in crop cultivation.

5.3 Changes in Agricultural Income at the National Level

India's National Accounts Statistics provides the agricultural GDP, which is estimated in terms of gross value added by deducting the value of consumption of intermediate inputs from the value of output for the sector. This also includes gross value added from the operation of government irrigation system. Figure 5.1 shows the trend in annual growth in gross value added and consumer price index for agricultural labourers (CPIAL). The gross value added indicates agricultural income, while the CPIAL shows the price that rural persons pay for the purchase

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[93] See Sen and Bhatia, 2004, p. 154.

of consumer products. It is evident that the percentage change in CPIAL was higher than the agricultural income during most of the years under study. The years which were characterised by high agricultural income over the consumer price index, were affected by drought and hence the higher base value has resulted in higher growth. Agricultural growth showed a declining trend continuously from the mid-1990s to the early 2000s. There was a revival in growth from 2005-06, albeit with wide fluctuations, but it declined sharply again during recent years. The trend in movement of agricultural income clearly indicates that the purchasing power of farmers has remained low and has, in fact, been worsening during recent years.

Figure 5.1 Annual Growth in Agricultural GVA and CPIAL
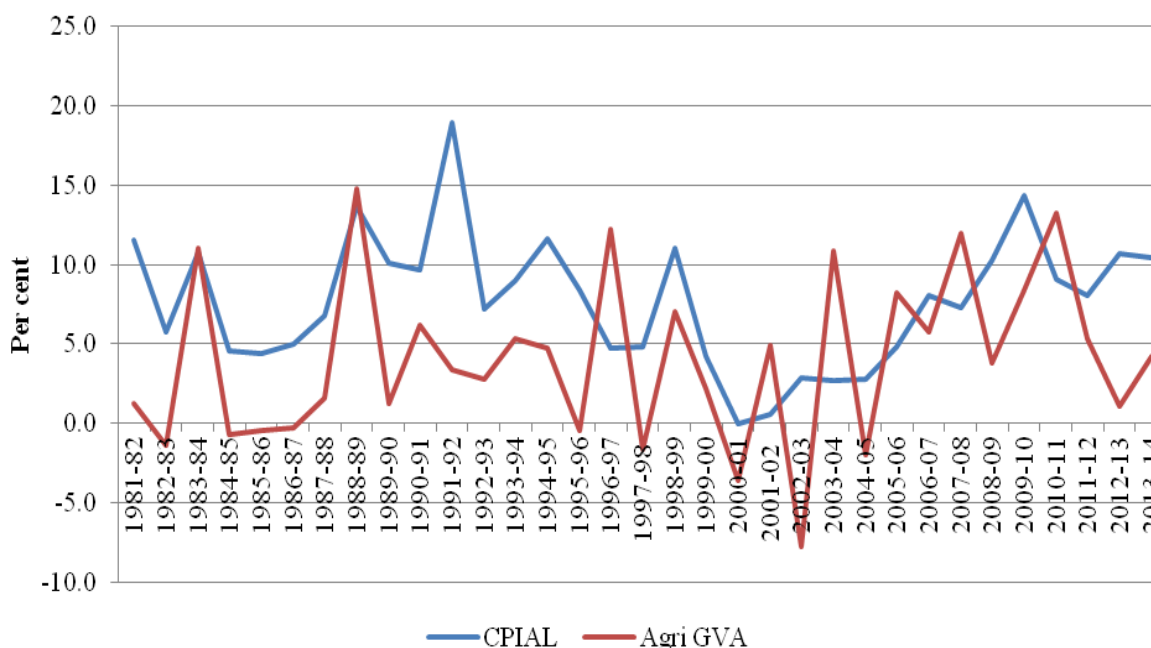
The status of welfare of the farmers can also be analysed through changes in productivity and terms of trade (TOT). The Directorate of Economics and Statistics (DES), Ministry of Agriculture, provides consistent estimates on the barter terms of trade. The TOT indicate that the purchase and sale by agriculture have has been increasing, by and large consistently, from 1981-82 to 1991-92 (Table 5.1). The average value of the index during this period was 79.1, which increased to 84.8 during the period 1992-93 to 2005-06, with inter-year deteriorations during a few years. This implies that the TOT was not much in favour of agriculture through the 1990s to the early 2000s. The terms of trade have, however, recovered during recent years and this improvement seems to be driving the overall growth in the agricultural sector with a technological breakthrough.

A comparison of trends in the wholesale price index (WPI) of food articles such as rice and wheat, and important purchased agricultural inputs like fertilisers, diesel and electricity used for irrigation purposes throws up certain revelations. The WPI figures of these items were chosen for the purpose of illustration to show that the prices received by farmers for food

articles moved in relation with the prices paid by farmers for the purchase of inputs. It can be observed from Table 5.1 that the WPI of food articles was lower than that of agricultural inputs for most years, indicating that the farmers received lower market prices for agricultural commodities than the prices paid for the purchase of inputs. However, the prices of food articles have risen at a faster rate since 2008-09. Various studies have shown that rising prices are unlikely to come down in the medium term, because of the increasing food demand coupled with rising incomes and urbanisation. As a result, the price series may not return to its long-term equilibrium price, and is likely to set a new normal trend. At the same time, input prices continued to show an increasing trend over time. The possible reasons for the prevalence of low prices of food articles during most parts of the study period may include the frequent occurrence of droughts, and high incidence of malnutrition, hunger and poverty. The government also undertakes procurement operations to maintain grain reserves and distribute grains to the poor through the public distribution system at subsidised rates. Therefore, it was useful to maintain lower food prices for a considerably long time. Despite the supply of agricultural inputs at subsidised rates, input prices showed an upward trend, which, in turn, brought down profitability from crop cultivation.

Table 5.1 Trends in TOT and the Agricultural Output-Input Ratio

Year	Agricultural Output–Intermediate Input Ratio	TOT	Wholesale Price Index (Base: 2011-12=100)				
			Rice	Wheat	Fertilisers	Diesel	Electricity (Irrigation)
1981-82	3.00	73.0	11.8	11.4	22.8	6.0	10.7
1982-83	3.08	75.2	14.2	13.0	24.0	6.3	11.9
1983-84	3.21	75.4	15.2	12.9	22.2	6.5	12.4
1984-85	3.21	77.3	14.4	12.7	22.5	6.7	12.2
1985-86	3.19	77.0	15.2	13.9	23.4	7.1	12.1
1986-87	3.12	78.8	16.1	14.6	24.6	7.2	14.6
1987-88	3.17	80.2	17.9	15.8	24.0	7.3	16.1
1988-89	3.35	80.9	19.4	17.9	22.6	7.2	14.8
1989-90	3.43	81.8	20.0	17.1	22.6	7.5	14.2
1990-91	3.50	83.9	21.8	20.3	22.6	9.8	15.2
1991-92	3.48	86.9	27.4	24.6	29.9	10.5	16.2
1992-93	3.60	85.5	29.4	26.4	39.8	12.3	18.7
1993-94	3.74	85.3	32.6	29.8	41.6	13.3	24.3
1994-95	3.75	87.7	36.9	32.7	50.6	12.0	29.3
1995-96	3.63	86.7	38.9	34.1	54.0	14.5	32.5
1996-97	4.10	84.9	42.7	42.6	54.5	16.7	33.8
1997-98	3.91	86.9	44.0	41.2	56.8	20.3	36.2
1998-99	4.00	86.6	50.1	47.2	58.0	19.6	37.9
1999-2000	3.77	84.5	56.0	53.3	60.9	25.5	40.0
2000-01	3.74	83.1	54.4	52.4	66.2	32.0	50.1
2001-02	3.76	84.6	53.8	52.1	67.8	33.7	58.5
2002-03	3.53	85.3	54.6	54.4	70.4	41.0	65.6
2003-04	3.61	83.1	55.3	55.1	71.6	50.3	66.8
2004-05	3.63	82.6	57.2	58.5	72.9	59.6	73.1
2005-06	3.68	80.8	59.3	65.9	74.2	62.2	76.7
2006-07	3.74	83.8	63.7	68.5	76.9	61.3	76.5
2007-08	4.01	87.8	72.0	72.6	81.9	64.2	75.5
2008-09	3.97	95.0	80.8	80.5	80.2	66.2	77.9
2009-10	3.98	99.6	92.1	99.0	80.2	82.3	86.3
2010-11	4.15	104.2	96.3	100.2	86.9	91.7	92.9
2011-12	4.25	100.0	100.0	100.0	100.0	100.0	100.0
2012-13	4.08	102.1	115.8	117.1	110.2	114.8	124.9
2013-14	4.71	105.5	133.0	125.0	111.5	134.0	150.9

Sources: TOT from Agricultural Statistics at A Glance, various issues; Ministry of Agriculture; Agricultural output-input ratio computed (at 2011-12 prices) from National Accounts Statistics, CSO, and WPI compiled from Office of the Economic Advisor, Ministry of Commerce and Industry,

The serious concerns that have emerged since the mid-1990s were a decline in crop productivity growth, lack of new technology and institutional support.[94] (). As is evident from Table 5.1, there was an increase in the agricultural output to input ratio during the 1980s, but it remained almost constant thereafter. In fact, the output–input ratio was around 3.75 during the entire 1990s and 2000s. These results imply that despite an increase in the overall agricultural output, the proportionate rise in input costs has not helped improve the output–input ratio over time. However, there has been some improvement in the output–input ratio during recent years.

Table 5.2 Composition of Intermediate Inputs Consumed (%)

Items	TE 1982-83	TE 1990-91	TE 2000-01	TE 2013-14
Seed	9.5	9.1	8.4	7.0
Organic manure	3.7	4.7	5.9	5.0
Chemical fertilisers	17.9	18.8	16.1	11.3
Current repairs, maintenance of fixed assets and other operational costs	0.9	1.3	1.7	2.4
Feed of livestock	55.3	51.6	51.2	48.4
Irrigation charges	0.6	0.6	0.5	1.0
Market charges	7.8	8.4	9.3	9.6
Electricity	1.6	1.7	2.3	2.3
Pesticides and insecticides	0.8	0.7	0.4	0.4
Diesel oil	1.4	1.6	3.0	7.5
Financial intermediation services indirectly measured	0.7	1.6	2.1	5.1
Total Intermediate Inputs	100.0	100.0	100.0	100.0

Source: National Accounts Statistics (various issues), Government of India.

In this context, an attempt has been made to look into the changes in composition of consumption of intermediate inputs in agriculture. Among the total input costs, feed of livestock constitutes the highest proportion followed by chemical fertilisers (Table 5.2). Since crop–livestock interactions are complex and it is difficult to separate the input and output contributions from each other, the value of outputs from livestock have been included along with the crop sector while estimating the gross value added from agriculture.[95]

The contribution of livestock to the total value of agricultural output has increased over time, reaching 25.0 per cent in 2014-15. Although in percentage terms, the livestock feed cost has declined, in terms of absolute values, it has increased substantially. Since the use of purchased feed has been increasing, any rise in feed cost is likely to affect the profitability of animal rearing. Interestingly, the share of seed cost has declined due to the operation of various input subsidy programmes, while the shares of electricity and diesel oil have increased. The increase in the share of electricity may be due to the introduction of tariffs on electricity used for agriculture in some states during recent years. Despite several initiatives taken by the government to supply agricultural credit at low interest rates, the cost share has surprisingly increased from 1.6 per cent in 1990-91 to 5.1 per cent in 2013-14. On the whole, the analysis

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[94] Kumar, et al., 2004; Janaiah, et al., 2005; Kannan, 2011; Chand, 2011.
[95] CSO, 2007.

at the macro level indicates that while the value of agricultural output has increased over time, the cost of inputs has also increased at the same or higher proportions in some cases.

5.4 Changes in Crop Income and Cost

This section discusses trends in crop income and cost for 23 crops grown in major states in India. The cost of cultivation surveys provide the detailed structure of input costs and the value of output of crops grown across the states. A series showing the real value of the output and costs has been constructed for the period 2004-05 to 2013-14. Five-year averages of incomes and costs for all the crops by major states have been worked out for analysing their changes over time. The details of average real income and cost by crops are discussed below.

5.4.1 Cereals
Paddy

The cost of cultivation surveys provide farm level information on the input cost and output on paddy cultivation for 18 major states (Table 5.3). Barring Bihar, Jharkhand and Odisha, all other states showed an increase in the gross value of output during the period 2009-10 to 2013-14 over the period 2004-05 to 2008-09. The per hectare value of paddy output was highest in Haryana followed by that in Punjab and Andhra Pradesh. However, the per hectare farm business income has declined in seven states during the recent period as compared to the previous period. Despite the increase in the value of output in states such as Andhra Pradesh, Chhattisgarh, Uttarakhand and West Bengal, a more than proportionate rise in paid out costs has resulted in a fall in farm business income. In other states such as Bihar, Jharkhand and Odisha, a marginal decline in the value of the output and rise in the paid-out cost have been observed during the period 2009-10 to 2013-14. This has resulted in a decline in the incomes of these states.

Table 5.3 Average real crop output value, cost and income (Rs./ha): paddy

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	59,885	28,403	52,982	31,482	6903
2009-10 to 2013-14	64,372	33,081	59,835	31,290	4537
Assam					
2004-05 to 2008-09	22,263	11,470	26,193	10,794	-3930
2009-10 to 2013-14	23,645	12,689	29,677	10,956	-6032
Bihar					
2004-05 to 2008-09	26,224	13,733	24,518	12,491	1706
2009-10 to 2013-14	23,571	14,310	25,753	9261	-2181
Chhattisgarh					
2004-05 to 2008-09	29,651	12,544	26,127	17,107	3524
2009-10 to 2013-14	31,261	14,675	28,779	16,586	2483
Gujarat					
2004-05 to 2008-09	44,693	19,897	31,271	24,796	13,422
2009-10 to 2013-14	53,254	24,443	38,696	28,811	14,558
Haryana					
2004-05 to 2008-09	71,420	25,515	52,997	45,906	18,423
2009-10 to 2013-14	77,270	25,961	55,680	51,308	21,590

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Himachal Pradesh					
2004-05 to 2008-09	26,642	7079	25,750	19,563	892
2009-10 to 2013-14	28,300	5943	21,924	22,357	6375
Jharkhand					
2004-05 to 2008-09	18,956	13,038	24,045	5918	-5089
2009-10 to 2013-14	16,490	13,453	23,442	3037	-6952
Karnataka					
2004-05 to 2008-09	58,994	27,917	47,439	31,077	11,555
2009-10 to 2013-14	63,673	30,997	52,716	32,676	10,957
Kerala					
2004-05 to 2008-09	50,745	32,543	47,736	18,203	3009
2009-10 to 2013-14	65,775	35,389	52,078	30,386	13,697
Madhya Pradesh					
2004-05 to 2008-09	23,007	10,911	22,498	12,097	509
2009-10 to 2013-14	35,508	14,065	29,443	21,444	6066
Maharashtra					
2004-05 to 2008-09	36,941	31,279	45,980	5662	-9038
2009-10 to 2013-14	42,814	29,642	48,588	13,171	-5775
Odisha					
2004-05 to 2008-09	31,347	16,538	32,517	14,809	-1170
2009-10 to 2013-14	30,930	17,861	36,061	13,069	-5132
Punjab					
2004-05 to 2008-09	73,006	26,376	52,538	46,629	20,468
2009-10 to 2013-14	74,253	28,647	56,889	45,606	17,364
Tamil Nadu					
2004-05 to 2008-09	52,292	32,926	54,161	19,366	-1869
2009-10 to 2013-14	60,573	36,324	57,670	24,249	2903
Uttar Pradesh					
2004-05 to 2008-09	36,451	16,733	34,103	19,718	2348
2009-10 to 2013-14	42,882	18,607	37,914	24,275	4968
Uttarakhand					
2004-05 to 2008-09	39,462	14,537	33,735	24,925	5727
2009-10 to 2013-14	42,951	20,419	39,335	22,532	3615
West Bengal					
2004-05 to 2008-09	39,698	21,805	42,843	17,893	-3146
2009-10 to 2013-14	42,773	25,651	48,397	17,122	-5625

Source: Computed based on Cost of Cultivation of Prinicipal Crops in India, Ministry of Agriculture,
Government of India

However, when the total cost is taken into consideration, the profitability from the cultivation of paddy appears to be very low or even negative in a few states. Out of 18 states, the real net income has increased in only seven states. The net income was highest in Haryana (Rs. 21,590/hectare) followed by Punjab (Rs. 17,364/hectare) and Gujarat (Rs. 14,558/hectare). Both the value of output and the total cost have increased in these states; a value of output higher than the rising cost and has resulted in positive income. However, the average net income was negative in six states, viz., Assam, Bihar, Jharkhand, Maharashtra, Odisha and West Bengal. Negative net income implies that the amount of loss incurred by the farmers from the cultivation of paddy results in poor economic condition for the paddy farmers. Further, the income has fallen in five states, including Andhra Pradesh, Chhattisgarh, Karnataka, Punjab

and Uttarakhand during the recent period. The increase in total costs was responsible for the decline in real income from paddy cultivation in these states.

Wheat

Farm level data on the cost of cultivation of wheat are available for 12 states, and they have been utilised for analysing the changes in income and cost overtime. The real value of output and cost are provided in Table 5.4. The value of wheat output was the highest in Haryana at Rs. 64,935/hectare followed by Punjab (Rs. 61,249/hectare) and Rajasthan (Rs. 58,912/hectare). Between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14, the real value of output increased in six states, declined in four states, and remained more or less constant in two states.

In terms of changes in farm business income, seven states, viz., Bihar, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Punjab and Rajasthan have shown an increase in income during the recent period as compared to the previous period. The rate of increase in gross value of output was higher than that of the rise in paid out cost, which resulted in higher farm business income in these states. Farm business income has shown a declining trend in four states, viz., Chhattisgarh, Himachal Pradesh, Uttarakhand and West Bengal. Despite a fall in the paid out cost, the decline in the value of output has pulled down the farm business income in these states.

Table 5.4 Average real crop output value, cost and income (Rs./ha): wheat

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Bihar					
2004-05 to 2008-09	32,015	14,783	25,285	17,232	6731
2009-10 to 2013-14	34,656	15,226	26,194	19,430	8462
Chhattisgarh					
2004-05 to 2008-09	22,376	12,314	22,003	10,062	373
2009-10 to 2013-14	21,736	11,969	22,,886	9767	-1150
Gujarat					
2004-05 to 2008-09	45,963	17,965	30,579	27,998	15,384
2009-10 to 2013-14	49,089	19,331	33,313	29,758	15,776
Haryana					
2004-05 to 2008-09	61,766	20,707	45,723	41,059	16,043
2009-10 to 2013-14	64,935	20,770	48,770	44,166	16,165
Himachal Pradesh					
2004-05 to 2008-09	28,861	11,256	27,740	17,605	1121
2009-10 to 2013-14	19,863	8903	21,800	10,959	-1937
Jharkhand					
2004-05 to 2008-09	18,347	16,135	24,943	2211	-6596
2009-10 to 2013-14	25,290	18,902	27,419	6388	-2129
Madhya Pradesh					
2004-05 to 2008-09	38,147	13,765	29,094	24,382	9053
2009-10 to 2013-14	43,947	13,648	31,071	30,298	12,876
Punjab					
2004-05 to 2008-09	61,129	22,658	45,769	38,471	15,360
2009-10 to 2013-14	61,249	22,533	46,205	38,717	15,045
Rajasthan					

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
2004-05 to 2008-09	57,982	17,481	37,269	40,501	20,713
2009-10 to 2013-14	58,912	16,514	39,036	42,399	19,876
Uttar Pradesh					
2004-05 to 2008-09	47,902	20,150	38,317	27,753	9586
2009-10 to 2013-14	47,605	20,001	39,436	27,604	8169
Uttarakhand					
2004-05 to 2008-09	44,250	17,681	37,391	26,569	6860
2009-10 to 2013-14	41,714	15,497	34,255	26,217	7459
West Bengal					
2004-05 to 2008-09	32,041	22,140	37,671	9900	-5630
2009-10 to 2013-14	31,990	22,957	38,925	9033	-6935

Source: Same as for Table 5.3

Further, profitability from the cultivation of wheat turns out to be quite low when total cost of cultivation is taken into account. As compared to farm business income, net income has shown a declining trend in most states. Even in the agriculturally advanced states such as Punjab and Haryana, profitability from wheat cultivation has, by and large, declined during the recent period. The decline in net income was largely due to an increase in the total cost, while the production may not be market-led. Punjab, with the highest level of wheat productivity and effective government procurement operations at the minimum support price (MSP), seems to be experiencing a phase of stagnation in the per hectare output value, but a continuous rise in the cost of inputs has resulted in a fall in net income during the recent period.

The net income has shown a marginal increase in states such as Bihar, Gujarat, Madhya Pradesh and Uttarakhand. Although the total cost of wheat cultivation has increased in these states, considerable increase in the value of output has resulted in positive and higher net income during the period 2009-10 to 2013-14. However, the average net income turned out to be negative in four states, viz., Chhattisgarh, Himachal Pradesh, Jharkhand and West Bengal. Except Jharkhand, a decline in the per hectare value of output and increase in the total cost have resulted in negative income in the other states. In fact, the rate of increase in the total cost was much higher than the rate of decline in the value of wheat output in these three states. In the case of Jharkhand, the average profit from wheat cultivation was negative during both the periods. Despite the increase in per hectare output during the recent period, a more than proportionate increase in the total cost has resulted in negative income.

Bajra

Details about the farm level cost of cultivation of *bajra* are available for six states, viz., Gujarat, Haryana, Karnataka, Maharashtra, Rajasthan and Uttar Pradesh. In order to promote the cultivation of coarse cereals by the farmers and also to improve nutrition security, the Government of India has increased the MSP of these crops during recent years. A few state governments have also started procuring these crops at the MSP for supplying them through the public distribution system to meet the local consumption requirements. The availability of

improved varieties of certain coarse cereals such as *bajra* and maize, and favourable policy measures seem to have motivated the farmers to increase their production.

