Policy Paper 31

Strategy for Doubling Income of Farmers in India

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Foreword

Agriculture continues to be a source of livelihood for majority of Indian population and contributed about 14 per cent to the gross domestic product (GDP) of the country in 2014-15. The agricultural sector grew at a growth of around 3.7 per cent per year during 2004-05 to 2014-15 and the growth was quite impressive as compared to 2.3 per cent per annum during the previous decade (1995-96 to 2004-05). Despite this notable achievement, interest of farming community in agriculture is reported to be declining and consequently, agricultural workers, including cultivators and agricultural labourers, are moving away from agriculture. The shift is welcome provided these workers are productively and gainfully employed in other sectors. Studies have also reported that agrarian distress is increasing owing to low farm income and inequality in income between agriculture and non-agriculture sectors, which is a matter of concern.

A number of initiatives have been taken up by the present Government to improve the performance of Indian agriculture. For the first time, Hon'ble Prime Minister of India has set a target of "Doubling Farmers' Income" by 2022. This goal has enthused and fueled motivation among the stakeholders and channelized the efforts in a holistic manner. All the major programs for agricultural development are revisited to attain this objective following a Seven-point Strategy.

Several initiatives are being taken up by different institutions to address this challenge and as a policy think tank of ICAR, NIAP has come out with a comprehensive strategy for doubling farmers' income. This policy paper highlights various aspects including issues in estimation of farmers' income and opportunities of growth for income augmentation in the next couple of years. It also outlines the role of different approaches, viz. use of technology, post-harvest management and value addition, marketing and prices, and non-farm income. I am sure that this paper will serve as a reference material for understanding the policies and programs and channelizing the efforts to realize the vision of doubling farmers' income within stipulated time frame.

Trilochan Mohapatra
Secretary, DARE & DG, ICAR

Dated the 29th November, 2017
New Delhi

Preface

A pre-requisite of inclusive economic growth is faster agricultural development and higher income of people dependent on this sector. However, inequality between agriculture and non-agriculture sectors is a major concern. The Government has therefore shifted policy focus to farmers income and a target of doubling farmers income by 2022 is envisaged. This is a major challenge but if a strategy to harness growth potential of different sub-sectors of agriculture along with a matching price and trade policy, are worked out, this challenge could be a reality.

ICAR-NIAP has accorded high priority to this policy goal and studies are undertaken to evolve the strategy and implementation plan. To begin with, analysis of present level and sources of farm income are analysed for different agro-ecoregions. The present policy paper takes this work further and examines potential of different sectors, e.g. livestock, horticulture, food processing etc. Agricultural diversification and non-farm sector are also analysed in the context of their income potential in different regions. Technology is another important source of productivity growth and reducing cost of production and therefore has been discussed in detail. Since market and price risks are increasingly becoming critical for higher income and welfare of farmers, these issues have also been given due attention.

The low productivity regions comprising SAT and eastern India are more vulnerable to climatic variability and therefore income trends and vulnerability of these have been special focus of this paper. I am sure that the measures suggested in the concluding section of this paper shall be examined by the Department of Agriculture, Cooperation and Farmers Welfare and Indian Council of Agricultural Research, who have been active partners in this task. Policy makers, researchers and students will also find this work equally useful. Comments and suggestions from the readers will be useful to improve our work on this topic.

Suresh Pal
Director

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Our special thanks are due to Prof Ramesh Chand, Member, NITI Aayog. This work started at ICAR-NIAP in 2015 itself under the guidance of Prof Ramesh Chand, which focused on the estimation and analysis of farm income in the country with more holistic approach. Afterwards also, the team has been enriched by his expertise and guidance to carry out this work.

We are grateful to Dr Suresh Pal, Director, NIAP and Dr P S Birthal, National Professor, ICAR for their valuable feedback and suggestions, which helped in improvements of the manuscript and sharpening the interpretations. We also acknowledge the valuable comments from referees on the manuscript. The research staff working under the project deserve special appreciation for their hard work and sincere efforts. Last but not the least, we are equally thankful to all those who helped us in bringing out this important policy paper.

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Executive Summary

The Prime Minister's call to double farmers' income by 2022 has brought renewed interest among stakeholders in the country, ranging from the agricultural research community, policy makers, state authorities, extension agencies, private players, and more importantly among farmers. Major approaches include re-orienting focus from intensification to diversification, from sustenance to commercialization, and turning the agricultural units to enterprises. Different central and state level programs have been floated to execute and monitor the outreach of technologies, soil health, farm credit and market to the farmers. Price supports are triggered for many of the crops and entrepreneurship is inculcated to the farming community.

The sources for doubling of farmers' income (DFI) would ultimately vary at disaggregated geographies, demanding numerous approaches in different environments. The present study attempts to devise strategies to double farmers' income, balancing both macro and meso environments. The study covers possible contributions of different sources at both national level, and at state level. The study also bypasses the other major hurdle: obtaining income estimates of the farmers, and generating methodology of estimation.

It highlights the role of total factor productivity (TFP) growth that emerges from agricultural R&D, extension services, new knowledge and practices in achieving the goal. It brings to our focus that technology dissemination than generation still provides us a promising scope to increase income at farm level. The estimates portray that yield gap vary from one-fourth to one-third within the paddy farms. Jowar farms in Maharashtra and Karnataka, and bajra farms in Rajasthan still exhibit yield gap as high as 50 per cent. The estimates for gram in Madhya Pradesh stands more than 30 per cent, and by 45 per cent in Rajasthan and Maharashtra. Cash crops, which are input intensive, also exhibit yield of around 30-50 per cent. These scenarios offer us to increase output, thereby income, by using the existing technologies itself. Tapping this potential depends on expanding irrigation, and delivering better quality seeds. The yield differences in irrigated fields produce around 8 quintals/ha of higher paddy, 2-5 quintals/ha of higher gram, 5-15 quintal/ha of higher maize and 3 quintal/ha of higher cotton. Even when prices turn poor, higher output

from the same land could offer increased income to the farmers. The issue can be addressed by expanding irrigation, use of improved seeds in sowing and better credit access.

The strategy of irrigation expansion holds true for maize as well. Area covered under irrigation in major states like Andhra Pradesh and Karnataka are 50 per cent and 36 per cent respectively. The other major state, Bihar, also suffers with less use of improved seeds. Only two-third of the farmers use hybrids and improved seeds use, and the irrigation coverage is just 65 per cent. Being an input responsive crop, yield levels can be appreciably raised by better seed delivery and irrigation. Irrigated cotton farms produce higher yield than the un-irrigated farms. The cotton yield margins in irrigated farms are 11 qtl/ha and 6 qtl/ha in Gujarat and Maharashtra, respectively. If these yield gaps are addressed through proper scientific and management interventions; there can be significant gain in output. Research and development organizations need to make concerted efforts to bridge such gaps.

In rice, there exists a huge potential to expand irrigation in West Bengal as just half of the rice area is irrigated, and yield differentials are significant. The irrigated fields, on an average, record 8 quintals/ha higher yield than the unirrigated fields. Odisha depicts considerable scope for improvement in yield levels under the unirrigated environment. All the major wheat producing states grow almost the entire crop under irrigation, hence, offer limited scope to expand irrigation. While Madhya Pradesh has 91 per cent area under irrigation; Uttar Pradesh, Punjab, Haryana and Rajasthan have more than 98 per cent area under irrigation. But the yield differentials are high, revealing scope to achieve higher production. The average yield levels in 2013-14 were around 50 quintals/ha in Punjab and Haryana; 30 quintals/ha in Uttar Pradesh and Rajasthan and around 24 quintals/ha and in Madhya Pradesh. Hence, an effort to achieve higher wheat production depends on factors other than irrigation. Considering the potential of micro-irrigation in saving of water and nutrients along with productivity enhancement, a lot of emphasis is being given to micro-irrigation in the country. Micro-irrigation can bring substantial increase in productivity and also result in water saving.

The non-traditional areas for cultivation can provide a remunerative solution for further enhancing the farmers' income. These may include shifting orientation from cereal dominance to high value crops (HVC) like horticulture and livestock. Even, as pulses are becoming a high value commodity, shift in favour of pulses can meet the nutritional as well as income security. Jammu & Kashmir and Himachal Pradesh, due to their

agro-ecological typologies, are highly suitable for cultivation of horticultural crops and bring highly substantial gains in cultivation of HVC. A marginal and small farmer in Himachal Pradesh is able to earn 23 times returns in HVC as compared to cereals. Cultivation of vegetables is profitable (in terms of gross returns) for small and marginal farmers across majority of the states except Haryana and Uttarakhand. The diversification strategy requires strong emphasis on regional crop planning and preparation of optimum crop plans for identification of competitive crops which ensure reasonable income, nutrition along with sustainability to particular agro-climatic conditions.

The other major strategy to follow is to encourage processing by the household sector. Against the corporate sector, which contributes by around 7 per cent, household sector contributes by around 13 per cent of the output of food processing sector. Fruits and vegetables, and livestock processing especially provide high scope. This would turn to reality under optimal skill delivery to the farm households. Special schemes could be introduced that cater processing by the farmers and simultaneously link the processed food to the urban market. Equally, encouraging Farmer Producer Organizations and other private sector to invest more in processing would complement the effort.