Table 5.5 Average Real Crop Output Value, Cost and Income (Rs./ha): Bajra

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Gujarat					
2004-05 to 2008-09	27,659	13,841	23,619	13,818	4040
2009-10 to 2013-14	35,807	15,751	27,984	20,056	7823
Haryana					
2004-05 to 2008-09	17,808	7597	21,309	10,211	-3502
2009-10 to 2013-14	20,854	9399	26,366	11,455	-5512
Karnataka					
2004-05 to 2008-09	6994	6375	9827	619	-2834
2009-10 to 2013-14	10,012	8397	13,343	1615	-3331
Maharashtra					
2004-05 to 2008-09	20,749	15,360	24,397	5389	-3648
2009-10 to 2013-14	25,661	18,615	30,418	7046	-4757
Rajasthan					
2004-05 to 2008-09	12,586	4333	12,824	8253	-238
2009-10 to 2013-14	15,149	5366	15,285	9784	-135
Uttar Pradesh					
2004-05 to 2008-09	20,622	8625	21,982	11,997	-1360
2009-10 to 2013-14	20,800	9362	22,917	11,438	-2117

Source: Same as for Table 5.3

The per hectare real value of *bajra* output has shown an increasing trend in all the six states (Table 5.5). During the period 2009-10 to 2013-14, the average value of output was highest in Gujarat, at Rs. 35,807/hectare followed by Maharashtra (Rs. 25,661/hectare), Haryana (Rs. 20,854/hectare) and Uttar Pradesh (Rs. 20,800/hectare). The value of output was relatively low at Rs. 10,012/hectare in Karnataka. Value of output is linked to markets' capacity to absorb the production, ie. demand. Interestingly, all the six states registered an improvement in farm business income during the period 2009-10 to 2013-14 over the period 2003-04 to 2008-09. This happened despite an increase in the paid out cost between these periods, implying that the rate of increase in the value of output was higher than that of the paid out cost. The per hectare farm business income was relatively high in Gujarat, at Rs. 20,056 and low in Karnataka at Rs. 1615.

However, the amount of income obtained from the cultivation of *bajra* changes drastically when the total cost of cultivation is taken into consideration. Except Gujarat, other states have registered negative income, which is quite visible during both the periods. In addition to the paid out cost, the total cost includes the imputed value of own land and family labour. The intensity of labour use for certain operations such as weeding and harvesting, which cannot be done easily by using machines due to the high planting density and delicate nature of the grains, is quite high. Since *bajra* is largely cultivated in dryland regions, the use of family labour is relatively high. Consequently, the imputed value of family labour use might have contributed to an increase in total cost. In addition, cost of material inputs such as seed and fertilisers has

also increased during the recent times. These factors might have contributed to the fall in profitability in *bajra* cultivation.

Maize

Farm level data on the use of inputs, cost and output of maize are available for 10 major states in India. The area under maize has shown an increasing trend in many states and maize seems to have emerged as a competing crop for wheat during the Rabi season. Among the states, only Gujarat and Himachal Pradesh showed a decline in the per hectare value of output during the period 2009-10 to 2013-14 as compared to the period 2004-05 to 2008-09 (Table 5.6). The average value of output in Gujarat and Himachal Pradesh declined by 8.1 per cent and 18.6 per cent, respectively. The value of output was highest in Tamil Nadu (Rs. 58,695/hectare) followed by Andhra Pradesh (Rs. 51,156/hectare), and Bihar (Rs. 41,457/hectare). The rate of increase in the value of output was relatively high at 63 per cent between the two periods under study. The average per hectare value of output was low at Rs. 12,077 in Chhattisgarh.

Farm business income has declined in three states, viz., Gujarat, Himachal Pradesh and Karnataka during the recent period. The decline in income was much sharper in Gujarat because of the fall in output value and rise in the paid out cost. In Karnataka, despite a rise in the output value, a more than proportionate increase in the paid out cost has led to a decline in income. In Madhya Pradesh, farm business income has increased by over three times during the period 2009-10 to 2013-14 as compared to the previous period due to a substantial increase in output over the cost. However, Bihar has registered the highest level of income (Rs. 25,506) followed by Andhra Pradesh. There was also an appreciable improvement in farm business income in Uttar Pradesh, Rajasthan and Tamil Nadu.

Table 5.6 Average Real Crop Output Value, Cost and Income (Rs./ha): Maize

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	36,297	20,434	37,902	15,863	-1604
2009-10 to 2013-14	51,156	26,667	48,079	24,488	3077
Bihar					
2004-05 to 2008-09	38,686	14,628	26,609	24,058	12,077
2009-10 to 2013-14	41,457	15,951	26,133	25,506	15,323
Chhattisgarh					
2004-05 to 2008-09	11,010	3216	10,995	7795	15
2009-10 to 2013-14	12,077	3614	13,834	8463	-1757
Gujarat					
2004-05 to 2008-09	24,226	13,939	23,349	10,288	878
2009-10 to 2013-14	22,273	15,929	26,468	6344	-4196
Himachal Pradesh					
2004-05 to 2008-09	21,402	7259	21,853	14,143	-451
2009-10 to 2013-14	17,411	6796	20,715	10,616	-3304
Karnataka					
2004-05 to 2008-09	31,888	13,909	24,499	17,979	7390
2009-10 to 2013-14	35,625	18,672	31,839	16,954	3786
Madhya Pradesh					
2004-05 to 2008-09	12,490	9266	18,328	3224	-5838

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
2009-10 to 2013-14	20,367	10,680	21,343	9687	-975
Rajasthan					
2004-05 to 2008-09	20,933	10,903	24,038	10,030	-3105
2009-10 to 2013-14	25,866	12,452	30,818	13,415	-4951
Tamil Nadu					
2004-05 to 2008-09	39,248	19,578	35,420	19,670	3828
2009-10 to 2013-14	58,695	31,954	52,168	26,741	6526
Uttar Pradesh					
2004-05 to 2008-09	17,516	9964	24,195	7551	-6679
2009-10 to 2013-14	21,609	11,015	28,099	10,595	-6489

Source: Same as for Table 5.3

The trend in net income/profitability from the cultivation of maize shows a mixed picture across states when the total cost of cultivation is taken into consideration. Out of 10 states, six states have shown negative income from maize cultivation. This implies that despite an increase in the gross value of output, the overall increase in the total cost is turning maize cultivation in these states into a non-viable crop enterprise. Four states that showed a positive net income included Andhra Pradesh, Bihar, Karnataka and Tamil Nadu. The average net income per hectare was relatively high in Bihar at Rs. 15,323. Although the other three states had registered positive net income, the amount of net income per hectare was quite negligible.

Jowar

The cost of cultivation data on *jowar* has been compiled for five states, viz., Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. The trend in real value of output and cost has been depicted in Table 5.7. The average per hectare value of output in all these states has shown an increasing trend over time.

Table 5.7 Average real crop output value, cost and income (Rs./ha): *jowar*

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	21,021	12,956	23,878	8066	-2857
2009-10 to 2013-14	30,087	16,216	31,451	13,871	-1364
Karnataka					
2004-05 to 2008-09	11,868	7524	12,805	4345	-937
2009-10 to 2013-14	17,405	9456	17,341	7950	64
Madhya Pradesh					
2004-05 to 2008-09	13,676	7838	16,055	5837	-2379
2009-10 to 2013-14	15,089	9840	17,970	5249	-2881
Maharashtra					
2004-05 to 2008-09	23,710	15,480	24,791	8229	-1082
2009-10 to 2013-14	28,006	17,056	29,689	10,950	-1683
Tamil Nadu					
2004-05 to 2008-09	15,359	9423	16,284	5936	-925
2009-10 to 2013-14	20,619	10,296	19,323	10,323	1296

Source: Same as for Table 5.3

The average value of output was the highest in Andhra Pradesh, at Rs. 30,087/hectare followed by Maharashtra (Rs. 28,006/hectare), and Tamil Nadu (Rs. 20,619/hectare) during the period 2009-10 to 2013-14. The average value of output was relatively low in Madhya Pradesh.

Farm business income shows returns to own factors of production. Barring Madhya Pradesh, other states have shown an improvement in farm business income during the recent period as compared to the previous period. In fact, Madhya Pradesh has registered a marginal decline in income because of a greater increase in the paid out cost than the value of output. The average farm business income has increased by over 70 per cent in Karnataka, Tamil Nadu and Andhra Pradesh between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. The highest level of farm business income was registered in Andhra Pradesh.

However, the average net income, which takes into account the total cost of cultivation, was found to be negative in Andhra Pradesh, Madhya Pradesh and Maharashtra. Further, the average net income per hectare was highly negligible in Karnataka. Despite an increase in the value of output, a more than proportionate rise in the total cost has led to a fall in net income in these states. This implies that the cultivation of *jowar* in these states is turning out to be a non-viable activity. The increase in the overall cost was largely responsible for the decline in net income. Only Tamil Nadu has registered a positive net income from the cultivation of *jowar*.

Ragi

Data on the input use, cost and output on *ragi* have been compiled for three states, viz., Karnataka, Maharashtra and Tamil Nadu through the cost of cultivation surveys. Karnataka accounts for a major proportion of the area under ragi cultivation in India. The average real value of cost and output are provided in Table 5.8. It can be observed from the table that the average real value of output has shown an increasing trend in all the three states. The average real value of output in Maharashtra and Tamil Nadu has increased by 35 per cent during the period 2009-10 to 2013-14 over the previous period. The value of output was relatively high in Tamil Nadu at Rs. 38,623/hectare.

Real farm business income varied from Rs. 1,466/hectare in Maharashtra to Rs. 23,482/hectare in Tamil Nadu during the recent period. The average per hectare income slightly decelerated in Karnataka from Rs. 4,649 during the period 2004-05 to 2008-09 to Rs. 4,287 during the period 2009-10 to 2013-14. Farm business income has improved slightly in Maharashtra during the recent period.

However, in terms of net income from the cultivation of *ragi*, both Karnataka and Maharashtra registered negative income during the period under study. This implies that the cultivation of *ragi* is uneconomical for farmers in these states. Despite an increase in the total cost, a more than proportionate rise in the value of output in Tamil Nadu has resulted in an improvement in net income during the recent period.

Table 5.8 Average Real Crop Output Value, Cost and Income (Rs./ha): *Ragi*

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Karnataka					
2004-05 to 2008-09	20,167	15,517	26,449	4649	-6283
2009-10 to 2013-14	22,580	18,294	31,765	4287	-9184
Maharashtra					
2004-05 to 2008-09	16,550	21,830	32,902	-5280	-16,353
2009-10 to 2013-14	22,530	21,064	37,465	1466	-14,935
Tamil Nadu					
2004-05 to 2008-09	27,738	11,386	27,454	16,352	284
2009-10 to 2013-14	38,623	15,141	30,619	23,482	8004

Source: Same as for Table 5.3

5.4.2 Pulses
Arhar

Data on cost of cultivation of *arhar dal* are available for eight states, viz., Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh. The per hectare real value of *arhar* output showed an increasing trend in six states (Table 5.9), while it declined marginally in two states. It appears that an increase in MSP during recent years has provided a signal to the market to push up the prices slightly, which has otherwise been rising due to an increase in the demand.

Further, interventions through certain government programmes such as National Food Security Mission and Integrated Scheme for Oilseeds, Pulses, Oil palm and Maize (ISOPOM) have helped increase the production of *arhar*. All these factors seem to have helped in increasing the per hectare value of output during the period 2009-10 to 2013-14.

The real value of output was highest in Maharashtra at Rs. 59,138/hectare followed by Gujarat (Rs. 33,916/hectare) and Uttar Pradesh (Rs. 32,766/hectare). The value of output showed a declining trend in Bihar and Uttar Pradesh. However, except in Gujarat and Uttar Pradesh, farm business income from *arhar* cultivation has increased in other states.

Despite an increase in the value of output, a more than proportionate increase in the paid out cost has led to a fall in income in Gujarat. Farm business income was relatively high in Maharashtra at Rs. 31,615/hectare and low in Odisha at Rs. 11,936/hectare.

Table 5.9 Average real crop output value, cost and income (rs./ha): *arhar*

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	24,681	12,727	25,914	11,953	-1233
2009-10 to 2013-14	31,836	16,769	32,204	15,067	-368
Bihar					
2004-05 to 2008-09	31,914	10,806	24,442	21,109	7473
2009-10 to 2013-14	30,643	7129	16,498	23,514	14,146

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Gujarat					
2004-05 to 2008-09	32,639	12,666	23,202	19,973	9437
2009-10 to 2013-14	33,916	14,950	25,685	18,965	8231
Karnataka					
2004-05 to 2008-09	23,592	11,325	19,907	12,267	3686
2009-10 to 2013-14	32,656	13,474	25,225	19,182	7431
Madhya Pradesh					
2004-05 to 2008-09	24,733	7124	18,616	17,610	6117
2009-10 to 2013-14	29,995	10,009	23,119	19,986	6876
Maharashtra					
2004-05 to 2008-09	33,421	19,020	31,563	14,401	1857
2009-10 to 2013-14	59,138	27,524	49,507	31,615	9631
Odisha					
2004-05 to 2008-09	12,023	5891	15,378	6132	-3356
2009-10 to 2013-14	17,362	5427	15,461	11,936	1901
Uttar Pradesh					
2004-05 to 2008-09	37,390	8250	28,887	29,140	8503
2009-10 to 2013-14	32,766	9659	31,867	23,107	899

Source: Same as for Table 5.3

As regards the trend in net income/profitability, a few states have witnessed a dip in income. Among the states, profitability from the cultivation of *arhar* was high in Bihar (Rs. 14,146/hectare) followed by Maharashtra (Rs. 9631/hectare) and Gujarat (Rs. 8231/hectare). In Andhra Pradesh, the average net income was negative during both the periods under the study. Odisha saw a turnaround from negative to positive net income between the periods 2003-04 to 2008-09 and 2009-10 to 2013-14. However, profitability from *arhar* cultivation has fallen in the states of Uttar Pradesh and Gujarat during the recent period. The average net profit from *arhar* cultivation was as low as Rs. 899/hectare in Uttar Pradesh.

The fall in profitability was due to a steep increase in total cost. The total cost of *arhar* cultivation has increased by over 50 per cent and about 25 per cent in Maharashtra and Andhra Pradesh, respectively, during the recent period as compared to the previous period.

Moong

Data on the input use, cost and output of *moong* have been compiled for five states, viz., Andhra Pradesh, Karnataka, Maharashtra, Odisha and Rajasthan, under the cost of cultivation surveys in India. All the five states registered an increasing trend in the per hectare value of *moong* output during the study period (Table 5.10). The value of output increased by over 50 per cent in Karnataka and by 35 per cent in Maharashtra between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. In fact, the average value of output was highest at Rs. 22,925 per hectare in Maharashtra, followed by Andhra Pradesh and Rajasthan during the recent period.

A higher value of *moong* output than the paid out cost has led to an increase in farm business income in all the states during the recent period as compared to the previous period. The average farm business income was relatively high in Andhra Pradesh, at Rs. 13,830/hectare and Rajasthan at Rs. 9,893/hectare. In Odisha, the average farm business income increased from Rs. 6,875/hectare during the period 2004-05 to 2008-09 to Rs. 8,826 during the period 2009-10 to 2013-14. However, profit from the cultivation of *moong* turns out to be low or negligible when the total cost is taken into account.

Table 5.10 Average Real Crop Output Value, Cost and Income (Rs./ha): Moong

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	20,626	8741	17,793	11,885	2834
2009-10 to 2013-14	21,949	8118	18,224	13,830	3725
Karnataka					
2004-05 to 2008-09	10,118	6573	10,316	3545	-198
2009-10 to 2013-14	15,436	8270	14,327	7166	1109
Maharashtra					
2004-05 to 2008-09	16,944	13,639	19,810	3306	-2865
2009-10 to 2013-14	22,925	16,955	26,491	5970	-3566
Odisha					
2004-05 to 2008-09	12,024	5148	12,064	6875	-41
2009-10 to 2013-14	13,796	4970	13,248	8826	549
Rajasthan					
2004-05 to 2008-09	13,579	4234	11,803	9345	1776
2009-10 to 2013-14	16,546	6653	15,090	9893	1456

Source: Same as for Table 5.3

The average net income worsened in Maharashtra, while it showed a little improvement in Odisha and Karnataka. The net income was relatively high only in Andhra Pradesh.

Urad

The cost of cultivation survey on *urad* covers eight states in India. The average real value of output, cost and income are presented in Table 5.11. Barring Odisha, Rajasthan and Uttar Pradesh, where the per hectare value of output has decelerated slightly, in the other states, the value of output increased during the period 2009-10 to 2013-14 as compared to the previous period.

The average value of output was highest at Rs. 36,773/hectare in Andhra Pradesh followed by Tamil Nadu (Rs. 21,748/hectare) and Madhya Pradesh (Rs. 21,501). However, the annual rate of increase in output was high in Chhattisgarh, Madhya Pradesh and Tamil Nadu. The output value was relatively low in Odisha, at Rs. 13,655/hectare.

Table 5.11 Average Real Crop Output Value, Cost and Income (Rs./ha): *Urad*

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	36,247	8933	20,679	27,315	15,568
2009-10 to 2013-14	36,773	15,084	28,104	21,688	8668
Chhattisgarh					
2004-05 to 2008-09	13,499	6900	13,022	6599	477
2009-10 to 2013-14	19,026	6418	16,777	12,608	2249
Madhya Pradesh					
2004-05 to 2008-09	15,401	7027	15,515	8373	-114
2009-10 to 2013-14	21,501	8833	18,474	12,668	3028
Maharashtra					
2004-05 to 2008-09	17,097	13,612	19,818	3485	-2721
2009-10 to 2013-14	20,039	15,491	24,306	4548	-4267
Odisha					
2004-05 to 2008-09	13,903	4825	12,109	9078	1794
2009-10 to 2013-14	13,655	4651	13,157	9005	498
Rajasthan					
2004-05 to 2008-09	19,813	5359	15,501	14,454	4311
2009-10 to 2013-14	17,966	6528	17,916	11,438	50
Tamil Nadu					
2004-05 to 2008-09	18,710	7899	15,496	10,811	3214
2009-10 to 2013-14	21,748	12,381	20,229	9368	1519
Uttar Pradesh					
2004-05 to 2008-09	14,227	5050	12,677	9177	1550
2009-10 to 2013-14	14,002	6802	15,123	7199	-1122

Source: Same as for Table 5.3

An analysis of real farm business income shows that Chhattisgarh registered the highest annual growth by over 90 per cent between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14; average income increased from Rs. 6,599/hectare to 12,608/hectare. Similarly, in Madhya Pradesh, farm business income rose by 50 per cent between these periods from Rs. 8,373/hectare to Rs. 12,668/hectare. This higher rate of increase is due to the low base income in these states. Out of eight states, four states, viz., Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh showed a declining trend in farm business income during the study period. Although the average farm business income declined in the states, it was the highest in Andhra Pradesh, at Rs. 21,688/hectare, followed by Madhya Pradesh and Chhattisgarh.

However, the average profit from the cultivation of *urad* has been seen to have declined drastically when the total cost is taken into consideration. In states such as Maharashtra and Uttar Pradesh, the cultivation of *urad* has become unprofitable during recent years. Despite the increase in MSP and operation of exclusive programmes on the rising productivity of pulses, the state of negative profitability from the cultivation of *urad* is worrisome. In fact, the average net income from *urad* was negligible in Rajasthan and Odisha.

The net income also fell drastically in Andhra Pradesh and Tamil Nadu. Despite an increase in the value of output, a more than proportionate rise in the total cost has led to a decline in the

net income in these states. In fact, the total cost of cultivation of *urad* increased by over 30 per cent in Andhra Pradesh and Tamil Nadu between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. A substantial increase in the total cost of cultivation has brought down the net income.

Gram

Data on the input use, cost and output on gram have been compiled for nine states through the cost of cultivation surveys. The average real output, cost and income are provided in Table 5.12. Out of nine states, only four states, viz., Bihar, Haryana, Madhya Pradesh and Maharashtra showed an improvement in the real value of output while in the remaining states, such as Andhra Pradesh, Chhattisgarh, Karnataka, Rajasthan and Uttar Pradesh, it has shown a decline during the recent period.

Table 5.12 Average Real Crop Output Value, Cost and Income (Rs,/ha): Gram

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	37,618	13,248	27,350	24,370	10,269
2009-10 to 2013-14	31,813	18,466	30,530	13,347	1282
Bihar					
2004-05 to 2008-09	30,030	9344	18,268	20,686	11,762
2009-10 to 2013-14	31,102	10,598	19,660	20,504	11,442
Chhattisgarh					
2004-05 to 2008-09	31,409	9481	20,392	21,928	11,017
2009-10 to 2013-14	21,669	10,397	19,926	11,273	1744
Haryana					
2004-05 to 2008-09	17,719	6039	15,597	11,680	2122
2009-10 to 2013-14	20,746	7294	20,719	13,452	27
Karnataka					
2004-05 to 2008-09	23,009	10,165	17,096	12,843	5913
2009-10 to 2013-14	22,576	12,446	20,301	10,130	2275
Madhya Pradesh					
2004-05 to 2008-09	29,981	10,767	22,620	19,215	7362
2009-10 to 2013-14	30,713	12,263	24,541	18,450	6172
Maharashtra					
2004-05 to 2008-09	25,188	13,819	22,860	11,368	2328
2009-10 to 2013-14	30,416	16,418	27,846	13,998	2570
Rajasthan					
2004-05 to 2008-09	27,367	7811	18,521	19,557	8847
2009-10 to 2013-14	25,788	7919	19,564	17,869	6224
Uttar Pradesh					
2004-05 to 2008-09	34,322	11,571	25,741	22,751	8580
2009-10 to 2013-14	28,073	12,416	26,356	15,657	1717

Source: Same as for Table 5.3

Even in the states where the average value of output has increased, the annual rate of change ranged from about 4 per cent to 20 per cent. Notwithstanding these figures, however, the average value of output was found to be highest in Andhra Pradesh, at Rs. 31,813/hectare,

followed by Bihar (Rs. 31,102) and Madhya Pradesh (Rs. 30,713) during the period 2009-10 to 2013-14. The value of output was relatively low in Haryana.

However, the real farm business income showed an increasing trend only in two states, viz., Haryana and Maharashtra. In Bihar, the average income was more or less stagnant between the two periods. In the other states, farm business income has recorded a decline during the recent period. The average income has fallen drastically by over 45 per cent in Andhra Pradesh and Chhattisgarh. Despite a fall in the gross value of output in Andhra Pradesh and Karnataka, the rising paid out cost has resulted in a decline in farm business income. However, even in states such as Madhya Pradesh and Maharashtra, where the average value of output has risen during the recent period as compared to the previous period, a much sharper rise in the paid out cost has led to a fall in the farm business income.

Trends in crop incomes can also be examined through the net income/profit, which considers own labour cost and own land cost in addition to the paid out cost. The analysis reveals that except Bihar and Maharashtra, where the average income improved slightly with a low base, the remaining seven states registered a deceleration in net income from the cultivation of gram.

The fall in net income was very drastic and this income was meagre in most states. The decline in net income was largely due to a substantial increase in the total cost during the recent period. The rising cost of labour seems to have accelerated the overall cost, resulting in a decline in income. The decline in net income indicates that the cultivation of gram seems to be a non-profitable crop enterprise in many states, which merits a greater role of the State in mitigation of distress when farmers face a glut of the product in the market.

Lentil
The cost of cultivation survey on lentil covered five states, viz., Bihar, Jharkhand, Madhya Pradesh, Uttar Pradesh, and West Bengal. The average value of output, cost and income are presented in Table 5.13. Barring Madhya Pradesh, the average real value of output has showed an increasing trend during the study period. Among the states, the annual rate of increase in output was slightly higher for Jharkhand between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. In fact, the real value of output rose from Rs. 19,303/hectare to Rs. 24,508/hectare. Notwithstanding these figures, the average value of output was highest in Uttar Pradesh, at Rs. 30,736, followed by Bihar, at Rs. 29489/hectare.

The real farm business income in Bihar was slightly higher at Rs. 21,381/hectare during the period 2004-05 to 2008-09, and it increased further to Rs. 21,587/hectare during the period 2009-10 to 2013-14. Similarly, the corresponding income in Uttar Pradesh increased from Rs. 18,937 to Rs. 20153/hectare. However, in Jharkhand, real farm business income increased by 26 per cent, which is the highest among other states, to reach Rs. 18,891/hectare during the recent period. In Madhya Pradesh, on the other hand, the average income has decelerated during the recent period because of the falling output value and rising input cost.

Despite an increase in the total cost, net income/profit from the cultivation of lentil was found to be relatively high in Jharkhand. Uttar Pradesh also registered an increase in net income during the recent period. The average net income in West Bengal was Rs. 3,608/hectare during 2009-10 to 2013-14, the period for which data were available. The average income in West Bengal was the lowest among all the states.

Table 5.13 Average real crop output value, cost and income (Rs./ha): lentil

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Bihar					
2004-05 to 2008-09	28,558	7177	16,869	21,381	11,689
2009-10 to 2013-14	29,489	7902	17,907	21,587	11,582
Jharkhand					
2004-05 to 2008-09	19,303	4362	10,741	14,941	8563
2009-10 to 2013-14	24,508	5618	15,220	18,891	9288
Madhya Pradesh					
2004-05 to 2008-09	30,420	8647	19,888	21,773	10,532
2009-10 to 2013-14	24,939	9141	18,450	15,797	6488
Uttar Pradesh					
2004-05 to 2008-09	29,040	10,103	23,360	18,937	5680
2009-10 to 2013-14	30,736	10,583	24,159	20,153	6577
West Bengal					
2009-10 to 2013-14	28,619	11,792	25,011	16,828	3608

Source: Same as for Table 5.3

5.4.3 Oilseeds
Groundnut
Data on the cost of cultivation of groundnut are available for five states, viz., Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamil Nadu. The real value of output and cost are presented in Table 5.14. The value of output has shown an increasing trend in all these states. In fact, the average value of output was highest in Andhra Pradesh, at Rs. 60,119/hectare, followed by Maharashtra (Rs. 55,771/hectare), and Gujarat (Rs. 48,131/hectare).

The real output increased by about 90 per cent in Andhra Pradesh and 75 per cent in Gujarat between the periods 2004-05 to 2008-08 and 2009-10 to 2013-14. The average value of output also increased considerably in Karnataka between these periods.

The average farm business income from the cultivation of groundnut showed an increasing trend in all the states during the period under study. The increase in the value of output was much higher than the rise in paid out cost, which has resulted in relatively high income.

However, there is a significant variation in income across states. Andhra Pradesh registered the highest farm business income (Rs. 28,177/hectare), followed by Maharashtra (Rs. 27,912), and Gujarat (Rs. 22,351). The average income was relatively low in Karnataka and Tamil Nadu.

Table 5.14 Average Real Crop Output Value, Cost and Income (Rs./ha): Groundnut

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	31,279	19,818	35,747	11,461	-4468
2009-10 to 2013-14	60,119	31,942	59,186	28,177	933
Gujarat					
2004-05 to 2008-09	42,378	20,591	33,391	21,787	8988
2009-10 to 2013-14	48,131	25,780	41,389	22,351	6742
Karnataka					
2004-05 to 2008-09	19,887	13,690	21,523	6197	-1636
2009-10 to 2013-14	28,355	18,642	30,229	9713	-1874
Maharashtra					
2004-05 to 2008-09	31,799	25,072	38,981	6727	-7182
2009-10 to 2013-14	55,771	27,858	48,459	27,912	7311
Tamil Nadu					
2004-05 to 2008-09	39,484	23,193	39,400	16,291	84
2009-10 to 2013-14	46,816	28,104	48,771	18,712	-1954

Source: Same as for Table 5.3

However, when the total cost was considered for the estimation of net income, Karnataka and Tamil Nadu registered negative income from the cultivation of groundnut. Karnataka showed a secular decline in net income because the rate of rise in the output value did not keep pace with the rate of increase in the cost.

This implies that the farmers in these two states incur losses in the cultivation of groundnut, which is increasingly making groundnut cultivation a non-profitable crop enterprise. In Andhra Pradesh and Maharashtra, however, net income has shown an improvement during the recent period as compared to the previous period. This turnaround in profitability in these states is largely due to a substantial increase in the value of output over the total cost. In Gujarat, the average net income from groundnut cultivation was positive, but it has decelerated during the recent period.

Sesamum
The cost of cultivation of data on sesamum has been compiled for six states, viz., Gujarat, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu and West Bengal. The average real cost and income are delineated in Table 5.15. Barring Rajasthan, other states have shown an increasing trend in the gross value of output during the study period.

The average per hectare value of output was highest in Andhra Pradesh, at Rs. 29,231, followed by Tamil Nadu (Rs. 28,983), and Madhya Pradesh (Rs. 28,392) during the period 2009-10 to 2013-14. In fact, in Madhya Pradesh, the sesamum output increased by 74 per cent between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. The average value of output was relatively low in Odisha, at Rs. 12,964/hectare.

Table 5.15 Average Real Crop Output Value, Cost and Income (Rs./ha): Sesamum

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Gujarat					
2004-05 to 2008-09	22,127	9701	17,983	12,426	4144
2009-10 to 2013-14	29,231	11,867	22,340	17,364	6891
Madhya Pradesh					
2004-05 to 2008-09	16,359	5735	14,307	10,625	2052
2009-10 to 2013-14	28,392	7176	20,370	21,216	8022
Odisha					
2004-05 to 2008-09	11,998	5166	13,880	6833	-1882
2009-10 to 2013-14	12,964	5214	13,032	7750	-68
Rajasthan					
2004-05 to 2008-09	16,606	3421	11,737	13,185	4869
2009-10 to 2013-14	15,900	3944	12,529	11,956	3371
Tamil Nadu					
2004-05 to 2008-09	21,678	10,958	21,016	10,720	662
2009-10 to 2013-14	28,983	12,379	25,962	16,603	3020
West Bengal					
2004-05 to 2008-09	24,579	10,866	23,115	13,713	1464
2009-10 to 2013-14	24,697	13,772	25,958	10,926	-1261

Source: Same as for Table 5.3

Farm business income was positive and showed an improvement over time in all the states except Rajasthan and West Bengal. A decline in output and rise in paid out cost brought down the income in these states. Farm business income was relatively high in Madhya Pradesh and it has more than doubled during the recent period over the income registered during the previous period.

The substantial rise in the value of output over the paid out cost has led to a considerable increase in income. The average income also increased considerably in Tamil Nadu and Gujarat despite an increase in the paid out cost. In fact, the paid out cost increased by over 20 per cent in Gujarat and West Bengal between the two periods. However, the rate of increase in output was much higher in Gujarat than in West Bengal; this resulted in an increase in farm business income in Gujarat and a decline in West Bengal during the recent period.

However, net income/profitability from the cultivation of sesamum shows a slightly different picture because of the inclusion of own labour and own land cost in the estimation. The average net income fell in Odisha and West Bengal, and it was negative during the recent period. This implies that the cultivation of sesamum is becoming an economically non-profitable enterprise in these states. Gujarat, Madhya Pradesh and Tamil Nadu have registered some improvement in net income during the recent period. The average net income increased by five times in Tamil Nadu and by four times in Madhya Pradesh between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. The net income was highest in Madhya Pradesh, followed by Gujarat and Tamil Nadu.

Soybean

The cost of cultivation surveys on soybean covered four states, viz., Chhattisgarh, Madhya Pradesh, Maharashtra and Rajasthan. The real value of output, cost and income are presented in Table 5.16. The average value of soybean output in Maharashtra increased by about 20 per cent to touch Rs. 33,781/hectare during the period 2009-10 to 2013-14, which is estimated to be the highest among all the states. The value of output in Madhya Pradesh was Rs. 30,078 per hectare during the recent period, up by 25 per cent over the value of output registered during the previous period. However, the average per hectare output declined in Chhattisgarh and Rajasthan during 2004-05 to 2008-09. The value of output was relatively low in Chhattisgarh.

Table 5.16 Average Real Crop Output Value, Cost and Income (Rs./ha): Soybean

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Chhattisgarh					
2004-05 to 2008-09	24,403	10,249	20,980	14,154	3423
2009-10 to 2013-14	17,715	9684	17,216	8031	499
Madhya Pradesh					
2004-05 to 2008-09	24,078	11,348	21,480	12,730	2598
2009-10 to 2013-14	30,078	12,597	24,549	17,481	5529
Maharashtra					
2004-05 to 2008-09	28,401	19,846	28,504	8555	-103
2009-10 to 2013-14	33,781	21,030	31,771	12,750	2010
Rajasthan					
2004-05 to 2008-09	25,974	11,228	20,008	14,746	5966
2009-10 to 2013-14	25,269	10,721	20,736	14,548	4533

Source: Same as for Table 5.3

The real farm business income was high in Madhya Pradesh (Rs. 17,481), which was largely led by an increase in the gross value of output even as the paid out cost rose during the periods under study. However, in Chhattisgarh, despite a fall in the paid out cost, the rate of decline in the gross value of output was much higher. This has resulted in a decline in farm business income. Similarly, in Rajasthan, the average farm business income came down marginally during the period 2009-10 to 2013-14, to reach Rs. 14,548/hectare. The average income in Maharashtra was Rs. 12,750. The net income, on the other hand, showed a declining trend in Chhattisgarh and Rajasthan. Profitability from the cultivation of soybean in Maharashtra has seen a turnaround from negative to a positive appreciable level of income during the recent period.

Sunflower

Data on input use, cost and income on sunflower cultivation are available for three states, viz., Andhra Pradesh, Karnataka and Maharashtra. The average per hectare real output, cost and income are given in Table 5.17. The average value of output was the highest in Maharashtra, at Rs. 26,344/hectare, followed by Rs. 25,497/hectare in Andhra Pradesh during the period 2009-10 to 2013-14. In fact, the average output value has increased by 40 per cent in Andhra Pradesh and by 21 per cent in Maharashtra during the recent period over the previous period.

Table 5.17 Average Real Crop Output Value, Cost and Income (Rs./ha): Sunflower

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	18,041	12,735	20,977	5306	-2936
2009-10 to 2013-14	25,497	17,630	31,230	7867	-5733
Karnataka					
2004-05 to 2008-09	14,434	9258	14,822	5176	-388
2009-10 to 2013-14	13,872	9810	15,271	4063	-1398
Maharashtra					
2004-05 to 2008-09	21,842	13,614	20,911	8228	931
2009-10 to 2013-14	26,344	15,818	24,513	10,527	1831

Source: Same as for Table 5.3

However, the real average farm business income increased by over 45 per cent in Andhra Pradesh between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. The average income was relatively high in Maharashtra, at Rs. 10,527/hectare, and low in Karnataka, at Rs. 4,063/hectare. However, when the total cost of cultivation is taken into account, profitability from the cultivation of sunflower shows a drastic decline in Andhra Pradesh and Karnataka. The average net income was negative in these two states during both the periods, and the net income showed some improvement only in Maharashtra.

Nigerseed

The major nigerseed growing states are Chhattisgarh, Madhya Pradesh, Odisha and Maharashtra though the consistent data on the cost of cultivation are available only for Odisha. The average per hectare real value of output, cost and income are provided in Table 5.18. The average value of output increased considerably from Rs. 7671/hectare during the period 2004-05 to 2008-09 to Rs. 12,112/hectare during the period 2009-10 to 2013-14.

Interestingly, the paid out cost declined between these two periods. This has led to an increase in farm business income by four times, to reach Rs. 7062/hectare. However, the net income from the cultivation of nigerseed registered negative growth during the study period. A more than proportionate increase in the total cost as compared to the value of output has led to a fall in profitability from the cultivation of nigerseed in Odisha.

Table 5.18 Average Real Crop Output Value, Cost and Income (Rs./ha): Nigerseed

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Odisha					
2004-05 to 2008-09	7671	5913	9888	1758	-2216
2009-10 to 2013-14	12,112	5050	12,950	7062	-837

Source: Same as for Table 5.3

Safflower

The consistent data on input use, cost and output from cost of cultivation survey on safflower are available only for Maharashtra. The average per hectare value of output, cost and income

are provided in Table 5.19. The real value of output has shown an increasing trend during the study period. The value of output increased from Rs. 16,688/hectare to Rs. 21,022/hectare between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. This significant increase in the value of output has led to an improvement in farm business income. In fact, the real farm business income has increased by 35 per cent during the recent period over the previous period. The average farm business income was Rs. 9772/hectare. However, the average net income declined from Rs. 926/hectare to Rs. 589/hectare between these periods. This decline in net income was due to a substantial increase in the overall cost.

Table 5.19 Average Real Crop Output Value, Cost and Income (Rs./ha): Safflower

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Maharashtra					
2004-05 to 2008-09	16,688	9424	15,762	7263	926
2009-10 to 2013-14	21,022	11,249	20,433	9772	589

Source: Same as for Table 5.3

Rapeseed and Mustard

Data on the input cost structure and output on rapeseed and mustard are available for seven states. The average real output, cost and income are provided in Table 5.20. It can be observed from the table that except in Rajasthan, the per hectare value of output showed an increasing trend in the other states. The value of output was more or less constant in Rajasthan. The average value of output was the highest in Haryana, at Rs. 52,711/hectare during the period 2009-10 to 2013-14, up by 18 per cent over the previous period. The value of output was Rs. 44,365/hectare in Gujarat and Rs. 39,789/hectare in Madhya Pradesh. Among the states, average per hectare value of output was relatively low in Assam.

Similar to the trend in value of output observed, average farm business income has, by and large, increased during the recent period as compared to the previous period. Despite a rise in the paid out cost, farm business income has increased across the states due to fact that the rate of increase in value of output was much higher than the increase in the paid out cost. Assam and Haryana have registered an increase of over 20 per cent in business income during the recent period as compared to the previous period. The real income was highest in Haryana, at Rs. 39,087/hectare, followed by Gujarat (Rs. 29,979) and Rajasthan (Rs. 29,304). The real farm business income was relatively low in Assam.

As compared to the trend in farm business income, net income/profit has shown a completely different picture across states. Besides the paid out cost, the net income takes into account the cost of own labour and land in the estimation of the total cost.

The net income from the cultivation of rapeseed and mustard was negative in Assam implying that rapeseed and mustard is not an economically viable crop enterprise in the state. The average net income has also fallen considerably during the recent period in the states of Gujarat, Rajasthan and Uttar Pradesh. The reduction in net income in these states could be attributed to

a substantial rise in the total cost. The average net income increased only in three states, viz., Haryana, Madhya Pradesh and West Bengal. The net income/profit from the cultivation of rapeseed and mustard was relatively high in Gujarat, Haryana and Madhya Pradesh.

Table 5.20 Average Real Crop Output Value, Cost and Income (Rs./ha): Rapeseed and Mustard

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Assam					
2004-05 to 2008-09	14,287	8179	18,681	6108	-4394
2009-10 to 2013-14	16,669	9050	21,555	7618	-4886
Gujarat					
2004-05 to 2008-09	41,873	13,397	25,354	28,476	16,518
2009-10 to 2013-14	44,365	14,386	28,818	29,979	15,547
Haryana					
2004-05 to 2008-09	44,605	12,465	33,319	32,140	11,286
2009-10 to 2013-14	52,711	13,624	37,795	39,087	14,916
Madhya Pradesh					
2004-05 to 2008-09	35,379	9045	23,624	26,334	11,755
2009-10 to 2013-14	39,789	9906	26,382	29,882	13,407
Rajasthan					
2004-05 to 2008-09	39,643	9923	23,743	29,720	15,900
2009-10 to 2013-14	39,154	9850	26,035	29,304	13,119
Uttar Pradesh					
2004-05 to 2008-09	37,691	11,382	28,349	26,309	9343
2009-10 to 2013-14	38,290	11,700	30,808	26,590	7482
West Bengal					
2004-05 to 2008-09	29,984	15,310	29,934	14,675	51
2009-10 to 2013-14	33,168	15,921	31,756	17,247	1411

Source: Same as for Table 5.3

5.4.4 Sugars
Sugarcane

Sugarcane is one of the most profitable cash crops grown in many states in India. The data on input use, cost and output are available for seven major sugarcane-growing states through the cost of cultivation surveys. The real value of the output, cost and income are provided in Table 5.21.

The average per hectare value of output showed an increasing trend in all the states during the study period. The average real value of output was the highest in Maharashtra, at Rs. 2,09,233/hectare, followed by Tamil Nadu (Rs. 1,94,695/hectare) and Karnataka (Rs. 1,69,703/hectare) during the period 2009-10 to 2013-14.

The annual rate of increase in output was relatively high in Maharashtra and Haryana. In fact, the value of output increased by 53 per cent and 33 per cent, respectively, in Maharashtra and Haryana, between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. Among the states, the value of output was found to be low in Uttar Pradesh.

Table 5.21 Average Real Crop Output Value, Cost and Income (Rs./ha): Sugarcane

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	1,29,014	59,743	1,13,706	69,271	15,308
2009-10 to 2013-14	1,42,411	60,333	1,12,211	82,077	30,200
Haryana					
2004-05 to 2008-09	1,14,850	34,765	82,817	80,085	32,033
2009-10 to 2013-14	1,52,131	42,521	1,00,632	1,09,610	51,499
Karnataka					
2004-05 to 2008-09	1,57,052	53,308	99,056	1,03,745	57,996
2009-10 to 2013-14	1,69,703	44,718	95,681	1,24,985	74,023
Maharashtra					
2004-05 to 2008-09	1,36,835	76,117	1,19,601	60,718	17,234
2009-10 to 2013-14	2,09,233	85,142	1,45,178	1,24,091	64,055
Tamil Nadu					
2004-05 to 2008-09	1,58,741	74,448	1,19,659	84,293	39,082
2009-10 to 2013-14	1,94,695	85,158	1,29,210	1,09,538	65,485
Uttar Pradesh					
2004-05 to 2008-09	98,209	24,398	63,747	73,811	34,461
2009-10 to 2013-14	1,25,506	29,328	73,522	96,178	51,984
Uttarakhand					
2004-05 to 2008-09	99,218	24,307	57,312	74,911	41,906
2009-10 to 2013-14	1,28,557	33,050	74,681	95,507	53,876

Source: Same as for Table 5.3

Similar to the trend observed in the value of output, real farm business income also showed an increasing trend across the states during the study period. Among the states, only Karnataka has registered a decline in the paid out cost. Even with an increase in the paid out cost, all the other states showed a substantial rise in farm business income.

The average income was the highest in Karnataka, at Rs. 1,24,985/hectare, followed by Maharashtra (Rs. 1,24,091) and Haryana (Rs. 1,09,610) during the recent period. The largest increase in income was observed in Maharashtra between the two periods. The farm business income was relatively low in Andhra Pradesh, at Rs. 82,077/hectare.

As regards the net income/profit, all the states showed an increasing trend during the study period. The average real net income was the highest in Karnataka, at Rs. 74,023/hectare, followed by Tamil Nadu (Rs. 65,485), and Maharashtra (Rs. 64055). Barring Andhra Pradesh and Karnataka, the other states registered an increase in total cost during the recent period as compared to the previous period.

Hence, despite the increase in the overall cost, net income has improved during the recent period. The rate of increase in the value of output was higher than the proportionate rise in the total cost, which has led to an increase in the net income from the cultivation of sugarcane.

5.4.5 Fibres
Cotton

The average real value of output, cost and income for cotton at 2011-12 prices are presented in Table 5.22. Detailed information about the farm level input cost and output are available only for nine states. It may be observed that the average value of cotton output increased in all these states during the period 2009-10 to 2013014 over the period 2004-05 to 2008-09.

The real value of output was the highest in Rajasthan, at Rs. 86,264 during the period 2009-10 to 2013-14, signifying an increase of about 80 per cent from the value of output achieved during the previous period. Gujarat registered the second highest level output at Rs. 76,308/hectare, followed by Punjab at Rs. 74,851/hectare. The average value of output per hectare was Rs. 69,075 in Haryana and Rs. 62,022 in Tamil Nadu.

As regards the farm business income, except Andhra Pradesh and Punjab, other states showed a robust improvement in income during the recent period. The farm business income was the highest in Rajasthan, at Rs. 68,368/hectare, followed by Gujarat (Rs. 45,783/hectare) and Haryana (Rs. 45,720/hectare). A positive and higher return implies better income to factors of production such as own labour and land.

The amount of income derived from the cultivation of cotton varies slightly when the total cost is taken into consideration. The average net income improved slightly from the period 2004-05 to 2008-09 to the period 2009-10 to 2013-14 in Maharashtra and Tamil Nadu.

Despite the increase in total cost, a more than proportionate rise in the gross value of output has resulted in positive income in these states. However, the per hectare net income decelerated in Andhra Pradesh from Rs. 4,794 during the period 2004-05 to 2008-09 to Rs. 739 during the period 2009-10 to 2013-14 due to a considerable increase in the total cost during the recent period. Similarly, Punjab also witnessed a fall in profitability from the cultivation of cotton whereas other states have shown an improvement in net income during the recent period.

The average net income from the cultivation of cotton was the highest in Rajasthan, at Rs. 34,628/hectare, followed by Gujarat, at Rs. 21,354/hectare. The net come was as low as Rs. 355/hectare in Tamil Nadu due to an increase in the total cost at more or less the same rate as the gross value of output.

The rate of increase in the total cost was relatively high in Karnataka and Rajasthan. However, a much higher value of output than the total cost has resulted in better income in these states. Improvement in production technology during the last one and a half decades has helped farmers in achieving a higher output value.