The market trends display relative price stability to the cereal sector against high volatility for the vegetables and fruits. For example, the wholesale price index (WPI) for onion for the year 2011 was 619, and has peaked to 783 during 2015. Further, cob-web phenomenon as well turns proved through this study. Market prices remain high, but as a contrary, farmers share remain low for these high value crops. While paddy, wheat and gram growers fetch by around 60-80 percent, fruits and vegetable growers report around 25-40 percent only. This demands attention of the researchers and policy makers while proposing farmers to diversify. It demands for improved market efficiency and price policies more in favour of high value crops, and creating localized market infrastructure that could store fruits and vegetables to reap market gains. Marketing infrastructure plays crucial role in increasing the efficiency of the agricultural transactions. Such efficiency and gains, if aggregated on a larger scale, may provide fruitful gains to the farmers.

Further, the study emphasized on reducing dependence on agriculture, rather focuses on increased emphasis on agri-business. This requires agriculture units not to remain as isolated cultivating units rather transformed into agri-enterprises performing more functions at the same time rather than simply the cultivation function. Encouraging processing

and building value chains would help create non-farm jobs in rural areas. The time has come when things are to be dealt in totality not in isolation. Neither the productivity centric nor the marketing and price centric approach are going to work in isolation. Every commodity has to be dealt in a holistic value chain approach where suitable interventions are required at all the critical stages.

It would be prerequisite that the implementation of DFI Plan should be with a clear visionary framework and strategic plans need to be formulated for all sub-sectors. This requires linkages among the high-powered think tanks and implementing bodies. Role of Indian Council of Agricultural Research would be extremely important to initiate and launch various technological breakthroughs for required transformation. Simultaneously, Centre-State linkages would be extremely important in mainstreaming and channelizing the policies and investment to the targeted goals for development. A crucial role would be played by the state and state development agencies in formulating state plans and strategic framework for fulfilling the objective.

Chapter **1**

Rationale for Doubling Farmers' Income

The agrarian distress in the farming community has increased overtime due to a number of reasons. Chand (2016) attributed this distress to the widening disparities between agricultural and non-agricultural sectors, resulting in burgeoning gap between the incomes generated per worker from the two sectors. Further, the National Crime Records Bureau data reveal that the number of farmers' suicides increased from 10,700 in 1995 to 18,200 in 2005; an increase of 70 per cent in 11 years. In an another study, Chand *et al.* (2015) reported that the growth rate in per farmer income during this period was mere 1.96 per cent the lowest during 1983-84 to 2011-12. The growth rate in per cultivator income accelerated to 7.29 per cent after 2004 and the number of farmers' suicides dropped to 13,700 by 2012. A clear indication may be drawn from the fact that the low growth rate in farm income is concomitant with an increase in farmers' distress. Any increase in farmers' income will reduce the agrarian distress and vice-versa. Further, price factors are also becoming increasingly important in ensuring the welfare of farmers and farm labourers.

The agricultural sector received continuous attention of the policy makers and stakeholders. A number of initiative were undertaken to improve the performance of the sector. However, for the first time in our history, Hon'ble Prime Minister of India exhorted to "Double the Farmers' Income" by 2022-23. This enthused and fuelled lot of energy and motivation among the stakeholders and channelized the efforts in unified direction. Doubling of farmers' income (DFI) goal was also coupled with many new and well-thought out schemes on insurance for mitigating losses (*Pradhan Mantri Fasal Bima Yojana*), ensuring effective marketing through unified national agricultural marketing platform (e-National Agricultural Market), and improving soil health via promoting organic farming through *Paramparagat Krishi Vikas Yojana* for maximising the gains from farming.

To ensure that DFI mission is moving in the desired direction within stipulated time frame *i.e.* 2022-23, it is important that accurate information on certain indicators which reflect the farmers' welfare is generated and made available to monitor the situation. The most appropriate measure of farmers' well-being is the level of income. It is unfortunate to note that farmers' income series are not prepared and published in the country by

any official agency on a regular basis. A few attempts have been made by some scholars to prepare estimates of farm income in the past and these are based either on a sample of farmers or a particular segment of agriculture (Narayanamoorthy, 2006; Sen and Bhatia, 2004). The researchers have come out with various methodologies which provide estimates of farmers' income; however, the estimates are available only for different time periods. The studies have largely referred to the growth in output, *i.e.* value of output (VoP), gross domestic product (GDP), gross state domestic product (GSDP), output and input price behaviour along with price spread, rise in wages, indebtedness, etc. to indicate the state of Indian framing. Thus, authentic estimates of farmers' income across all states are warranted for affecting a strategy which can translate the vision of DFI into reality.