Table 5.22 Average Real Crop Output Value, Cost and Income (Rs./ha): Cotton

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	59,907	30,943	55,113	28,964	4794
2009-10 to 2013-14	60,663	33,628	59,924	27,035	739
Gujarat					
2004-05 to 2008-09	62,000	26,184	46,705	35,816	15,295
2009-10 to 2013-14	76,308	30,525	54,954	45,783	21,354
Haryana					
2004-05 to 2008-09	56,257	20,435	49,644	35,822	6613
2009-10 to 2013-14	69,075	23,354	57,626	45,720	11,449
Karnataka					
2004-05 to 2008-09	28,237	14,570	24,251	13,667	3986
2009-10 to 2013-14	51,800	21,857	39,186	29,943	12,615
Madhya Pradesh					
2004-05 to 2008-09	47,330	21,523	43,421	25,807	3908
2009-10 to 2013-14	54,108	14,849	36,928	39,259	17,180
Maharashtra					
2004-05 to 2008-09	35,570	25,383	37,840	10,187	-2270
2009-10 to 2013-14	58,952	35,753	57,139	23,198	1812
Punjab					
2004-05 to 2008-09	72,699	29,446	59,972	43,253	12,727
2009-10 to 2013-14	74,851	32,782	64,292	42,069	10,559
Rajasthan					
2004-05 to 2008-09	48,279	12,296	32,503	35,983	15,776
2009-10 to 2013-14	86,264	17,896	51,636	68,368	34,628
Tamil Nadu					
2004-05 to 2008-09	44,867	25,345	47,533	19,522	-2666
2009-10 to 2013-14	62,022	31,761	61,667	30,261	355

Source: Same as for Table 5.3

Jute

The cost of cultivation surveys on jute cover three states, viz., Assam, Odisha and West Bengal. The details of real output, cost and income from the cultivation of jute are provided in Table 5.23. It can be observed from the table that the real value of output increased in all the three states during the study period.

The average value of output was relatively high in West Bengal, and increased from Rs. 47,159/hectare to Rs. 56,396/hectare between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14. However, among these three states, the annual rate of increase in output was found to be higher in Assam between these periods.

Barring Odisha, real farm business income has, by and large, shown an increasing trend in Assam and Bengal during the study period. The average income was relatively high in West Bengal, at Rs. 30,945, during the period 2009-19 to 2013-14, up by 21 per cent over the previous period.

Table 5.23 Average Real Crop Output Value, Cost and Income (Rs./ha): Jute

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Assam					
2004-05 to 2008-09	31,253	17,525	31,985	13,729	-731
2009-10 to 2013-14	43,937	24,497	49,034	19,440	-5098
Odisha					
2004-05 to 2008-09	36,235	15,812	37,496	20,424	-1261
2009-10 to 2013-14	37,651	18,762	46,433	18,888	-8782
West Bengal					
2004-05 to 2008-09	47,159	22,810	46,423	24,349	736
2009-10 to 2013-14	56,396	25,451	52,822	30,945	3574

Source: Same as for Table 5.3

The average per hectare farm business income in Assam increased from Rs. 13,729 to Rs. 19,440 between the two periods. However, as regards the net income/profit, Assam and Odisha registered negative net income during the study period. Only West Bengal recorded an improvement in net income during the recent period.

5.4.6 Vegetables
Onion

The cost of cultivation survey on onion covered four states, viz., Andhra Pradesh, Gujarat, Karnataka and Maharashtra. The real value of output, cost and income at 2011-12 prices are delineated in Table 5.24. It can be observed from the table that the per hectare value of output has increased in all the four states during the study period. The average value of output was the highest in Gujarat (Rs. 1,47,923/hectare) followed by Maharashtra (Rs. 1,18,523/hectare) and Andhra Pradesh (Rs. 82,530/hectare) during the period 2009-10 to 2013-14. However, the largest increase in output was observed in Karnataka, going up from Rs. 42,777/hectare to Rs. 77,420/hectare between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14.

Table 5.24 Average Real Crop Output Value, Cost and Income (Rs./ha): Onion

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Andhra Pradesh					
2004-05 to 2008-09	68,940	30,464	57,895	38,476	11,045
2009-10 to 2013-14	82,530	37,921	72,446	44,609	10,084
Gujarat					
2004-05 to 2008-09	1,11,744	47,629	78,829	64,115	32,916
2009-10 to 2013-14	1,47,923	54,077	89,596	93,846	58,327
Karnataka					
2004-05 to 2008-09	42,777	19,501	32,479	23,276	10,299
2009-10 to 2013-14	77,420	16,723	39,121	60,696	38,299
Maharashtra					
2004-05 to 2008-09	1,10,705	47,383	81,409	63,322	29,295
2009-10 to 2013-14	1,18,523	55,594	91,666	62,929	26,857

Source: Same as for Table 5.3

Real farm business income also showed an increasing trend in all the states. The average income was the highest in Gujarat, at Rs. 93,846/hectare followed by Karnataka and

Maharashtra, during the recent period. As compared to the other states, Karnataka witnessed the largest increase in income by over 60 per cent between the periods 2004-05 to 2008-09 and 2009-10 to 2013-14.

The average per hectare farm business income in Andhra Pradesh increased from Rs. 38,476 to Rs. 44,609. As regards the net income/profit, all the four states showed an increasing trend even with varying rates across states. The average per hectare net income was relatively high in Gujarat, at Rs. 58,327 while it was Rs. 38,299 in Karnataka, during the recent period. It is clear from the analysis that the cultivation of onion is highly a profitable activity in these states.

Potato

Data on the cost of cultivation surveys for potato are available for four states viz., Bihar, Himachal Pradesh, Uttar Pradesh and West Bengal. The real value of output, cost and income are presented in Table 5.25.

The average value of output showed a declining trend in all the states during the study period. The largest fall of 33 per cent in output from Rs. 1,21,241/hectare during 2004-05 to 2008-09 to Rs. 90,965/hectare during the period 2009-10 to 2013-14, was noticed in Uttar Pradesh. There has also been a significant decline in the value of potato output in Bihar during the recent period.

Table 5.25 Average Real Crop Output Value, Cost and Income (Rs./ha): Potato

Particulars	Gross Value of Output (GVO)	Paid Out Cost (Cost A2)	Total Cost (Cost C2)	Farm Business Income (GVO over Cost A2)	Net Income (GVO over Cost C2)
Bihar					
2004-05 to 2008-09	97,521	43,783	63,516	53,738	34,006
2009-10 to 2013-14	80,375	37,700	50,735	42,675	29,640
Himachal Pradesh					
2004-05 to 2008-09	91,950	36,469	66,545	55,481	25,405
2009-10 to 2013-14	89,802	30,308	61,056	59,494	28,746
Uttar Pradesh					
2004-05 to 2008-09	1,21,241	51,721	80,431	69,521	40,810
2009-10 to 2013-14	90,965	48,674	76,529	42,291	14,435
West Bengal					
2004-05 to 2008-09	1,03,677	70,754	1,07,563	32,923	-3887
2009-10 to 2013-14	1,00,956	75,278	1,10,877	25,678	-9921

Source: Same as for Table 5.3

However, the average farm business income has showed an increasing trend only in Himachal Pradesh. Despite a fall in the value of the output, farm business income has increased in this state because of a sharper decline in the paid out cost than in the output. In other states, the decline in the value of the output was much higher than that in the paid out cost. This has led to a decline in farm business in these states during the recent period.

A similar trend can also be observed with respect to net income. Only Himachal Pradesh has shown an improvement in net income, at Rs. 28,746/hectare during the recent period as

compared to the previous period. The average net income was negative in West Bengal, implying that the cultivation of potato is turning to be a non-profitable activity.

5.5 Annotation

An analysis of the changes in agricultural income at the national level and crop income at the state level shows there was a revival in growth from 2005-06, but it declined sharply again during recent years. The state level crop income analysis covered 23 crops for the period 2004-05 to 2013-14 and the analysis of agricultural growth at the macro level shows a declining trend from the mid-1990s to the early 2000s.

The trend in the movement of agricultural income clearly indicates that the purchasing power of farmers has remained low and not improving during recent years. An analysis of the TOT also indicates that it was not in favour of agriculture through the 1990s to the early 2000s. The TOT had recovered during recent years, which seems to have emerged as an important driver of overall agricultural growth during the concomitant period.

In the case of paddy, net income from its cultivation was negative in six states, viz., Assam, Bihar, Jharkhand, Maharashtra, Odisha, and West Bengal. Further, the average income has fallen in five states including Andhra Pradesh, Chhattisgarh, Karnataka, Punjab, and Uttarakhand during the recent period. The increase in the total cost was responsible for a decline in real income from paddy cultivation in these states.

The net income from wheat, on the other hand, has shown a marginal increase in some states including Bihar, Gujarat, Madhya Pradesh, and Uttarakhand due to a considerable increase in the value of the output over the total cost during the period 2009-10 to 2013-14. However, the average net income has turned out to be negative in four states, viz., Chhattisgarh, Himachal Pradesh, Jharkhand, and West Bengal.

As regards coarse cereals, five of the six major *bajra-* growing states, viz., Haryana, Karnataka, Maharashtra, Rajasthan, and Uttar Pradesh, have shown negative income during the period under study. A similar trend can be observed for maize, *jowar*, and *ragi*. All states except Andhra Pradesh have shown positive net income from the cultivation of *arhar*. However, *moong* and *urad* have brought negative net income for some states. In the case of gram and lentil, the net income was positive in all the major states, but has shown a declining trend.

Of the five major groundnut growing states, Karnataka and Tamil Nadu have registered negative income, while Andhra Pradesh and Maharashtra have shown some improvement during the recent period. Sesamum and soybean have, by and large, shown positive net income. However, the cultivation of sunflower has turned out to be non-profitable in Andhra Pradesh and Karnataka.

In the case of rapeseed and mustard, all states except Assam have recorded positive net income during the study period. The average net income from the cultivation of cash crops such as

cotton and sugarcane has registered significant improvement during the period 2009-10 to 2013-14 over the preceding period 2004-05 to 2008-09. Similarly, the average net income from the cultivation of onion has been significantly higher among the major onion-producing states.

To analyse the performance of major segments of the agricultural economy, it is important to assess the target growth rates at the national and state levels required for achieving the goal of doubling farmers' income. The next chapter outlines the target growth rates and identifies the sources of growth at both the national and sub-national levels. This will help to focus on the relevant growth drivers that will help augment farmers' income, including through enhanced public spending and other policy initiatives.

Key Extracts

- The decline in agricultural income has been more conspicuous after 1991. The economic reforms introduced in 1991 were largely focused on industries, and it was believed that the removal of industrial protection would help the agricultural sector indirectly through the increased availability of cheap material inputs.

- However, the analysis instead shows a substantial increase in the cost of material inputs, which has actually led to a decline in crop income.

- The analysis of income from crop cultivation reveals a mixed picture across states. The net income from the cultivation of many crops has declined and turned out to be negative in many states.

- By and large, the per hectare real value of output increased for most crops during the period 2004-05 to 2013-14, but the rise in input cost was much higher than the increase in the value of the output.

- This resulted in lowered net income from the cultivation of most crops. The paddy growing states such as Assam, Bihar, Jharkhand, Maharashtra, Odisha, and West Bengal have registered negative income during the most recent period.

- The average net income from the cultivation of cash crops such as cotton and sugarcane registered significant improvement during the period 2009-10 to 2013-14 over the preceding period 2004-05 to 2008-09.

- Similarly, the average net income from the cultivation of onion was significantly higher among the focus states, but, the per hectare net income from the cultivation of potato showed a declining trend during the period 2004-05 to 2013-14.

Chapter 6
Target Growth Rates

This chapter presents the DFI Committee's estimates of the per annum growth rate required to double farmers' income by March 2023 (2022-23). This exercise has been done for the states as well as the Union Territories (UTs). Here, the base year for the exercise is 2015-16 and the terminal year for doubling farmers' income is 2022-23.

6.1 Doubling of Income for States/UTs

The agricultural households derive income from four sources, viz., cultivation, livestock, non-farm business, and wages and salaries. At the national level, the average agricultural household income is targeted to be doubled by 2022-23 over 2015-16. The aggregate base year's (2015-16) all-India average income of an agricultural household is estimated at Rs. 74,108 at 2011-12 prices or Rs. 96,703 at current (2015-16) prices. The doubling would imply that the average farmer's household income would go up to Rs. 1,48,216, measured at 2011-12 prices or Rs. 1,93,406 measured at 2015-16 prices.

The objective of doubling of the average all-India income of the agricultural households in seven years would be equitable if the incomes of the agriculturally less developed states/UTs increase faster than the states where the incomes of the agricultural households are higher than the national average. In other words, the DFI Committee desires that the incomes of the agriculturally less developed states/UTs should be boosted such that these rise by more than 100 per cent so as to achieve convergence of incomes across states. The increase should get adjusted in such a way that the all-India average income doubles up in seven years. The growth of agricultural income of the agriculturally advanced states/UTs might slow down over time due to the already realised potential sources of growth while the agriculturally less developed states/UTs still have significant growth potential that remains to be exploited. These states/UTs have not greatly benefited from the Green Revolution.

To achieve this goal, a hypothetical reference scenario, as depicted in Box 6.1, has been devised:

Box 6.1 Reference Scenario for States/UTs

Assuming the national average agricultural household income as Rs. 100, the assumed the rule for income increase in our scenario is as follows:

Average Income in States/UTs (Rs.)	Targeted Growth in Income (%)
< 50	125
51 -75	120
76 - 100	110
100-125	95
126-175	90
> 175	75

Note: The scenarios are hypothetical. The states may plan to achieve an even higher growth path.

Table 6.1 shows the mean income in current prices for the various states/UTs in the base year and the extent by which their income is raised according to the rule articulated in the reference scenario.

Table 6.1: Mean Income (State/UTs) in the Base Year (Current Price), and Rate of Increase in Income in the Reference Scenario

S N	Zone	State	Mean Income (Rs.) in 2015–16	Deviation from Mean Income (%)	Percentage Increase in Income
1	Northern Zone	Haryana	1,87,225	93.61	75
2		Punjab	2,30,905	138.87	75
3		Uttar Pradesh	78,973	-18.33	110
4	North Eastern Zone	Arunachal Pradesh	1,76,152	82.16	75
5		Assam	85,962	-11.11	110
6		Manipur	1,22,889	27.08	90
7		Meghalaya	1,80,384	86.53	75
8		Mizoram	1,28,494	32.87	90
9		Nagaland	1,37,139	41.81	90
10		Sikkim	1,20,633	24.75	95
11		Tripura	78,962	-18.35	110
12	Eastern Zone	Bihar	45,317	-53.14	125
13		Jharkhand	84,820	-12.29	110
14		Odisha	63,285	-34.56	120
15		West Bengal	78,708	-18.61	110
16	Central Zone	Chhattisgarh	71,064	-26.51	120
17		Madhya Pradesh	1,16,878	20.86	95
18	Western Zone	Goa	1,18,410	22.45	95
19		Gujarat	1,18,043	22.07	95
20		Maharashtra	1,00,033	3.44	95
21		Rajasthan	92,914	-3.92	110
22	Southern Zone	Andhra Pradesh	1,04,092	7.64	95
23		Karnataka	1,54,399	59.66	90
24		Kerala	1,55,788	61.10	90
25		Tamil Nadu	1,33,568	38.12	90
26		Telangana	86,291	-10.77	110
27	Northern Hill Zone	Himachal Pradesh	1,14,876	18.79	95
28		Jammu & Kashmir	1,72,216	78.09	75
29		Uttarakhand	61,833	-36.06	120
30	Union Territories	Andaman &Nicobar Island	1,52,312	57.50	90
31		Chandigarh	3,38,362	249.90	75
32		Dadra & Nagar Haveli	1,09,002	12.72	95
33		Daman & Diu	1,09,067	12.79	95
34		Delhi	2,76,026	185.44	75
35		Lakshadweep	2,40,395	148.59	75
36		Puducherry	1,03,652	7.19	95
	All India (Mean Income)		**96,703**		

Source: DFI Committee's estimates.

The simulation scenario depicted in Box 6.1 indicates that the agriculturally less developed states/UTs must grow at a faster pace during the period 2015-16 to 2022-23 than their counterparts with higher agricultural incomes, which have already realised their growth potential more than the agriculturally less developed states. Only then would the conditions of the agricultural households in the agriculturally less developed states/UTs improve relative to their richer counterparts. This would lead to convergence of the incomes of agricultural households across states/UTs.

Table 6.2 provides the expected compound average growth rate (CAGR) for major states/UTs for this scenario. As this table shows, the target annual growth rate for agriculturally less

developed states like Bihar should be as high as 12.3 per cent. In contrast, the average agricultural household income of the agriculturally advanced states like Punjab and Haryana may grow by about 8.3 per cent per annum. It is possible to increase the growth rate in the lagging states/UTs at a faster pace in the coming years with the implementation of improved agricultural practices and development in agriculture-related infrastructure. This would lead to an increase of more than 100 per cent in incomes in agriculturally less developed states/UTs in seven years.

Table 6.2 Target Real Annual Growth Rate and Increase in Income in 7 Years (%)

SN.	Zone	State	Reference Scenario	Real Income Increase in 7 Years	Farm Income growth	Non-Farm Income growth
1	Northern Zone	Haryana	8.3	75	8.7	4.8
2		Punjab	8.3	75	8.8	4.5
3		Uttar Pradesh	11.2	110	9.6	2.4
4	North-Eastern Zone	Arunachal Pradesh	8.3	75	8.7	3.6
5		Assam	11.2	110	10.9	5.4
6		Manipur	9.6	90	10.7	0.9
7		Meghalaya	8.3	75	9.6	5.1
8		Mizoram	9.6	90	9.3	2.6
9		Nagaland	9.6	90	9.3	2.3
10		Sikkim	10.0	95	9.8	0.5
11		Tripura	11.2	110	9.8	6.2
12	Eastern Zone	Bihar	12.3	125	9.8	3.3
13		Jharkhand	11.2	110	8.8	3.3
14		Odisha	11.9	120	10.9	7.7
15		West Bengal	11.2	110	9.0	4.2
16	Central Zone	Chhattisgarh	11.9	120	8.3	2.2
17		Madhya Pradesh	10.0	95	9.2	3.7
18	Western Zone	Goa	10.0	95	10.6	4.9
19		Gujarat	10.0	95	8.6	4.0
20		Maharashtra	10.0	95	10.8	2.4
21		Rajasthan	11.2	110	8.7	1.1
22	Southern Zone	Andhra Pradesh	10.0	95	9.3	4.8
23		Karnataka	9.6	90	8.7	7.0
24		Kerala	9.6	90	10.4	4.4
25		Tamil Nadu	9.6	90	8.3	4.9
26		Telangana	11.2	110	10.9	6.9
27	Northern Hill Zone	Himachal Pradesh	10.0	95	8.3	2.2
28		Jammu & Kashmir	8.3	75	8.4	1.6
29		Uttarakhand	11.9	120	8.3	3.2
30	UTs	Andaman & Nicobar Islands	9.6	90	11.4	3.8
31		Chandigarh	8.3	75	8.5	3.3
32		Dadra & Nagar Haveli	10.0	95	10.1	3.2
33		Daman & Diu	10.0	95	10.0	3.2
34		Delhi	8.3	75	12.1	3.3
35		Lakshadweep	8.3	75	8.2	3.2
36		Puducherry	10.0	95	11.2	6.8
	All India		**10.4**	**100**	**9.2**	**3.3**

Source: DFI Committee's estimates.

6.2 Contributing Factors of Income Growth

As mentioned earlier, the income of the agricultural households originates from four sources, viz., crops, livestock, non-farm business, and wages and salaries. Agriculture and allied sectors explicitly cover the first two components of the household income, and are within the purviews of the Ministry of Agriculture and Farmers Welfare. The other two components, though doubtless important for agricultural households, are not directly affected by agricultural policies even though there are indirect linkages. The focus of discussion in this section is limited to the first two components of the agricultural households' income, viz., crops and livestock.

The DFI Committee has identified the following major sources of growth operating within the agriculture sector:[96]

(i) Improvement in crop productivity;
(ii) Improvement in livestock productivity;
(iii) Resource use efficiency or saving in cost of production;
(iv) Increase in cropping intensity; and
(v) Diversification towards high value crops.

Further, the following two sources of growth operate outside the agriculture sector and contribute to farmers' incomes:

(vi) Improvement in real prices received by farmers, and
(vii) Shift from farm to non-farm occupations.

It is important to note that strong policy measures would be needed to ensure capitalisation of all possible sources of farmers' income within as well as outside the agriculture sector.

Chand (2017b) has estimated the scope and contribution of these seven factors of growth at the all-India level, and has concluded that the combined effect of the seven potential sources of growth implies about 75.1 per cent growth in farmers' income in seven years if the factors underlying the growth in farmers' income rise at the same rate as experienced during the decade ending 2014. Price realisation plays an important role. The DFI Committee has estimated state-specific parameters of scope and contribution using state-specific data of recent years. The analysis has been undertaken for all the states and UTs. However, there are data limitations in estimating the UT-specific parameters for the sources of growth. In such cases, the all-India values of the estimated parameters or the neighbouring states' parameters have been used.[97]

6.2.1 Improvement in Crop Productivity
Crop productivity is usually measured by the increase in agricultural output per unit of land. The DFI Committee has collated the state-wise values of the agricultural output (crop segment) at constant prices (in 2011-12 prices) for the years 2004-05 to 2013-14. The estimate of crop

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[96] This approach follows the work by Chand (2017b).
[97] States/UTs may look at these values and suggest more precise estimates.

productivity per unit of land for each of the years 2004-05 to 2013-14 has been derived by dividing the value of agricultural output by the state-wise data of the net area.[98] To smoothen the year-to-year fluctuations, the average of the annual growth rates in crop productivity for the period 2005-06 to 20013-14 are used as the measure of the state-wise crop productivity. However, there are data anomalies (missing data, negative productivity) in some of the states/UTs for which the estimated all-India crop productivity number has been used. The states/UTs which fall under this category are Andhra Pradesh, Himachal Pradesh, Kerala, Nagaland, Telangana, and Uttarakhand.

If R_i is the per annum crop productivity percentage growth in crop agriculture in ith state, and S_i is the share of the crop segment in the agriculture sector (crops and livestock) in the same state, then the increase in farm income from this factor in seven years amounts to $[\{(1+R_i/100)^7 -1\}*S_i*100]$ per cent.

The state-wise share parameters of the crop segment are estimated on the basis of the average shares for the period 2011-12 to 2013-14. The source of data is CSO, Ministry of Statistics and Program Implementation (MoSPI)

6.2.1 Improvement in Livestock Productivity

The state-wise average growth rates of value added from the livestock sector in real terms have been estimated for the period 2005-06 to 2013-14 and used as the measure of sources of growth from livestock. The source of data is http://mospi.nic.in. However, because of the data anomaly, livestock value-added growth in the states of Nagaland and Jammu and Kashmir is assumed to be 4.58 per cent per annum, which is the estimated all-India figure.

If R_i is the per annum livestock value-added growth in ith state, and S_i is the share of the livestock segment in agriculture in the same state, then the increase in farm income from this factor in seven years amounts to $[\{(1+R_i/100)^7 -1\}*S_i*100]$ per cent.

The state-wise share parameters of the livestock segment are estimated on the basis of the average shares for the period 2011-12 to 2013-14. The source of data is MoSPI.

6.2.2 Improvement in Resource Use Efficiency

The improvement in resource use efficiency, interpreted as total factor productivity (TFP), is an important source of output growth since it directly contributes to cost savings and thereby increase in income. The DFI Committee has taken estimates from literature for the values of this parameter.[99] The average growth rate of TFP for recent years is considered as a measure of TFP growth for the doubling period (2015-16 to 2022-23).[100] Where estimates are not available for a particular state/UT, the respective neighbouring state's estimate of TFP growth has been used for the analysis.

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[98] The source of our data is the Ministry of Agriculture, Agricultural Statistics at a Glance, various issues.
[99] Rada, 2013.
[100] Since the latest estimates available are for the year 2008, data for the period 2000–2008 has been used for the analysis.

If R_i is the per annum percentage TFP growth per cent in agriculture in ith state, then, the increase in farm income from this factor in seven years amounts to $[\{(1+ R_i/100)^7 -1\}*100]$ per cent.

6.2.3 Diversification towards High Value Crops

The diversification towards high value crops (HVC) offers great scope to improve farmers' income. In this analysis, the horticulture sector has been considered to represent high-value crops. The DFI Committee has estimated the state-wise percentage share of the area under horticulture in the total gross sown area for the period 2004-05 to 2013-14. The source of data is http://mospi.nic.in. The percentage increase in area under horticulture for each of the years 2005-06 to 2013-14 has been estimated from this database. The average annual rate of increase for the period 2005-06 to 2013-14 is considered as the measure of crop diversification (area increase towards HVC) for analysing its implications for increasing farmers' income during the period 2015-16 to 2022-23.

The shift toward HVC is expected to lead to higher income. Land substitution from staple crops and HVC would lead to an increase in income from HVC, which may be higher than the income lost from moving away from staple crops. Thus, one may estimate increase in net income from 1 per cent shift in area from staples to HVC, i.e. the extent of increase in income after netting out the decline in income due to the shift in area from staple crops to HVC. The state-wise elasticities have been estimated using the NSSO 70th Round data (Chapter 4).

If R_i is the per annum area percentage increase in HVC in ith state, S_i is the share of crop segment in the same state, and E_i is the income elasticity of HVC in ith state, then the increase in farm income from this factor in seven years amounts to $[\{(1+ R_i/100)^7 -1\}*E_i*S_i*100]$ per cent.

6.2.4 Increase in Cropping Intensity

India has two main crops, Rabi and Kharif. With increased availability of irrigation facilities and new technologies, it has now become possible to raise short-duration crops apart from the main Kharif and Rabi crops. The collated information from land use statistics has been used to estimate the state-wise cropping intensity for the years 2004-05 to 2013-14.[101] The above information is used to derive the change in cropping intensity for the period 2005-06 to 2013-14. The average annual growth in cropping intensity for the above period is used as a parameter for the source of growth in farmers' income. However, it should be noted that there are a few states, including Manipur, Mizoram, Sikkim, and Tripura, for which information is not available, or for which there are anomalies in the data. In such cases, the estimated all-India figures have been applied.

If R_i is the per annum crop intensity increase (per cent) in crop agriculture in ith state, and S_i is the share of the crop segment in the same state, then the increase in farm income from this factor in seven years amounts to $[\{(1+ R_i/100)^7 -1\}*S_i*100]$ per cent.

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[101] Source: https://data.gov.in/keywords/land-use-statistics

6.2.5 Better Price Realisation

Farmers earn income from the sale of their produce at current prices. Thus, if the prices received by the farmers do not increase relative to the inflation in the economy, the farmers' income in real terms would decline. It is therefore important to ensure that the prices received by farmers in real terms also increase during the period 2015-16 to 2022-23, otherwise the gains from increase in income from various components of income growth would diminish. Various factors that lead to lower price realisation by farmers include the absence of nearby markets, lack of connectivity from the field to the market, market imperfections, and lack of information on prices, among others.

There is little evidence on the various aspects of market reforms and market modernisation efforts on prices received by farmers at the national level. The experience in the state of Karnataka provides evidence on the effect of online marketing by farmers using the Unified Market Platform (UMP) created by the Rashtriya e-market Services Ltd (ReMS), a joint venture between the government of Karnataka and NCDEX Spot Exchange Limited.[102] The available evidence indicates that the farmers in Karnataka have received a 13 per cent increase in average prices in real terms between the years 2013-14 and 2015-16, with the introduction of online trading and UMP modal prices in *mandi*s.[103]

As regards the status of marketing reforms, seven parameters are usually considered, namely: (a) establishment of a private wholesale market, (b) direct wholesale purchase from agriculturists at their farm gates (direct purchase by processors and exporters), (c) contract farming, (d) establishment of farmer/consumer markets in the private sector (direct sale by the producer to consumer in retail), (e) e-trading, (f) single point levy of market fee across the state, and (g) single unified trading licence in *mandi*s across the state.[104] Karnataka has undertaken reforms in all these aspects while some of the other states/UTs have partially reformed these. In the present analysis, other states/UTs have been ranked relative to Karnataka based on the progress of reforms achieved by them with regard to these parameters.[105] Thus, the best performers get the value 13 while others get a value of less than 13, depending on the extent of reforms in these areas. Of course, marketing reforms would lead to better price realisation only if connectivity to markets exists. This is an important factor to be considered in many of the states/UTs where connectivity is low and farmers usually receive lower prices for their produce than the potential market values. The state-wise connectivity index has been constructed on the basis of the length of road per square km of area using information for the year 2012.[106] The DFI Committee observes that Karnataka ranks high in respect of the connectivity index. Taking the connectivity index for Karnataka as 13, the constructed connectivity indices for other states/UTs have been rescaled accordingly. The price realisation is then derived as the simple average of the connectivity index and marketing index.

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[102] The ReMS initiative is similar to the eNAM initiative of the Government of India.
[103] See Chand (2017b).
[104] Source: http://dmi.gov.in/Apmc.aspx.
[105] Source: http://dmi.gov.in/Apmc.aspx.
[106] Source: https://data.gov.in/catalog/all-india-and-state-wise-total-and-surfaced-road-length.

Assuming that R_i is the value of the price realisation parameter (per cent) in crop agriculture in ith state, and S_i is the share of the crop segment in the same state, the increase in farm income from this factor in seven years amounts to (R_i*S_i*100) per cent.[107]

6.2.6 Shift to Non-farm Occupations

The incomes of farmers can be significantly improved by shifting the workforce away from agriculture to more productive employment in the non-farm sector. In fact, some farmers have started moving away from cultivation and many have been leaving farming.[108] Data from the Censuses of 2001 and 2011 have been used to understand this trend.

The comparison shows that there has been a decline in the number of cultivators both at the all-India level as well in most of the states. The state-wise annual rate of decline of cultivators has been estimated using the information from the Censuses of 2001 and 2011. There are a few states in the North-East as well as some hill states like Himachal Pradesh and Uttarakhand where this shift away from agriculture has not taken place due to the lack of alternative employment opportunities. In the case of such states, it is assumed that this trend will not prevail in the near future due to the lack of increase in employment opportunities elsewhere. For these states, the estimated all-India annual rate of decline has been applied as the estimated parameter for shifting the workforce away from agriculture.

If R_i is the per annum rate of shift to non-farm occupations in per cent in i*th* state from farm occupations, then the increase in farm income from this factor in seven years amounts to

$$[\{(1+ R_i/100)^7 -1\}*100] \text{ per cent.}$$

6.3   Income Growth Potentials

At the first instance, this analysis examines the extent to which farmers' income increases if one uses the estimated state-wise parameters for these seven factors of income growth. The value of the parameters are shown in Table 6.3. As mentioned earlier, the parameters are estimated based on past data (generally for the period 2003-04 to 2013-14).

However, the parameters have changed since 2013-14 because of development in various aspects of the economy, in general, and agriculture, in particular. Several initiatives have been undertaken by the present government which are expected to prove favourable for improving these parameters.

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[107] Chand (2017b) has assumed that the gains from the full effects of better price realisation would be manifested in seven years.

[108] The micro level study by Himanshu, et al. (2016) provides evidence of youth not being interested in working in agriculture.

Table 6.3 Estimated Values of State-wise Parameters

SN	State	Share		Scope							
		Crop	Livestock	Crop Productivity (%)	Livestock Value Added (%)	Improvement inn Resource Use Efficiency (%)	Crop Intensity (%)	Crop Diversification (9%)		Better Price Realisation in 7 Years: Crops Only(%)	Shift to Non –farm Occupations (%)
								Area	Elasticity		
1	Andhra Pradesh	0.53	0.47	2.91	4.69	2.20	0.54	5.99	0.34	12.07	1.65
2	Arunachal Pradesh	0.82	0.18	2.15	7.24	1.68	0.54	1.75	0.05	9.71	0.70
3	Assam	0.73	0.27	4.58	3.91	1.68	0.43	5.06	0.23	10.71	0.70
4	Bihar	0.62	0.38	2.03	5.14	1.46	1.28	1.56	0.11	6.50	1.28
5	Chhattisgarh	0.76	0.24	6.99	4.07	1.92	0.20	1.56	0.24	12.50	0.75
6	Goa	0.49	0.51	2.35	0.54	1.72	0.71	1.32	0.47	13.50	5.05
7	Gujarat	0.73	0.27	4.30	5.81	1.57	0.65	3.84	0.15	12.50	0.63
8	Haryana	0.65	0.35	0.95	5.46	1.56	0.32	7.48	0.03	11.14	1.70
9	Himachal Pradesh	0.70	0.30	2.91	2.93	1.55	0.70	1.85	0.91	13.00	0.70
10	Jammu & Kashmir	0.62	0.38	3.67	4.58	1.56	0.70	3.72	0.84	6.00	2.39
11	Jharkhand	0.69	0.31	4.19	3.02	1.46	1.10	6.50	0.13	11.57	0.21
12	Karnataka	0.74	0.26	4.89	3.88	1.66	0.18	3.34	0.43	13.00	0.45
13	Kerala	0.64	0.36	2.91	3.49	2.12	0.70	1.78	0.69	7.00	0.77
14	Madhya	0.79	0.21	5.19	6.17	1.92	1.85	5.27	0.07	10.64	1.14
15	Maharashtra	0.74	0.26	2.91	3.32	1.80	0.71	2.80	0.62	13.00	0.70
16	Manipur	0.73	0.27	2.25	4.58	1.68	0.68	1.82	0.17	6.50	0.70
17	Meghalaya	0.74	0.26	4.19	2.76	1.68	0.70	1.79	0.42	6.00	0.70
18	Mizoram	0.69	0.31	6.43	1.47	1.68	0.68	1.56	0.55	12.50	1.08
19	Nagaland	0.72	0.28	2.91	4.58	1.68	0.91	1.56	0.32	12.57	0.16
20	Odisha	0.72	0.28	5.65	6.17	1.56	0.70	5.50	0.40	8.86	0.35
21	Punjab	0.68	0.32	1.65	5.60	1.52	0.11	3.88	0.24	10.71	0.81
22	Rajasthan	0.64	0.36	3.57	5.34	2.15	1.75	1.56	0.11	12.50	0.70
23	Sikkim	0.89	0.11	2.98	2.92	1.68	0.68	1.22	0.29	12.50	0.89
24	Tamil Nadu	0.58	0.42	0.63	9.87	1.92	1.06	3.93	0.26	6.50	1.71
25	Telangana	0.60	0.40	2.91	4.69	2.20	0.70	1.56	0.16	12.07	1.65
26	Tripura	0.71	0.29	5.74	8.77	1.68	0.68	3.48	0.22	10.71	0.43
27	Uttar	0.67	0.33	2.07	4.10	1.74	0.70	2.53	0.09	9.79	1.50
28	Uttarakhand	0.67	0.33	2.91	4.08	1.74	0.39	0.91	0.13	12.07	0.70
29	West	0.63	0.37	2.20	2.80	2.08	0.73	1.88	0.29	9.79	0.99
30	Andaman & Nicobar	0.45	0.55	0.63	9.87	1.92	1.00	3.93	0.26	6.00	2.76
31	Chandigarh	0.15	0.85	1.65	5.60	1.52	0.11	3.88	0.24	9.79	0.70
32	Dadra & Nagar Haveli	0.71	0.29	2.91	3.32	1.80	2.42	2.80	0.62	7.00	3.68
33	Daman & Die	0.03	0.97	4.30	5.81	1.57	2.42	3.84	0.15	7.00	3.68
34	Delhi	0.29	0.71	0.95	5.46	1.56	0.49	7.48	0.03	7.00	6.51
35	Lakshadweep	0.15	0.85	2.91	3.49	2.12	2.97	1.78	0.69	7.00	0.70
36	Puducherry	0.32	0.68	0.63	9.87	1.92	1.06	3.93	0.26	7.00	0.01
	All India	0.70	0.30	2.91	4.58	1.78	0.68	1.56	0.32	13.00	0.70

Source: DFI Committee's estimates

Table 6.4 shows the gain in income in real terms in the coming seven years if parametric values of sources of growth in states/UTs follow the past trends. As this table shows, most of the states/UTs are unable to double income in real terms in seven years. At the national level, the increase comes to about 66.5 per cent. Thus, there is need to undertake policies related to the above-mentioned seven factors of growth in agriculture so that the parametric values of the sources of growth improve in the coming years.

Table 6.4 Contribution of the Seven Factors in Income Growth

S N	State	Crop Produ ctivity (%)	Livesto ck Value Added (%)	Improvem ent in Resource Use Efficiency (%)	Crop Intens ity (%)	Crop Diversif ication (%)	Better Price Realisat ion (%)	Shift to Non - farm Occupat ion (%)	Total Increase in Income in 7 Years (%)
1	Andhra Pradesh	11.7	17.9	16.5	2.0	9.1	6.4	12.1	75.7
2	Arunachal Pradesh	13.2	11.3	12.4	3.2	0.5	8.0	5.0	53.6
3	Assam	26.8	8.4	12.4	2.2	7.0	7.8	5.0	69.5
4	Bihar	9.4	15.8	10.7	5.8	0.8	4.1	9.3	55.9
5	Chhattisgarh	45.9	7.7	14.2	1.1	2.1	9.5	5.3	85.9
6	Goa	8.7	2.0	12.7	2.5	2.2	6.6	41.2	75.8
7	Gujarat	25.0	13.1	11.5	3.4	3.3	9.1	4.5	69.8
8	Haryana	4.4	16.0	11.5	1.5	1.1	7.2	12.5	54.2
9	Himachal Pradesh	15.6	6.7	11.4	3.5	8.7	9.1	5.0	60.0
10	Jammu & Kashmir	17.7	14.1	11.4	3.1	15.0	3.7	18.0	83.1
11	Jharkhand	22.8	7.3	10.7	5.5	4.8	7.9	1.5	60.4
12	Karnataka	29.3	8.0	12.2	0.9	8.2	9.6	3.2	71.4
13	Kerala	14.2	9.8	15.8	3.2	5.8	4.5	5.5	58.8
14	Madhya Pradesh	33.8	10.7	14.2	10.9	2.4	8.5	8.3	88.8
15	Maharashtra	16.5	6.6	13.3	3.8	9.8	9.7	5.0	64.6
16	Manipur	12.2	10.1	12.4	3.5	1.6	4.7	5.0	49.5
17	Meghalaya	24.8	5.4	12.4	3.7	4.1	4.5	5.0	59.8
18	Mizoram	37.7	3.3	12.4	3.4	4.3	8.6	7.8	77.6
19	Nagaland	16.0	10.3	12.4	4.7	2.6	9.0	1.1	56.2
20	Odisha	33.6	14.8	11.4	3.6	13.0	6.3	2.5	85.2
21	Punjab	8.3	14.8	11.2	0.5	5.0	7.3	5.8	52.8
22	Rajasthan	17.9	15.7	16.0	8.3	0.8	8.0	5.0	71.7
23	Sikkim	20.3	2.5	12.4	4.3	2.3	11.1	6.4	59.3
24	Tamil Nadu	2.6	39.3	14.2	4.4	4.7	3.8	12.6	81.6
25	Telangana	13.4	15.1	16.5	3.0	1.1	7.3	12.1	68.4
26	Tripura	34.1	22.9	12.4	3.5	4.1	7.6	3.1	87.8
27	Uttar Pradesh	10.3	10.8	12.8	3.3	1.1	6.5	11.0	55.9
28	Uttarakhand	14.8	10.7	12.8	1.8	0.6	8.1	5.0	53.9
29	West Bengal	10.4	7.8	15.5	3.3	2.6	6.2	7.1	52.9
30	A & N Islands	2.0	51.2	14.2	3.3	3.6	2.7	21.0	98.1
31	Chandigarh	1.8	39.6	11.2	0.2	1.1	1.4	5.0	60.3
32	Dadra & Nagar Haveli	15.8	7.5	13.3	3.5	9.3	5.0	28.8	83.1
33	Daman & Diu	1.0	47.1	11.5	0.5	0.1	0.2	28.8	89.2
34	Delhi	2.0	32.0	11.5	1.5	0.5	2.0	55.5	105.0
35	Lakshadweep	3.2	23.2	15.8	3.8	1.3	1.0	5.0	53.4
36	Puducherry	1.4	63.4	14.2	1.6	2.6	2.2	0.0	85.5
	All India								66.5*

Note: *Computed from income increases in individual states/UTs.

The above discussion indicates that the average income from crops and livestock, measured at the all-India level, may increase by 66.5 per cent over the period 2015-16 to 2022-23 if one uses values of the parameters of sources of growth from past state-specific data.

There has been progress in the various sources of growth at the state level since 2013-14, the terminal year for estimating the parameters of the sources of growth. Also, the present government has taken several initiatives relating to the factors responsible for accelerating agricultural growth.[109] Hence, the DFI Committee has considered improvement in the seven

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[109] See Volume 1, *Report of Committee for Doubling Farmers' Income*.

parameters of sources of growth and has examined the extent to which it is possible to bridge the gap with our targets.

While considering improvement in the parameters, it is generally assumed that the wide variations across states/UTs in any parameter would converge over time, that is, the low performers would catch up with the high performers in all the elements pertaining to the sources of growth. As regards crop (livestock) productivity, it is assumed that in states/UTs which exhibit lower than the estimated all-India parameters of crop/livestock productivity, it would grow at the all-India rate, that is, 2.91 per cent (4.58 per cent) per annum. As regards TFP growth, the DFI Committee has assumed that it would grow at the all-India level for states/UTs which have achieved low productivity growth in the past years, which is assumed to be 2.26 per cent per annum.[110] This seems to be a reasonable assumption. It is expected that the values of these parameters in the agriculturally less developed states would at least be at par with the Indian average in view of the emphasis laid on agricultural development by the present government. It should be noted that the values of these parameters are lower than those of many of the developed countries. Thus, there is ample scope for further improvement in coming years.

As regards the increase in area under crop diversification, the assumption is that the area would increase by 3.13 per cent in states/UTs that have achieved a growth of less than 3.13 per cent per annum.[111] The elasticity of 0.32 is assumed in states/UTs which have exhibited an elasticity value of less than 0.32 in the past year.[112] As regards the parameter for price realisation, the thumb rule adopted is that the parameter takes the value 13 if it less than 10 in the observed period, and increases by 20 per cent if it is more than 10.

No doubt, farmers' income would increase faster if the shift of cultivators to non-farm jobs occurs at a faster pace as compared to the past years. This rate of increase is assumed to be 1.8 per cent per annum for all the states/UTs.[113] This is also a conservative assumption because if the *Make in India* programme is successful, and the manufacturing sector starts flourishing, one can expect a greater shift of cultivators to non-farm jobs. The values of the modified parameters are shown in Table 6.5. Understandably, this is only a hypothetical scenario. The basic approach is to ensure that the parametric values of the sources of growth in the agriculturally less developed states improve and catch up with the national average.

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[110] The source of the data is Chand, 2017b.
[111] This is the value estimated by Chand, 2017b, at the all-India level.
[112] Our estimates using NSSO data turn out to be 0.32 at the all-India level.
[113] This is the rate assumed by Chand, 2017b.

Table 6.5 estimated values of state-wise parameters

State	Share		Potentials							
	Crop	Livestock	Crop Productivity (%)	Livestock Value Added (%)	Improvement in Resource Use Efficiency (%)	Crop Intensity (%)	Crop Diversification (9%)		Better Price Realisation in 7 Years: Crops Only (%)	Shift To Non-farm Occupations (%)
							Area	*Elasticity*		
Andhra Pradesh	0.54	0.46	2.91	4.69	2.26	0.68	5.99	0.34	14.49	1.81
Arunachal Pradesh	0.88	0.12	2.91	7.24	2.26	0.68	3.13	0.32	13.0	1.81
Assam	0.75	0.25	4.58	4.58	2.26	0.68	5.06	0.32	12.86	1.81
Bihar	0.65	0.35	2.91	5.14	2.26	1.29	3.13	0.32	13.0	1.81
Chhattisgarh	0.79	0.21	6.99	4.58	2.26	0.68	3.13	0.32	15.00	1.81
Goa	0.74	0.26	4.30	5.81	2.26	0.68	3.84	0.32	15.00	1.81
Gujarat	0.67	0.33	2.91	5.46	2.26	0.68	7.48	0.32	13.37	1.81
Haryana	0.79	0.21	2.91	4.58	2.26	0.71	3.13	0.91	15.60	1.81
Himachal Pradesh	0.73	0.27	4.19	4.58	2.26	1.11	6.50	0.32	13.89	1.81
Jammu & Kashmir	0.76	0.24	4.89	4.58	2.26	0.68	3.34	0.43	15.60	1.81
Jharkhand	0.67	0.33	2.91	4.58	2.26	0.71	3.13	0.69	13.00	1.81
Karnataka	0.81	0.19	5.19	6.17	2.26	1.87	5.27	0.32	12.77	1.81
Kerala	0.77	0.23	2.91	4.58	2.26	0.72	3.13	0.62	15.60	1.81
Madhya Pradesh	0.76	0.24	2.91	4.58	2.26	0.69	3.13	0.32	13.00	1.81
Maharashtra	0.79	0.21	4.19	4.58	2.26	0.71	3.13	0.42	13.00	1.81
Manipur	0.77	0.23	4.19	4.58	2.26	0.69	3.13	0.55	15.00	1.81
Meghalaya	0.77	0.23	2.91	4.58	2.26	0.92	3.13	0.32	15.09	1.81
Mizoram	0.75	0.25	5.65	6.17	2.26	0.71	5.50	0.40	13.00	1.81
Nagaland	0.70	0.30	2.91	5.60	2.26	0.68	3.88	0.32	12.86	1.81
Odisha	0.68	0.32	3.57	5.34	2.26	1.76	3.13	0.32	15.00	1.81
Punjab	0.89	0.11	2.98	4.58	2.26	0.69	3.13	0.32	15.00	1.81
Rajasthan	0.60	0.40	2.91	9.87	2.26	1.07	3.93	0.32	13.00	1.81
Sikkim	0.61	0.39	2.91	4.69	2.26	0.71	3.13	0.32	14.49	1.81
Tamil Nadu	0.78	0.22	5.74	8.77	2.26	0.69	3.48	0.32	12.86	1.81
Telangana	0.69	0.31	2.91	4.58	2.26	0.71	3.13	0.32	13.00	1.81
Tripura	0.73	0.27	2.91	4.58	2.26	0.68	3.13	0.32	14.49	1.81
Uttar Pradesh	0.65	0.35	2.91	4.58	2.26	0.74	3.13	0.32	13.00	1.81
Uttarakhand	2.91	9.87	2.26	1.01	3.93	0.32	13.0	2.76	2.91	9.87
West Bengal	2.91	5.60	2.26	0.68	3.88	0.32	13.0	1.81	2.91	5.60
Andaman & Nicobar Is	2.91	4.58	2.26	0.71	3.13	0.62	13.0	3.68	2.91	4.58
Chandigarh	4.30	5.81	2.26	2.54	3.84	0.32	13.0	3.68	4.30	5.81
Dadra & Nagar Haveli	2.91	5.46	2.26	0.71	7.48	0.32	13.0	6.51	2.91	5.46
Daman & Diu	2.91	4.58	2.26	3.42	3.13	0.69	13.0	1.81	2.91	4.58
Delhi	2.91	9.87	2.26	0.71	3.93	0.32	13.0	1.81	2.91	9.87
Lakshadweep	2.91	9.87	2.26	1.01	3.93	0.32	13.0	2.76	2.91	9.87
Puducherry	2.91	5.60	2.26	0.68	3.88	0.32	13.0	1.81	2.91	5.60

Source: DFI Committee's estimates.

With this value of the parameters, the DFI Committee finds that the farmers' income would increase rise by 85 per cent (Table 6.6).

It may be noted that the income would be doubled in many of the states/UTs though incomes in some of the most progressive agricultural states do not double. By and large, incomes in the agriculturally less developed states would nearly double during the target period. This would only be a reality if the associated policy reforms in agriculture are undertaken and investment in agriculture is accelerated.

Table 6.6 Contribution of the Seven Factors in Income Growth

State	Crop Productivity (%)	Livestock Value Added (%)	Improvement in Resource Use Efficiency (%)	Crop Intensity (%)	Crop Diversi-fication (%)	Better Price Realisation (%)	Shift to Non-farm Occupations (%)	Total Increase in Income-in 7 Years (%)	Target Increase in Income in 7 Years (%)
Andhra Pradesh	11.7	17.9	16.9	2.6	9.1	7.6	13.4	79.2	95
Arunachal Pradesh	18.2	11.3	16.9	4.0	6.3	10.7	13.4	80.9	75
Assam	26.8	10.1	16.9	3.5	9.6	9.3	13.4	89.6	110
Bihar	13.9	15.8	16.9	5.9	4.8	8.1	13.4	78.8	125
Chhattisgarh	45.9	8.8	16.9	3.7	5.9	11.4	13.4	106.0	120
Goa	10.9	18.8	16.9	2.5	5.5	7.9	41.2	103.8	95
Gujarat	25.0	13.1	16.9	3.5	7.0	10.9	13.4	90.0	95
Haryana	14.3	16.0	16.9	3.1	13.6	8.6	13.4	86.0	75
Himachal Pradesh	15.6	11.0	16.9	3.5	15.3	10.9	13.4	86.7	95
Jammu & Kashmir	17.7	14.1	16.9	3.1	15.0	8.0	18.0	92.9	75
Jharkhand	22.8	11.6	16.9	5.5	12.1	9.5	13.4	91.9	110
Karnataka	29.3	9.6	16.9	3.6	8.2	11.5	13.4	92.6	90
Kerala	14.2	13.3	16.9	3.2	10.6	8.3	13.4	80.0	90
Madhya Pradesh	33.8	10.7	16.9	11.0	11.0	10.1	13.4	106.9	95
Maharashtra	16.5	9.5	16.9	3.8	11.0	11.6	13.4	82.7	95
Manipur	16.2	10.1	16.9	3.6	5.6	9.4	13.4	75.1	90
Meghalaya	24.8	9.4	16.9	3.8	7.5	9.7	13.4	85.5	75
Mizoram	37.7	11.4	16.9	3.4	9.1	10.4	13.4	102.3	90
Nagaland	16.0	10.3	16.9	4.8	5.5	10.9	13.4	77.8	90
Odisha	33.6	14.8	16.9	3.6	13.0	9.3	13.4	104.6	120
Punjab	15.2	14.8	16.9	3.3	6.7	8.8	13.4	79.0	75
Rajasthan	17.9	15.7	16.9	8.4	5.0	9.6	13.4	86.9	110
Sikkim	20.3	4.1	16.9	4.4	6.8	13.3	13.4	79.2	95
Tamil Nadu	12.9	39.3	16.9	4.5	5.7	7.5	13.4	100.2	90
Telangana	13.4	15.1	16.9	3.0	4.6	8.7	13.4	75.2	110
Tripura	34.1	22.9	16.9	3.5	6.2	9.2	13.4	106.2	110
Uttar Pradesh	14.9	12.2	16.9	3.4	5.1	8.7	13.4	74.6	110
Uttarakhand	14.8	12.3	16.9	3.2	5.1	9.7	13.4	75.4	120
West Bengal	14.1	13.5	16.9	3.3	4.9	8.2	13.4	74.4	110
Andaman & Nicobar Is	10.0	51.2	16.9	3.3	4.5	5.9	21.0	112.8	90
Chandigarh	3.3	39.6	16.9	0.7	1.4	1.9	13.4	77.3	75
Dadra & Nagar Haveli	15.8	10.7	16.9	3.6	10.5	9.2	28.8	95.5	95
Daman & Diu	1.0	47.1	16.9	0.6	0.3	0.4	28.8	95.0	95
Delhi	6.4	32.0	16.9	1.5	6.1	3.8	55.5	122.3	75
Lakshadweep	3.2	31.5	16.9	3.9	2.4	1.9	13.4	73.2	75
Puducherry	7.1	63.4	16.9	1.6	3.2	4.2	13.4	109.8	95
All India								85.5*	

Source: DFI Committee's computation.

Note: *Computed from income increases in individual states/UTs.

The foregoing analysis focuses on the crop and livestock sector. In Chapter 2, it has been mentioned that there are other two sources of income growth of farmers' households, namely non-farm business and wages and salaries, which are not directly under the focus of the DFI Committee.

The DFI Committee expects that the share of farm income in the terminal year of the doubling income period would rise in comparison to base year of the analysis, that is, 2015-16. The DFI committee has estimated the state/UTs-wise per cent share of farm's income for the base year and terminal for the various states/UTs for two scenarios: (i) business-as-usual scenario reflecting the past trend rate of growth of farm income, and (ii) accelerated agricultural growth scenario corresponding to Table 6.6. The results are presented in Table 6.7, which shows that the per cent share of farm's income in the terminal year would rise as compared to the base year.

Table 6.7 Per cent Share of Farm's Income in Base Year and Terminal Year

SN	State/UTs	% share of farms income in Agricultural Household Income Base Year (2015-16)	Per cent Share of farm Income in Agricultural Household income	
			Business-as-usual Scenario Terminal Year (2022-23)	Accelerated Agricultural Growth Scenario Terminal Year (2022-23)
1	Andhra Pradesh	52	57.9	58.4
2	Arunachal Pradesh	70.7	73.1	76.2
3	Assam	74.8	81	82.7
4	Bihar	57.6	62.4	65.5
5	Chhattisgarh	65	70.4	72.5
6	Goa	35.1	47.2	50.9
7	Gujarat	61.8	66	68.5
8	Haryana	73	77.7	80.8
9	Himachal Pradesh	45.2	53	56.8
10	Jammu & Kashmir	31	44.2	45.5
11	Jharkhand	57.8	59	63.3
12	Karnataka	63.2	70	72.4
13	Kerala	35	40.6	43.6
14	Madhya Pradesh	76.6	78.6	80.1
15	Maharashtra	60.9	65.8	68.1
16	Manipur	50.4	56.7	60.5
17	Meghalaya	60.8	65.7	69
18	Mizoram	59.6	65.3	68.2
19	Nagaland	42.8	47	50.3

SN	State/UTs	% share of farms income in Agricultural Household Income Base Year (2015-16)	Per cent Share of farm Income in Agricultural Household income	
			Business-as-usual Scenario Terminal Year (2022-23)	Accelerated Agricultural Growth Scenario Terminal Year (2022-23)
20	Odisha	54.5	65.2	67.4
21	Punjab	69.6	76.4	79.1
22	Rajasthan	56.3	61.4	63.4
23	Sikkim	40.7	40.5	43.4
24	Tamil Nadu	43.1	50.5	52.9
25	Telangana	73.6	77	77.7
26	Tripura	69.2	72.6	74.4
27	Uttar Pradesh	71.9	77.5	79.4
28	Uttarakhand	30.5	37.7	40.8
29	West Bengal	31.1	35.5	38.6
30	Andaman & Nicobar Is	37.7	48.1	49.9
31	Chandigarh	9.3	11.7	12.7
32	Dadra & Nagar Haveli	8.1	11.4	12.1
33	Daman & Diu	22.6	30.7	31.3
34	Delhi	4.8	7.6	8.2
35	Lakshadweep	27.7	31.9	34.6
36	Puducherry	60.2	64	66.8
	All India	**60.2**	**66.8**	**69.2**

Source: Estimated by the DFI Committee.

Note: Farm's income growth is estimated based on Table 6.4 and Table 6.6. Non-farm growth is assumed based on growth rate of agricultural net state domestic product for the recent past period (2005-06 to 2015-16). However, in the case of any state/UT that has registered a negative or near-zero growth rate, the all-India growth rate (3.25 per cent) is assumed for the same. This basically applies for the states/UTs of Kerala, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Delhi, and Lakshadweep.

6.4   Targeted Farmers' Income

From the above analysis presented in a macro perspective, the DFI Committee has estimated the extent to which farm's income (income from crop agriculture, livestock, non-farm business and wages and salaries) would rise between the years 2015-16 to 2022-23. These are shown in Table 6.8, both in real terms and in nominal terms assuming the inflation to be 5 per cent per annum during the period 2015-16 to 2022-23.

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Table 6.8 Farmers' Income in Base and Terminal Year (Rs)

States/UTs	Base Year: 2015-16 At 2015-16 Prices			Terminal Year: 2022-23 At 2015-16 Prices			Terminal Year: 2022-23 At Current Prices		
	Farm	Non-Farm	Total	Farm	Non-Farm	Total	Farm	Non-Farm	Total
Andhra Pradesh	54,135	49,957	1,04,092	97,010	69,202	1,66,212	1,36,503	97,374	2,33,876
Arunachal Pradesh	1,24,461	51,691	176,152	225,149	70,369	295,518	316,808	99,016	415,824
Assam	1,28,574	43,350	1,71,924	2,43,776	51,122	2,94,898	3,43,017	71,934	4,14,951
Bihar	26,116	19,201	45,317	46,695	24,567	71,262	65,704	34,568	100,273
Chhattisgarh	46,172	24,892	71,064	95,115	36,059	1,31,174	1,33,837	50,738	1,84,575
Goa	41,581	76,829	1,18,410	84,742	81,801	1,66,543	1,19,240	1,15,103	2,34,343
Gujarat	72,969	45,074	1,18,043	1,38,642	63,895	2,02,536	1,95,083	89,906	2,84,989
Haryana	1,36,622	50,603	1,87,225	2,54,117	60,535	3,14,652	3,57,568	85,179	4,42,747
Himachal Pradesh	51,933	62,943	1,14,876	96,959	73,757	1,70,716	1,36,431	1,03,784	2,40,215
Jammu & Kashmir	53,391	1,18,825	1,72,216	1,02,992	1,23,405	2,26,396	1,44,920	1,73,643	3,18,562
Jharkhand	49,060	35,760	84,820	94,146	54,639	1,48,785	1,32,473	76,883	2,09,355
Karnataka	97,547	56,852	1,54,399	1,87,875	71,557	2,59,432	2,64,359	1,00,688	3,65,047
Kerala	54,452	1,01,336	1,55,788	98,013	1,26,764	2,24,777	1,37,915	1,78,369	3,16,284
Madhya Pradesh	89,434	27,354	1,16,788	1,85,039	45,960	2,30,999	2,60,368	64,671	3,25,039
Maharashtra	60,885	39,148	1,00,033	1,11238	52,071	1,63,309	1,56,523	73,269	2,29,792
Manipur	61,973	60,916	122,889	108,515	70,729	179,243	152,691	99,522	252,213
Meghalaya	1,09,707	70,677	1,80,384	2,03,506	91,328	2,94,834	2,86,354	1,28,508	4,14,861
Mizoram	76,612	51,882	1,28,494	1,54,987	72,376	2,27,363	2,18,082	1,01,840	3,19,922
Nagaland	58,666	78,473	1,37,139	1,04,308	1,03,255	2,07,563	1,46,772	1,45,290	2,92,062
Odisha	34,463	28,822	63,285	70,511	34,116	1,04,627	99,216	48,005	1,47,221
Punjab	1,60,683	70,222	2,30,905	2,87,623	75,910	3,63,533	4,04,714	1,06,813	5,11,527
Rajasthan	52,270	40,644	92,914	97,693	56,494	1,54,187	1,37,464	79,493	2,16,957
Sikkim	49,129	71,504	1,20,633	88,039	1,14,811	2,02,850	1,23,879	1,61,551	2,85,430
Tamil Nadu	57,511	76,057	1,33,568	1,15,138	1,02,538	2,17,676	1,62,010	1,44,282	3,06,292
Telangana	63,492	22,799	86,291	1,11,238	31,916	1,43,153	1,56,522	44,909	2,01,431
Tripura	54,642	24,320	78,962	1,12,672	38,724	1,51,396	1,58,541	54,489	2,13,030
Uttar Pradesh	56,785	22,188	78,973	99,146	25,758	1,24,904	1,39,508	36,245	1,75,753
Uttarakhand	18,862	42,971	61,833	33,084	48,011	81,095	46,552	67,556	1,14,108
West Bengal	24,441	54,267	78,708	42,626	67,883	1,10,509	59,979	95,519	155,497
Andaman &Nicobar Island	57,417	94,895	1,52,312	1,22,184	1,22,844	2,45,028	1,71,926	1,72,853	3,44,779
Chandigarh	31,571	3,06,791	3,38,362	55,975	3,83,772	4,39,747	78,762	5,40,006	6,18,768
Dadra & Nagar Haveli	8,806	1,00,196	1,09,002	17,216	1,25,337	1,42,553	24,224	1,76,362	2,00,587
Daman & Diu	24,665	84,402	1,09,067	48,097	1,05,580	1,53,677	67,677	1,48,562	2,16,239
Delhi	13,204	2,62,822	2,76,026	29,352	3,28,770	3,58,122	41,301	4,62,613	5,03,914
Lakshadweep	66,496	1,73,899	2,40,395	1,15,172	2,17,534	3,32,705	1,62,058	3,06,092	4,68,150
Puducherry	62,431	41,221	1,03,652	1,30,980	65,181	1,96,161	1,84,302	91,716	2,76,019
All India	58,246	38,457	96,703	1,08,045	48,108	1,56,154	1,52,031	67,693	2,19,724

Source: Estimated by the DFI Committee.

It should be noted that the stakeholders in the states/UTs need to identify their respective strengths/weaknesses and would need to take steps accordingly. In earlier analysis, the seven sources of income growth are indicated, irrespective of whether the states/UTs take steps to improve their position relative to others.

Even within these, the states/UTs may focus on certain sources of growth depending on their respective strengths/weaknesses. For instance, livestock has several components such as dairy, fishing, and bee-keeping, among others. Some states may have inherent strengths in fishing due to their locational advantage providing them access to the sea/rivers. The policy focus should be on exploiting the untapped potential of these sources.

As analysed in Chapter 4, farm income can be substantially raised by crop diversification (horticultural crops). In states where the farmers are slow in moving towards the cultivation of horticultural crops, it is imperative for policy-makers to encourage farmers to take up the farming of horticultural crops for increasing their incomes.

The average income of the farmer households is targeted to increase from Rs 96,703 in 2015-16 (current prices) to Rs. 2,19,724 in 2022-23 (current prices). The corresponding values for farm income are Rs. 58,246 and Rs. 1,52,031, respectively. This implies the share of farm income in in total farmer household income would increase from 60.2 per cent in 2015-16 to 69.2 per cent in 2022-23 with variations across states.

Key Extracts

- The state-/UT-wise per annum real income growth rates of agricultural households' incomes (farm plus non-farm), would vary between 8 and 12 per cent.

- Following the past trends in income growth, all-India farm income would increase by 66.5 per cent. States need to boost the contribution of those sources of farm income where they have relative comparative advantage. Growth targets, sector-wise have been listed for each farming region.

- Growth in non-farm income would also be enhanced with growth in farm-related marketing activities and this would add further to the total income.

- In pursuing all the recommendations made to enhance farm income, the share of farm income in agricultural households' is expected to increase from current 60 per cent in 2015-16 to 80 per cent or more by 2022-23.

- The enhanced farm income, along with growth in non-farm income, will lead to overall doubling of farmers' income.

Chapter 7
Policy Recommendations

1. The strategy for doubling farmers' income should primarily focus on enhancing viability of farming. Hence, the strategy should aim at increasing the ratio of farm income to the non-farm income from its current level of 60 per cent to 70 per cent.

2. The growth strategy should simultaneously focus on equitability by promoting higher agricultural growth in less developed regions including rainfed areas, among more vulnerable sections like   marginal and small land holders.

3. There are wide variations in the average agricultural household income across regions, seasons, and land size classes. Income variations should be minimised, by the States adopting those sources of growth which hold higher relative potential in their case. This approach would help in each state contributing optimally to the national level in average farm income growth rate. It is imperative to adopt differential strategies across regions and land size classes because of the prevalence of differences in the relative significance of income sources. For instance, for marginal and small landholders, the preferential need is to strengthen livestock-related activities and crop diversification in line with market signals.

4. Diversification into high value produce, such as horticulture, livestock and fisheries, have been found to contribute more to income growth and these sectors need to be given priority.

5. An analysis of sources of growth also brings out that marketing is a significant contributor to farm income growth. The existing production activities need to be restructured to be market led and take into account the rapidly changing consumption patterns and dietary habits. In this context, the appropriate strategy would be to focus on the demand-driven fork-to-farm approach to augment farmers' income. This needs innovative thinking in terms of generating a higher level of monetisation of farmers' produce by shifting priority focus to post-production management and the agricultural marketing system.

6.   The targeted growth rate of farm income demands a certain minimum level of capital investments, consisting of private and public inflows. The target of DFI by 2022 entails, that the average private investment should increase by 6.62 per cent per annum from the base year 2015-16 at the national level. The required rate of increase varies widely across the states. In the case of public investment *for* agriculture (agriculture per se, plus irrigation, rural roads-transport and energy), the average weighted increase should be 6.92 per cent per annum. The less developed states would require higher rate of public investment owing to the initial low capital base in rural areas.

7. Cumulative private investment of Rs. 463 billion at 2004-05 prices is required for doubling of farmers' income by 2022-23. This requirement varies from Rs. 1.16 billion to Rs. 125 billion across the country. In the case of public investment, the required cumulative investment for agriculture would be Rs. 1023 billion at 2004-05 prices, varying from Rs. 4 billion to Rs. 679 billion across select 20 states. This magnitude of impact on agriculture through such investment, can be enhanced by bringing in efficiency in capital use.

8. Returns from additional spending tend to be higher in the less developed States as compared to the high-income States for most of the economic services. The developed States tend to show diminishing marginal returns from additional public investments, thereby suggesting the need to step up investments in the less developed and rainfed regions to meet the future growth challenges in agriculture. Owing to higher marginal returns from additional public spending in the less developed and rainfed States, the Committee suggests a relatively higher increase in the capital intensity of investments in irrigation and infrastructure in such regions to meet the future growth challenges.

9. The marginal efficiency of capital is much higher in minor irrigation than that in the major and medium irrigation systems, implying the usefulness of allocation of more resources towards the former by the respective State Governments.

10. There is a strong need for a sizeable increase in institutional credit as only 50 to 60 per cent of the investment needs of farmers are currently being fulfilled through institutional loans. The current dependence of landless, small and marginal on non-institutional credit which stands at 40.6, 52.1 and 30.8 per cent should be minimised. Further, the north-eastern, eastern and rainfed state/regions require the most attention in building scope for access to institutional credit.

11. In order strengthen investments in agriculture and simultaneously lighten the financial obligations of the government, the policy framework should be reoriented such as to incentivise private corporate sector participation. Currently their share in capital investment in agriculture is as low as 2 per cent. Examples that can crowd in private investment are reforms in marketing system, contract farming, liberalisation in FDI norms, etc.

12. The government investments can be strengthened in agriculture by convergence of resources through schemes that are operated in different departments and ministries. Such examples include utilising the funds under MNREGA, for creating small irrigation sources, rural roads, etc.

13. Since capital investments are found vital for growth, it is necessary that mobilisation of resources and their efficient utilisation are taken up as one of the important functions of the agriculture ministry at both national and state levels. Towards this, it is suggested that the present Division of RKVY in DAC&FW may be re-designated as Division of agri-investment and entrepreneurship. It can draw up policies and guidelines, that will

maximise investments from different sources, compile relevant data for monitoring, help in increasing the marginal efficiency of capital investments by deciding on the priorities.

14. There exist data gaps for assessing the changes in farmers' income and investments over time. There is a need to measure the farmers' income, saving and investment on a regular basis to facilitate the formulation of evidence-based appropriate policy interventions. In addition to refining the data inputs in the future, this will also help to monitor and course correct the interventions needed for doubling farmers income.

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Annexures

Annex Table 2.1: State-wise annual net income per household from cultivation in 2012–13 (Rs.)

SN	Zone	State	Visit 1	Visit 2	(Visit 1 and Visit 2)
			July 2012–December 2012	January 2013–June 2013	July 2012–June 2013
			(Kharif)	(Rabi)	Total
1	Northern Zone	Haryana	48,395	46,016	94,411
2		Punjab	75,616	54,546	1,30,163
3		Uttar Pradesh	15,812	18,400	34,212
4	North-Eastern Zone	Arunachal Pradesh	10,352	13,856	24,209
5		Assam	28,980	21,542	50,521
6		Manipur	32,525	2534	35,059
7		Meghalaya	50,972	26,382	77,354
8		Mizoram	33,449	21,280	54,729
9		Nagaland	29,683	8862	38,545
10		Sikkim	13,414	6936	20,350
11		Tripura	16,877	16,393	33,270
12	Eastern Zone	Bihar	9113	11,520	20,633
13		Jharkhand	11,295	6090	17,383
14		Odisha	12,971	3921	16,892
15		West Bengal	5442	6295	11,737
16	Central Zone	Chhattisgarh	35,213	5016	40,229
17		Madhya Pradesh	23,656	24,383	48,039
18	Western Zone	Goa	6456	10,437	16,893
19		Gujarat	24,319	10,833	35,137
20		Maharashtra	35,851	10,534	46,385
21		Rajasthan	17,399	20,222	37,620
22	Southern Zone	Andhra Pradesh	10,352	13,856	24,209
23		Karnataka	40,492	18,555	59,047
24		Kerala	25,708	16,776	42,483
25		Tami Nadu	10,065	12,924	22,989
26		Telangana	33,976	16,836	50,813
27	Northern Hill Zone	Himachal Pradesh	30,436	4566	35,001
28		Jammu & Kashmir	29,984	6651	36,635
29		Uttarakhand	22,365	7986	30,351
30	Union Territories	Andaman& Nicobar Islands	18,090	16,832	34,927
31		Chandigarh	24,015	16,372	40,387
32		Dadra & Nagar Haveli	6587	685	7272
33		Daman & Diu	2090	389	2479
34		Delhi	9604	4475	14,079
35		Lakshadweep	4442	4292	8734
36		Puducherry	10,660	8472	19,132
		All India	**21,490**	**15,460**	**36,950**

Source: DFI Committee's estimates from NSSO Unit Level Data, 70th Round (Situation Assessment Survey of Agricultural Households).

Annex Table 2.2: State-wise annual net income per household from livestock in 2012-13 (Rs.)

SN	Zone	State	Visit 1	Visit 2	(Visit 1 and Visit 2)
			July 2012–December 2012	January 2013–June 2013	July 2012–June 2013 Total
1	Northern Zone	Haryana	16,531	16,152	32,683
2		Punjab	10,742	10,415	21,157
3		Uttar Pradesh	3239	3872	7111
4	North-Eastern Zone	Arunachal Pradesh	5395	3071	8466
5		Assam	5994	3557	9551
6		Manipur	17,040	1430	18,470
7		Meghalaya	3865	5943	9808
8		Mizoram	4277	6222	10,499
9		Nagaland	8300	2090	10,391
10		Sikkim	6666	6889	13,555
11		Tripura	1697	1987	3684
12	Eastern Zone	Bihar	1173	3647	4820
13		Jharkhand	3961	12,955	16,919
14		Odisha	8232	7245	15,477
15		West Bengal	1815	1149	2964
16	Central Zone	Chhattisgarh	297	637	934
17		Madhya Pradesh	4090	5084	9174
18	Western Zone	Goa	3414	11,683	15,097
19		Gujarat	11,835	12,343	24,179
20		Maharashtra	4484	4824	9308
21		Rajasthan	4322	7573	11,893
22	Southern Zone	Andhra Pradesh	7490	5463	12,953
23		Karnataka	4046	4860	8907
24		Kerala	3864	4438	8303
25		Tami Nadu	5954	7669	13,623
26		Telangana	3718	2463	6181
27	Northern Hill Zone	Himachal Pradesh	5657	7248	12,905
28		Jammu & Kashmir	6099	5029	11,129
29		Uttarakhand	5602	4792	10,394
30	Union Territories	Andaman & Nicobar Islands	4023	2670	6698
31		Chandigarh	30,294	27,310	57,604
32		Dadra & Nagar Haveli	434	495	929
33		Daman & Diu	1670	2955	4626
34		Delhi	16,163	22,390	38,553
35		Lakshadweep	1352	34	1386
36		Puducherry	470	110	580
		All India	**4683**	**5333**	**10,016**

Source: Estimated by the DFI Committee from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households).

Annex Table 2.3: State-wise annual net income per household from non-farm business in 2012–-13 (Rs.)

SN	Zone	State	Visit 1	Visit 2	(Visit 1 and Visit 2)
			July 2012-Dec 2012	January 2013-June 2013	July 2012-June 2013 Total
1	Northern Zone	Haryana	2502	2699	5201
2		Punjab	5269	3531	8800
3		Uttar Pradesh	2036	2581	4617
4	North Eastern Zone	Arunachal Pradesh	2781	8138	10,919
5		Assam	1470	1609	3078
6		Manipur	2364	4472	6835
7		Meghalaya	4846	5991	10,837
8		Mizoram	-111	425	314
9		Nagaland	288	451	740
10		Sikkim	6368	5618	11,986
11		Tripura	883	1093	1976
12	Eastern Zone	Bihar	1575	1254	2829
13		Jharkhand	1230	1705	2935
14		Odisha	3121	3329	6451
15		West Bengal	3373	4635	8008
16	Central Zone	Chhattisgarh	-12	26	14
17		Madhya Pradesh	744	825	1569
18	Western Zone	Goa	4171	8072	12,243
19		Gujarat	2048	2490	4538
20		Maharashtra	4920	5124	10,044
21		Rajasthan	4333	4165	8499
22	Southern Zone	Andhra Pradesh	3104	1431	4534
23		Karnataka	3783	3705	7489
24		Kerala	13,070	18,233	31,303
25		Tami Nadu	4074	9573	13,646
26		Telangana	1597	1476	3074
27	Northern Hill Zone	Himachal Pradesh	4910	4874	9784
28		Jammu & Kashmir	8200	9880	18,081
29		Uttarakhand	1703	1245	2947
30	Union Territories	Andaman & Nicobar Islands	13,430	13,044	26,476
31		Chandigarh	N.A.	N.A.	N.A.
32		Dadra & Nagar Haveli	8297	7848	16,145
33		Daman & Diu	4339	9522	13,860
34		Delhi	842	1098	1939
35		Lakshadweep	693	828	1521
36		Puducherry	1365	1739	3104
		All India	**2883**	**3326**	**6209**

Source: Estimated by the DFI Committee from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households)

Annex Table 2.4: State-wise annual net income per household from wages and salaries in 2012–13 (Rs.)

SN	Zone	State	Visit 1	Visit 2	(Visit 1 and Visit 2)
			July 2012-December 2012	January 2013-June 2013	July 2012 June 2013 Total
1	Northern Zone	Haryana	21,303	20,570	41,873
2		Punjab	27,546	29,784	57,330
3		Uttar Pradesh	6374	7402	13,775
4	North-Eastern Zone	Arunachal Pradesh	10,306	14,609	24,915
5		Assam	7338	9838	17,176
6		Manipur	24,209	21,572	45,781
7		Meghalaya	21,003	24,313	45,316
8		Mizoram	20,343	23,515	43,858
9		Nagaland	28,962	35,756	64,718
10		Sikkim	16,478	20,883	37,361
11		Tripura	15,326	10,890	26,217
12	Eastern Zone	Bihar	6745	9141	15,885
13		Jharkhand	8374	13,692	22,068
14		Odisha	9225	11,395	20,620
15		West Bengal	11,541	13,943	25,484
16	Central Zone	Chhattisgarh	7339	14,838	22,177
17		Madhya Pradesh	7342	8588	15,930
18	Western Zone	Goa	18,856	28,009	46,865
19		Gujarat	12,865	19,230	32,102
20		Maharashtra	11,048	14,716	25,765
21		Rajasthan	14,126	15,876	30,001
22	Southern Zone	Andhra Pradesh	13,984	15,776	29,760
23		Karnataka	14,101	18,015	32,116
24		Kerala	32,081	31,129	63,211
25		Tami Nadu	16,834	17,938	34,772
26		Telangana	7858	9534	17,392
27	Northern Hill Zone	Himachal Pradesh	24,878	23,400	48,278
28		Jammu & Kashmir	41,148	47,072	88,220
29		Uttarakhand	6330	6644	12,974
30	Union Territories	Andaman & Nicobar Islands	38,892	27,004	65,943
31		Chandigarh	36,563	1,25,388	1,61,951
32		Dadra & Nagar Haveli	32,326	31,223	63,549
33		Daman & Diu	28,011	38,970	66,981
34		Delhi	81,763	96,400	1,78,163
35		Lakshadweep	1,05,474	94,447	1,99,921
36		Puducherry	23,571	24,876	48,446
		All India	**11,236**	**13,565**	**24,801**

Source: Estimated by the DFI Committee from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households).

Annex Table 2.5: State-wise annual net income per household from all the four income components in 2012-13 (Rs.)

SN	Zone	State	Cultivation	Livestock	Non-farm business	Wages and Salaries	Total Income
1	Northern Zone	Haryana	94,411	32,683	5201	41,873	1,74,168
2		Punjab	1,30,163	21,157	8800	57,330	2,17,450
3		Uttar Pradesh	34,212	7111	4617	13,775	59,716
4	North-Eastern Zone	Arunachal Pradesh	77,814	8466	10,919	24,915	1,22,115
5		Assam	50,521	9551	3078	17,176	80,327
6		Manipur	35,059	18,470	6835	45,781	1,06,146
7		Meghalaya	77,354	9808	10,837	45,316	1,43315
8		Mizoram	54,729	10,499	314	43,858	1,09,401
9		Nagaland	38,545	10,391	740	64,718	1,14,394
10		Sikkim	20,350	13,555	11,986	37,361	83,251
11	Eastern Zone	Bihar	20,633	4820	2829	15,885	44,167
12		Jharkhand	17,383	16,919	2935	22,068	59,305
13		Odisha	16,892	15,477	6451	20,620	59,440
14		West Bengal	11,737	2964	8008	25,484	48,192
15	Central Zone	Chhattisgarh	40,229	934	14	22,177	63,354
16		Madhya Pradesh	48,039	9174	1569	15,930	74,712
17	Western Zone	Goa	16,893	15,097	12,243	46,865	91,098
18		Gujarat	35,137	24,179	4538	32,102	95,957
19		Maharashtra	46,385	9308	10,044	25,765	91,501
20		Rajasthan	37,620	11,893	8499	30,001	88,012
21	Southern Zone	Andhra Pradesh	24,209	12,953	4534	29,760	71,456
22		Karnataka	59,047	8907	7489	32,116	1,07,558
23		Kerala	42,483	8303	31,303	63,211	1,45,299
24		Tami Nadu	22,989	13,623	13,646	34,772	85,031
25		Telangana	50,813	6181	3074	17,392	77,459
26	Northern Hill Zone	Himachal Pradesh	35,001	12,905	9784	48,278	1,05,969
27		Jammu & Kashmir	36,635	11,129	18,081	88,220	1,54,064
28		Uttarakhand	30,351	10,394	2947	12,974	56,666
29	Union Territories	Andaman & Nicobar Islands	34,927	6698	26,476	65,943	1,34,044
		Chandigarh	40,387	57,604	0	1,61,951	2,59,942
		Dadra & Nagar Haveli	7272	929	16,145	63,549	87,894
		Daman & Diu	2479	4626	13,860	66,981	87,946
		Delhi	14,079	38,553	1939	1,78,163	2,32,734
		Lakshadweep	8734	1386	1521	1,99,921	2,11,562
		Puducherry	19,132	580	3104	48,446	71,262
		All India	**36,950**	**10,016**	**6209**	**24,801**	**77,977**

Source: Estimated by the DFI Committee from NSSO 70th Round unit level data (Situation Assessment Survey of Agricultural Households).

Annex Table 2.6: State-wise share of value of each component in total livestock output in visit 1 in 2012-13 (%)

Sl. No.	Zone	State	Milk	Eggs	Live Animals	Wool	Fish	Honey	Hide, Bones and Manure	Other Receipts
1	Northern Zone	Haryana	95.2	0.0	0.0	0.0	0.0	0.0	2.8	2.0
2		Punjab	91.2	0.1	0.0	0.0	0.0	0.0	3.7	5.0
3		Uttar Pradesh	76.8	0.9	1.4	0.0	0.0	0.0	8.3	12.7
4	North-Eastern Zone	Arunachal Pradesh	5.3	3.8	80.5	0.1	2.0	0.0	0.0	8.3
5		Assam	35.5	6.0	40.2	0.1	17.8	0.2	0.2	0.1
6		Manipur	0.6	2.8	52.0	0.0	21.4	6.0	0.0	17.2
7		Meghalaya	4.7	1.3	93.9	0.0	0.0	0.0	0.0	0.0
8		Mizoram	5.0	9.1	85.9	0.0	0.0	0.0	0.0	0.0
9		Nagaland	0.0	0.3	99.7	0.0	0.0	0.0	0.0	0.0
10		Sikkim	84.6	1.9	13.6	0.0	0.0	0.0	0.0	0.0
11		Tripura	63.9	2.4	16.5	0.2	10.2	0.1	0.3	6.4
12	Eastern Zone	Bihar	76.3	1.9	6.9	0.1	0.0	0.0	3.8	10.9
13		Jharkhand	3.5	0.3	95.5	0.1	0.1	0.0	0.4	0.0
14		Odisha	17.8	0.4	78.4	0.0	1.4	0.0	1.0	1.0
15		West Bengal	44.6	1.5	18.9	0.4	13.2	0.0	14.5	6.8
16	Central Zone	Chhattisgarh	19.0	12.0	32.7	0.0	0.0	1.9	17.3	17.0
17		Madhya Pradesh	78.9	0.4	4.2	0.0	0.0	0.0	8.4	8.1
18	Western Zone	Goa	96.5	2.0	1.5	0.0	0.0	0.0	0.0	0.0
19		Gujarat	93.6	0.0	0.4	0.0	0.0	0.0	3.6	2.3
20		Maharashtra	62.7	0.4	28.5	0.0	0.0	0.0	4.8	3.6
21		Rajasthan	74.4	0.1	10.2	0.4	0.0	0.0	11.4	3.5
22	Southern Zone	Andhra Pradesh	53.2	5.3	33.6	0.0	0.0	0.0	7.5	0.3
23		Karnataka	74.8	0.5	4.4	0.0	0.0	0.0	19.1	1.2
24		Kerala	79.0	3.4	5.5	0.0	0.2	0.3	10.5	1.1
25		Tamil Nadu	63.7	0.3	8.3	0.0	24.0	0.0	3.5	0.1
26		Telangana	78.7	0.1	19.2	0.0	0.0	0.0	2.0	0.0
27	Northern Hill Zone	Himachal Pradesh	75.8	2.3	3.9	0.0	0.0	0.0	17.1	0.9
28		Jammu & Kashmir	85.3	0.1	11.4	0.0	0.0	0.0	3.3	0.0
29		Uttarakhand	83.3	0.6	2.3	0.0	0.2	0.0	12.9	0.7
30	Union Territories	Andaman & Nicobar Islands	23.6	11.7	64.7	0.0	0.0	0.0	0.0	0.0
31		Chandigarh	97.8	0.0	0.0	0.0	0.0	0.0	2.2	0.0
32		Dadra & Nagar Haveli	9.8	3.4	0.7	0.0	0.0	0.0	86.1	0.0
33		Daman & Diu	70.6	1.6	7.4	0.0	0.0	0.0	20.4	0.0
34		Delhi	92.7	0.0	0.0	0.0	0.0	0.0	0.0	7.3
35		Lakshadweep	15.6	1.0	17.1	0.0	43.8	0.0	14.0	8.5
36		Puducherry	96.5	0.8	0.0	0.0	0.0	0.0	2.7	0.0
		All India	70.0	0.9	15.5	0.1	2.0	0.0	6.8	4.8

Source: Estimated from NSSO unit level data, 70th Round (Situational Assessment Survey of Agricultural Households).

Annex Table 2.7: State-wise share of value of each component in total livestock output in visit 2 in 2012-13 (Per cent)

Sl. No.	Zone	State	Milk	Eggs	Live Animals	Wool	Fish	Honey	Hide, Bones and Manure	Other Receipts
1	Northern Zone	Haryana	95.0	0.1	0.0	0.0	0.0	0.0	3.4	1.4
2		Punjab	91.9	0.1	0.0	0.0	0.0	0.0	3.5	4.5
3		Uttar Pradesh	76.5	0.1	0.9	0.0	0.0	0.0	8.1	14.3
4	North-Eastern Zone	Arunachal Pradesh	25.2	1.5	63.9	3.9	1.4	0.0	0.0	4.0
5		Assam	22.5	5.2	62.3	0.1	9.6	0.0	0.1	0.2
6		Manipur	2.6	0.7	92.7	0.2	3.7	0.0	0.0	0.1
7		Meghalaya	6.3	0.5	92.4	0.4	0.0	0.0	0.3	0.0
8		Mizoram	6.0	6.6	87.1	0.0	0.3	0.0	0.0	0.0
9		Nagaland	1.9	5.3	92.8	0.0	0.0	0.0	0.0	0.0
10		Sikkim	77.7	2.4	19.9	0.0	0.0	0.0	0.0	0.0
11		Tripura	65.1	0.4	19.6	0.0	8.0	0.0	0.4	6.3
12	Eastern Zone	Bihar	76.0	0.4	13.5	0.1	0.2	0.0	4.0	5.8
13		Jharkhand	8.1	0.0	90.6	0.0	0.0	0.0	0.7	0.7
14		Odisha	14.0	0.3	82.3	1.3	0.2	0.0	1.2	0.7
15		West Bengal	37.4	1.3	39.7	0.6	8.2	0.0	7.3	5.4
16	Central Zone	Chhattisgarh	26.5	3.7	52.3	0.0	0.0	0.0	9.1	8.4
17		Madhya Pradesh	70.5	0.3	9.3	0.0	1.8	0.0	8.7	9.5
18	Western Zone	Goa	94.5	0.5	5.0	0.0	0.0	0.0	0.0	0.0
19		Gujarat	95.2	0.0	0.7	0.0	0.0	0.0	3.2	0.9
20		Maharashtra	60.8	0.3	34.2	0.0	0.1	0.0	2.1	2.4
21		Rajasthan	82.5	0.1	1.9	0.3	0.0	0.0	11.4	3.9
22	Southern Zone	Andhra Pradesh	40.4	5.6	42.1	6.0	0.0	0.0	5.5	0.4
23		Karnataka	60.7	0.5	16.7	0.0	0.0	0.0	20.7	1.4
24		Kerala	76.8	2.4	11.9	0.5	1.3	0.0	5.5	1.5
25		Tamil Nadu	63.3	0.4	9.4	0.0	22.7	0.0	3.9	0.3
26		Telangana	44.8	0.0	49.9	0.0	0.0	0.0	5.2	0.0
27	Northern Hill Zone	Himachal Pradesh	77.6	0.1	3.0	0.0	0.0	0.0	18.8	0.4
28		Jammu & Kashmir	85.4	0.3	11.2	0.1	0.0	0.0	3.0	0.0
29		Uttarakhand	75.3	0.0	12.3	0.0	1.3	0.0	7.7	3.4
30	Union Territories	Andaman & Nicobar Islands	2.5	0.7	96.8	0.0	0.0	0.0	0.0	0.0
31		Chandigarh	95.3	0.0	0.0	0.0	0.0	0.0	4.4	0.3
32		Dadra & Nagar Haveli	14.8	2.3	12.4	0.0	0.0	0.0	70.3	0.3
33		Daman & Diu	82.7	0.9	4.6	0.0	0.0	0.0	11.5	0.2
34		Delhi	91.5	0.0	0.0	0.0	0.0	0.0	0.0	8.5
35		Lakshadweep	17.0	1.1	29.6	0.0	10.9	0.0	7.8	33.6
36		Puducherry	94.4	0.0	4.9	0.0	0.0	0.0	0.7	0.0
		All India	68.1	0.7	18.5	0.4	1.6	0.0	6.1	4.4

Source: Estimated from NSSO unit level data, 70th Round (Situational Assessment Survey of Agricultural Households).

Annex Table 3.1: Per Hectare Agriculture Investments on Public Accounts (Capital Expenditure) and Private Accounts (Rs.) at 2004-05 Prices

State	Year	Public Investment		Private Investment 'in' Agriculture	State	Public Investment		Private Investment 'in' Agriculture
		in Agriculture &Allied Activities	'for' Agriculture			'in' Agriculture	'for' Agriculture	
Andhra Pradesh	TE 1981-83	788	917	604	Odisha	1127	1243	120
	TE 1991-93	903	1043	562		804	1144	133
	TE 2001-03	1406	2433	681		968	1300	374
	TE 2011-13	5793	6535	1250		2519	4305	558
Assam	TE 1981-83	661	1068	257	Punjab	631	825	1602
	TE 1991-93	703	1320	115		549	663	999
	TE 2001-03	377	1030	172		308	784	1376
	TE 2011-13	1248	3232	512		474	1100	2799
Gujarat	TE 1981-83	806	921	468	Rajasthan	326	464	282
	TE 1991-93	1007	1125	385		360	530	576
	TE 2001-03	1107	1351	751		412	786	970
	TE 2011-13	4412	6072	1762		351	1253	1256
Haryana	TE 1981-83	813	1065	961	Tamil Nadu	454	623	745
	TE 1991-93	630	830	1066		379	607	1274
	TE 2001-03	278	1004	2312		844	1829	1427
	TE 2011-13	2368	4013	1611		2157	6780	1076
Himachal Pradesh	TE 1981-83	863	2846	663	West Bengal	257	414	253
	TE 1991-93	837	3013	1407		341	530	328
	TE 2001-03	1242	4645	2508		247	799	262
	TE 2011-13	3208	10735	7772		628	1647	593
J&K	TE 1981-83	1453	2519	550	Bihar-Jharkhand	1001	1145	237
	TE 1991-93	1502	3544	431		437	512	209
	TE 2001-03	2263	6464	966		663	1262	64
	TE 2011-13	5811	12264	2273		2052	8215	540
Karnataka	TE 1981-83	536	635	406	MP-Chhattisgarh	529	625	224
	TE 1991-93	905	1162	901		417	559	719
	TE 2001-03	1913	2189	386		567	890	161
	TE 2011-13	3339	5200	1659		1681	2899	1173
Kerala	TE 1981-83	1351	1720	1147	UP-Uttarakhand	636	821	684
	TE 1991-93	1149	1655	1179		311	534	770
	TE 2001-03	808	1719	1532		798	1634	1184
	TE 2011-13	1794	6757	5447		1206	3812	2791
Maharashtra	TE 1981-83	718	832	399	Total 20 States	653	809	471
	TE 1991-93	994	1143	733		644	849	672
	TE 2001-03	927	2404	664		986	1528	687
	TE 2011-13	3358	4562	1843		2328	4224	1645

Source: AIDIS, NSS and Finance Accounts

Annexure Table 3.2: Marginal Efficiency of Investments at 2004-05 prices							
			Public Investment in:				
		Private Investment Agriculture & Allied	**Agriculture & Allied**	**Irrigation (excluding flood control)**	**Rural Energy**	**Rural Road-Transport**	**Public Investment "for" Agriculture**
Five Year Plan Period	**Study Years**		1	2	3	4	(1-4)
Major States							
Plan VI	1981-85	1.26	12.49	1.03	120.95	4.65	1.70
Plan VII	1985-90	1.30	10.14	1.23	54.51	5.48	2.02
Plan VIII	1992-97	1.85	14.70	1.99	18.61	7.66	3.17
Plan IX	1997-02	0.75	3.35	0.64	9.39	1.87	0.98
Plan X	2002-07	1.36	9.27	0.89	11.01	2.37	1.35
Plan XI	2007-12	1.42	5.69	0.85	10.47	1.71	1.21
Plan XII	2012-14		7.68	1.11	12.29	1.81	1.49
High Income States							
Plan VI	1981-85	0.60	3.75	0.62	52.48	2.70	1.27
Plan VII	1985-90	1.25	7.69	1.51	58.47	6.29	3.05
Plan VIII	1992-97	1.61	7.62	1.62	19.21	7.13	3.27
Plan IX	1997-02	0.31	0.91	0.25	4.07	0.75	0.47
Plan X	2002-07	10.38	64.37	2.13	53.36	3.89	3.91
Plan XI	2007-12	1.00	2.75	0.61	9.07	1.68	1.16
Plan XII	2012-14		2.05	0.51	6.14	1.02	0.91
Middle Income States							
Plan VI	1981-85	1.73	26.01	1.23	89.76	6.73	1.40
Plan VII	1985-90	1.62	21.13	1.38	82.67	9.30	1.58
Plan VIII	1992-97	1.74	23.12	1.46	9.24	6.77	1.61
Plan IX	1997-02	1.57	12.29	0.97	20.80	3.59	1.06
Plan X	2002-07	1.45	18.70	0.65	16.90	2.56	0.71
Plan XI	2007-12	2.18	33.03	0.80	15.66	3.83	0.90
Plan XII	2012-14		13.16	0.62	7.67	1.75	0.66
Low Income States							
Plan VI	1981-85	1.93	38.86	1.25	100.00	5.08	0.52
Plan VII	1985-90	1.20	8.72	0.86	34.56	3.05	0.35
Plan VIII	1992-97	2.27	27.32	3.25	50.00	7.52	1.23
Plan IX	1997-02	0.84	4.31	0.99	7.21	1.78	0.35
Plan X	2002-07	1.37	4.67	1.14	5.34	1.46	0.36
Plan XI	2007-12	2.65	5.17	1.47	8.51	1.04	0.37
Plan XII	2012-14		20.25	3.02	27.75	2.40	0.82

Source: AIDIS, NSS and Finance

Accounts

Annex Table 4.1: Staple Crops Replaced by the Horticultural Crops to Generate Additional Income

State/Region	Kharif				Rabi			
Hill Zone								
Himachal Pradesh	Maize	Paddy	-	-	Wheat	Barley	-	-
Jammu & Kashmir	Maize	Wheat	-	-	Rapeseed Mustard	Wheat	Barley	-
Uttarakhand	*Ragi*	Maize	-	-	maize	-	-	-
North Zone	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Haryana	*Bajra*	*Jowar*	-	-	-	-	-	-
Punjab	Cotton*	-	-	-	Wheat	Maize	-	-
Uttar Pradesh	Paddy	*Bajra*	-	-	Wheat	Rapeseed Mustard	-	-
South Zone	-	-	-	-	-	-	-	-
Andhra Pradesh	Paddy	-	-	-	Paddy	-	-	-
Karnataka	*Jowar*	Maize	*Ragi*	Paddy	*Jowar*	-	-	-
Kerala	Paddy	-	-	-	Paddy	-	-	-
Tamil Nadu	Paddy	Maize	-	-	Paddy	Maize	-	-
Telangana	Paddy	Maize	-	-	Paddy	Maize	*Jowar*	Gram**
East Zone	-	-	-	-	-	-	-	-
Bihar	Paddy	Maize	*Jowar*	-	*Masur**	Rapeseed Mustard	Gram**	Wheat
Jharkhand	Paddy	Maize	*Ragi*	-	Paddy	Moong**	Ground Nut	Urad
Odisha	Maize	*Bajra*	-	-	Wheat	Gram	-	-
West Bengal	Paddy	-	-	-	Paddy	Rapeseed Mustard	*Til*	-
West Zone	-	-	-	-	-	-	-	-
Goa	Paddy	-	-	-	Paddy	-	-	-
Gujarat	Paddy	*Jowar*	*Bajra*	-	Wheat	Rapeseed Mustard	*Bajra*	-
Maharashtra	Soyabean	Paddy	*Jowar*	-	Gram	Wheat	*Jowar*	-
Rajasthan	*Bajra*	Maize	-	-	Rapeseed Mustard	Gram**	Barley	Wheat
Central Zone	-	-	-	-	-	-	-	-
Chhattisgarh	Small Millets	-	-	-	Paddy	Wheat	Maize	Gram**
Madhya Pradesh	Paddy	Maize	-	-	Wheat	Gram**	*Masur**	-
North-East								
Arunachal Pradesh	Maize	Other Millets	Small Millets		Maize	Rapeseed Mustard		
Assam	Paddy	-	-	-	Paddy	-	-	-
Manipur	Paddy	-	-	-	Paddy	-	-	-
Meghalaya	Paddy	-	-	-	Paddy	-	-	-
Mizoram	Paddy	Maize	-	-	Paddy	Maize	-	-
Nagaland	Paddy	Maize	-	-	Paddy	Maize	-	-
Sikkim	maize	-	-	-	Maize	-	-	-
Tripura	Paddy	-	-	-	Paddy	-	-	-
All India (Major Crops Considered)	Paddy	Maize	Soyabean	*Bajra*	Paddy	Rapeseed Mustard	Gram**	Wheat

Source: Computation by the DFI Committee.

* Cotton is a high values crop. It can be omitted from the list of crops to be replaced. However it is mentioned just to show that horticulture can yield higher income than cotton.

** These crops are part of pulses which are a major source of protein in the Indian vegetarian diet. One may like to omit these from the list of crops to be replaced by horticultural crops. However, the purpose to list there is to show that horticultural crops are more profitable than pulses.

Note: 1 Income of crops that last more than one season is adjusted for state-specific cropping intensity to make it comparable with income from one season crops. For example, income from fruits is divided by the state specific cropping intensity to make 'Adjusted income' of fruits per hectare comparable with the income per hectare of maize or paddy.

2 The crops for a given state and season (Kharif, Rabi) arranged in their magnitude of profitability per ha, in other words, the crops are arranged in descending order of the additional income (per ha) if replaced by horticulture crop.

Annex Table 4.2: Coefficient of Variation of Production, Value of Output and Implicit Price of Fruits and Vegetables Coefficient of Variation

State/UT	Production		VOP	Implicit Price
	Up to 2013-14	Up to 2016-17	Up to 2013-14	Up to 2013-14
Andhra Pradesh	24.8	23.34	38.15	26.66
Assam	20.69	21.55	24.79	21.52
Bihar	8.02	7.39	36.75	28.67
Chhattisgarh	39.65	40.88	56.82	19.02
Gujarat	26.45	27.62	51.52	26.22
Haryana	23.23	27.92	49.27	25.57
Himachal Pradesh	16.94	18.39	33.44	20.72
J & K	21.6	19.59	42.64	28.27
Jharkhand	13.41	13.41	35.77	23.03
Karnataka	21.37	21.03	23.43	12.54
Kerala	17.05	20.5	38.78	33.77
Madhya Pradesh	69.49	64.31	99.64	25.55
Maharashtra	13.61	12.37	36.7	23.45
North eastern	30.95	32.75	61.91	27.5
Odisha	9.06	8.78	27.89	23.15
Punjab	18.73	20.49	43.35	26.12
Rajasthan	21.67	29.17	50.9	38.23
Tamil Nadu	15.88	15.6	37.78	28.69
Uttar Pradesh	11.23	15.35	42.35	35.91
Uttarakhand	4.03	4.14	29.85	29.21
West Bengal	12.69	12.69	40.35	33.26
India	16.1	16.22	38.89	22.97

Source: Computation by DFI Committee.

Notes: The values of the relevant variables are taken beginning with year 2004-05.

1. VOP: Gross Value of Output (Source: CSO).

Up to 2013-14 and up to 2016-17 refers to the period 2004-05 to 2013-14 and 2004-05 to 2016-17, respectively.

2. The coefficient of variation in VOP and implicit price is given for the period 2004-05 to 2012-13 as the data on VOP from CSO are available up to 2012-13 only

3. The implicit price is arrived at by dividing the VOP figure (in constant prices) by production quantity.

Annex Table 4.3 Growth Rate (Y-O-Y) of Production of Fruits and Vegetables of Top 13 States*

S. No.	State	Mean Growth Rate (Year-on-Year %)		
		Production		
		2004-05 to 2010-11	*2011-12 to 2016-17*	*2004-05 to 2016-17*
1	Andhra Pradesh**	10.7	2.01	6.36
2	Assam	11.57	5.88	8.73
3	Bihar	2.39	0.23	1.31
4	Chhattisgarh	25.62	6.82	16.22
5	Gujarat	11.3	4.71	8.01
6	Karnataka	11.35	0.34	5.85
7	Madhya Pradesh	12.82	21.95	17.38
8	Maharashtra	2.69	3.75	3.22
9	Odisha	0.84	2.34	1.59
10	Tamil Nadu	10.36	-3.69	3.34
11	Uttar Pradesh	4.17	3.8	3.99
12	Uttarakhand	0.15	0.08	0.12
13	West Bengal	7.68	-1.34	3.17
	.	.	.	.
	.	.	.	.
	India	6.72	2.14	4.43

Source: Computation by DFI Committee based on Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare.

Notes: * In terms of share in production in all India.
** Includes Telangana.

Annex Table 4.4: Mean Growth Rate (Year-on-Year) of Area under Total Horticulture by States (%)

State	Full Series 2005-06 to 2016-17	Series A 2005-06 to 2009-10	Series A 2010-11 to 2016-17	Series B 2005-06 to 2010-11	Series B 2011-12 to 2016-17	Feature of Growth (Grouping B)
	1	2	3	4	5	6
Hill Zone						
Himachal Pradesh	1.42	2.26	0.82	1.78	1.06	Dec; low growth
Jammu and Kashmir	2.95	4.83	1.60	4.41	1.48	Dec; low growth
Uttarakhand	0.21	1.07	-0.41	-0.55	0.96	Positive; V. low growth
North Zone						
Haryana	7.01	8.69	5.81	10.07	3.94	Dec; initial high growth
Punjab	3.96	4.66	3.46	3.80	4.12	Acc; high growth
Uttar Pradesh	5.21	6.22	4.49	2.85	7.57	Acc; later high growth
South Zone						
Andhra Pradesh	2.50	4.91	0.78	4.29	0.72	Dec
Karnataka	2.74	3.34	2.32	3.68	1.81	Dec
Kerala	-0.28	0.40	-0.77	0.13	-0.70	Dec; low growth
Tamil Nadu	2.33	3.56	1.45	3.80	0.86	Dec
East Zone						
Bihar	-0.07	-0.83	0.46	-0.49	0.34	Positive; V. low growth
Odisha	0.51	0.71	0.37	-1.12	2.14	Acc; low growth
Jharkhand	4.81	0.30	8.03	5.67	3.96	Dec; high growth
West Bengal	1.73	2.29	1.33	2.43	1.03	Dec; low growth
West Zone						
Gujarat	4.47	0.83	7.07	5.85	3.09	Dec; high growth
Maharashtra	-0.34	3.20	-2.86	3.85	-4.52	High dec; negative growth
Rajasthan	2.16	-6.60	8.42	-3.21	7.53	Acc; V. high growth
Central Zone						
Chhattisgarh	10.27	17.05	5.42	17.06	3.47	Dec; high growth
Madhya Pradesh	6.66	-2.45	13.17	2.11	11.21	Acc; V. high growth
North-East Zone						
Arunachal Pradesh	1.17	2.25	0.39	1.45	0.89	Dec; V. low growth
Assam	4.99	4.57	5.29	6.77	3.21	Dec; high growth
Manipur	4.12	-1.50	8.14	7.17	1.08	High Dec; low growth
Meghalaya	3.96	5.14	3.11	3.36	4.55	Acc; high growth
Mizoram	13.64	19.09	9.74	17.27	10.01	Dec; V. high growth
Nagaland	14.36	12.33	15.82	6.20	22.53	Acc; V. high growth
Sikkim	1.17	3.76	-0.68	2.71	-0.37	Dec; negative growth
Tripura	5.69	2.04	8.29	3.54	7.84	Acc; high growth
India	**1.62**	**0.70**	**2.27**	**1.34**	**1.89**	**Acc; low growth**

Source: Computation by DFI Committee; Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare.

Notes:
- Deceleration: Dec; Acceleration: Acc; v.high: very high
- Focus on Grouping B as it shows less biased growth rate
- Acceleration: if period II shows higher growth rate than period I
- Deceleration: if period II shows lower growth rate than period I
- High growth: growth @ 3 per cent or more; otherwise designated as low growth rate
- Very high growth: growth more than @ 5 per cent
- Low growth: growth less than @ 2 per cent
- Very low growth: growth @ 1 per cent or less

Annex Table 4.5: Estimate of Post-Harvest Losses in Horticulture in Different Studies

S. No.	Organisation	Commodities Covered	Area/ Region	Measurement of PHL	Remarks
1	Kannan, Elumalai (2014)	Paddy, wheat, *tur*, soybean This study does not cover perishable items like horticultural produce.	Assam, MP, WB, TN, UP, Raj. , Karnataka, Punjab, Maharashtra,	PHL are estimated from the point of harvesting to marketing. PHL are due to excess moisture, improper harvesting time, unsuitable harvesting methods, poor mode of transport & unscientific storage practices by the farmers. It encompasses losses during intermediate processes like threshing, cleaning, packing, transportation and storage. Major PHL due to transportation and storage by the farmers.	This study covers pre-harvest losses too (crop loss due to pests & diseases). The study does not cover PHL incurred by the traders after the farmer has sold his product in the agency.

S. No.	Organisation	Commodities Covered	Area/ Region	Measurement of PHL	Remarks
2	SFAC (2015)	Pineapples, kiwi, passion fruit, citrus, ginger, turmeric, chilli	NER	PHL is from production zone to markets, due to: 1. Poor infrastructure of roads and railways causes loss of 15-20 per cent in reaching distant markets. 2. Lack of proper/alternative markets enables middlemen to earn profits at the expense of farmers. 3. Lack of primary processing and poor post-harvest infrastructure quality leads to deterioration and loss of value, especially for perishable products, for example, losses in pineapples are 20-30 per cent. 4. Use of gunny bags/bamboo baskets instead of plastic crates causes physical injury to vegetables. 5. Almost 20-30 per cent of the produce gets wasted in the farm itself.	1. In terms of the manner in which it is measured, the PHL basically reflects the loss to the farmers. 2. The study focuses on perishable horticultural produce.

S. No.	Organisation	Commodities Covered	Area/Region	Measurement of PHL	Remarks
3	Post-harvest Education Foundation (FAO) (2015)	Fruits and vegetables like mangoes, yam, tomatoes, banana, onion, potato	Different regions of the developing world	Loss is counted till the unit is considered unfit for human consumption. PHL is due to rough handling, poor packaging, high temperature, delay in marketing. PHL includes cullage.	1. It covers PHL incurred by the traders too, including that in the cold chain process but exclude the losses in the processing units. 2. The main focus is on perishable horticultural produce. 3. The study is a kind of meta-analysis; it re-analyses the data from various regions for the period, 1995-2015. The study makes an interesting remark that it is not easy to compare the results of post-harvest losses from different regions with varying crops and seasons, particularly when "without much explanation of what is being measured, when, or how."
4	NCCD (2015)	Total of 15 vegetables and 8 fruits	Area-specific field level sampling study, covering the activities from farm to whole-sale markets located mostly in North India. (Uttar Pradesh, Uttarakhand and Haryana).	The measurement of loss was conducted on the actual physical loss of edible mass at each level of activity in the supply chain, upto first wholesale market. Included rejects or culled produce, handling damage, transit damage and other discards due to any cause that made the produce unfit for market and resulted in loss of saleable quantity/mass	Its special focus is on horticultural produce, fruits and vegetables only and did not include measures of loss that may occur between the wholesale markets to retail.

S. No.	Organisation	Commodities Covered	Area/Region	Measurement of PHL	Remarks
5	ICAR-CIPHET (2015)	Cereals, pulses, oilseeds, livestock, fruits and vegetables	Conducted surveys in 14 agro-climatic zones by enquiry and observation (10 per cent of first stage unit, i.e. district must be selected. 120 districts were selected).	"Post-harvest food loss is defined as measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest till its consumption or other end uses (De Lucia and Assennato, 1994; Hodges et al., 2011) Food losses can be quantitative as measured by decreased weight or volume, or can be qualitative, such as reduced nutrient value and unwanted changes in taste, colour, texture, or cosmetic features of food (Buzby and Hymen, 2012)"	Nanda, et al. (2012): 46 major crops and commodities including livestock produce. Collected data by enquiry and observation For marine fish, refer Poulter, et al., 1987. He defined the term post-harvest as the period of separation of fish from its growth medium.
6	FAO (2011)	Wide range of commodities: cereals, pulses, oilseeds, fruits & vegetables, fish, meat, dairy, etc.	Europe, North America, Oceania, Industrialised Asia, Sub-Saharan Africa, North Africa, West and Central Asia, South and Southeast Asia, and Latin America -	"Food losses refer to the decrease in edible food mass throughout the part of supply chain that specifically leads to edible food for human consumption. Food losses takes place at production post-harvest and processing stages in the food supply chain (Parfitt, et al. 2010). Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumer' behaviour (Parfitt, et al. 2010)" FAO (2011)	This study (DFI Committee) does not deal with food waste at the point of retail and final consumption.

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Annex Table 4.6: SFAC Value Chain Analysis in North-Eastern States, Food Loss (in %)

Vegetables	Farmers Level	Wholesale Level	Retail Level	Total
Potato	5	2	2	9
Carrot	6	2	2	10
Knol-Khol	5	5	5	15
Radish	5	5	5	15
Ridge gourd	5	5	5	15
Cow Pea	5	5	5	15
Landyfinger	5	5	5	15
Ash gourd	5	5	5	15
Tomato	7	5	4	16
Brinjal	5	6	6	17
Spine gourd	5	6	6	17
French bean	5	7	7	19
Cucumber	10	5	5	20
Onion		15	5	20
Bottle gourd	4	15	5	24
Chilli	5	15	5	25
Pumpkin	5	15	5	25
Bitter gourd	5	15	5	25
Ginger	5	15	5	25
Cabbage	10	8	8	26
Pointed gourd	5	15	7	27
Sweet gourd	5	15	7	27
Garlic	7	15	5	27
Capsicum	5	15	8	28
Cauliflower	10	10	10	30
Pea	10	15	7	32

Source: SFAC (2015).

Annex Table 4.7: Investment Requirement for Specialized Infrastructure for Integration of Cold-chains

Infrastructure Component	Shortfall, All-India	Unit Cost (Rs. Lakhs)	Investment (Rs. Crores)
Integrated pack-houses (units)	70,000	95	66,339
Reefer transport (units)	62,000	30	15,848
Cold storage (bulk) (units)	650	400	2,600
Cold storage (hub) (units)	360	350	1,260
Ripening chambers (units)	8,000	40	3,328
Total Investment (Rs. Crores)			89,375

Source: NCCD (2016).

Annex Table 4.8: Characterisation of States by the Linkage between Agriculture and Food Processing

Group	State	Nature of Linkage between Agriculture and Food Processing
1. Agriculturally backward States		
Group A	Madhya Pradesh	Established linkage between agriculture and food processing. Show potential for growth although its share in employment in food processing is relatively low at present.
	Odisha	Established linkage between agriculture and food processing. Already contributing to 4.5 per cent of all-India employment.
	Rajasthan West Bengal	
		All the above four states have shown high growth of employment in food processing.
Group B	Assam Bihar Uttar Pradesh	All of these states have negative growth of TFP, Indicating that food processing activity is not sustainable. Uttar Pradesh has a high share in employment but that is merely due to the size of the state and not because of productivity. These states show a clear case of missed opportunity of establishing a sound linkage between agriculture and food processing.
2. Relatively Agriculturally developed States		
Group C	Gujarat Himachal Pradesh Jammu & Kashmir	All these three states established strong linkage between agriculture and food processing. All of these show high employment growth. Himachal Pradesh and J&K show high potential of growth of food processing, although their share in all-India employment is small because of being relatively small states in term of farm population and net sown area (NSA).
Group D	Haryana	Linkage established Positive TFP growth but low employment growth negligible TFP growth but
	Karnataka	Employment growth as good as observed at the all India level.
		These states do not produce evidence of a high potential for growth
Group E	Punjab	Linkage established but TFP growth is almost nil or even negative in the case of Punjab.
	Kerala	Needs rejuvenation of the food processing industry.
	Andhra Pradesh & Tamil Nadu	Andhra Pradesh and Tamil Nadu need special mention as they have high share in employment but low/ negative growth of TFP. The issue of technological up gradation needs examination.
	Maharashtra	Maharashtra case also deserves special mention. Its share in employment is high (12.75%). In the post-2000 period, the growth of employment and labour productivity has been relatively low. TFP being negative in term of GVA of early period is not sustainable. This needs a detailed examination.

Source: Compilation by DFI Committee based on information in Bathla and Gautam, 2016.