The pathway for doubling of farmers' income requires consideration of different dimensions related to enhancement in agricultural production along with providing efficient markets and improved marketing facilities. As area expansion is limited, production enhancement can be done through bridging yield gaps in crops through adoption of efficient and effective cultivation practices, crop diversification with focus on high value crops, further improvements in the total factor productivity, proper irrigation management along with other factors leading to productivity improvements (GoI, 2007; Evenson *et al.*, 1999; Chand *et al.*, 2011; Birthal *et al.*, 2007). The enhanced output may support the farmers in getting better returns. However, the efficient marketing network would be the key factor for monetization of the output and realization of better gains. The markets would need to be accompanied by market infrastructure, market accessibility and market related policies which finally reflect in enhanced producer share along with the gains and losses from burgeoning agricultural price volatility especially in case of vegetables (Saxena and Chand, 2017). The primary factor triggering abnormal hike in prices is production shock generally caused by weather related events (Government of India, 2015). Studies show that this situation is aggravated by further exploitation by a section of traders and middlemen through stocking and market manipulations (GoI, 2015). A probe would also be required that how the post-harvest management would save the losses in crops and livestock sectors. The losses in India's agricultural produce is estimated to be Rs. 92,651 crore, approximately $13 billion (MoFPI, 2016), indicating that there is need for better infrastructure and proper management to prevent these losses. Household level and small scale value addition and processing may prove to be success factors in this regard. Thus, it is also important that these sources of growth in farmers' income are examined to ensure the realization of DFI mission. This paper provides dissection of important sources of growth and the desired approach for doubling of farmers' income in the country.

Chapter 2

Methodological Approach

For doubling of farmers' income, it is essential that different income sources are identified and their potential contribution is quantified. This section provides the estimated contributions of various critical factors, which have potential to contribute to the desired growth. Box 1 lists various sources of growth broadly under four categories *viz*. technology and cropping system related, post-harvest management and value addition; marketing and price related and non-farm income sources.

Box 1 : Sources for doubling of farmers' income

1. Technology and Cropping System Related

- Increase in total factor productivity
- Reducing yield gaps
- Through diversification
- Gains from irrigation

2. Post Harvest Management and Value Addition

- Reducing post-harvest losses
- Encouraging value addition and processing

3. Marketing and Price Related

- Improving price realization to the farmers
- Reducing price volatility

4. Enhancing Non-Farm Income

- Creating non-farm opportunities
- Reducing dependence on agriculture

The study is based on secondary data and information from different official sources and publications. GDP data from 1980-81 to 2014-15 at 2004-05 prices were compiled from the National Accounts Statistics to compute the growth rates in GDP across sub-sectors. To estimate yield and income differences in irrigated and unirrigated plots, plot level data provided for the year 2013-14 by the Ministry of Agriculture and Farmers' Welfare (MoAFW) were used. As the data doesn't directly provide the status of irrigation for a given plot, it was assumed that when a given plot received at least one irrigation, the crop was treated as irrigated and the rest were treated as unirrigated (rainfed). The t-statistics was used to study the significance in yield and income differences among irrigated and unirrigated plots. Further, extent of use of local, improved and hybrid seeds in different crops across states was calculated using the same data source pertaining to the years 2011-12 to 2013-14. Descripitive analysis was used in arriving the shares of improved and hybrid seeds use in total seed use. Yield gap estimates were obtained using plot level data pertaining to the years 2011-12 to 2013-14. The yield gaps were calculated using the formula

$$Y_g = \left\{1 - \frac{Y_a}{Y_r}\right\} * 100$$

where, Y_g, Y_a and Y_r are yield gap, actual mean yield and reference yield respectively. Actual mean yield are averages of yield at farmers' plots, and 90th percentile of yield distribution was used as reference yield for a given crop at a given state during the reference period.

To examine the gains from diversification, unit record data of Situation Assessment Survey of agricultural households for 2012-13 (NSSO, 2014) was used. The data provides the total disposal of different commodities along with the price realized. The gross returns for cereals, fruits, vegetables and flowers were obtained by aggregating the individual gross returns for various commodities in that group. To examine the relative profitability of horticultural commodity groups (fruits, vegetable and flowers) over cereals, the ratio of gross returns in horticultural commodity crops (high-value crops) was obtained over the cereals. A ratio of more than one signifies higher relative profitability of former to the later indicating greater potential for high value crops.

The price volatility was measured on the basis of monthly wholesale price index (WPI) at 2004-05 base for major crops compiled from WPI database of the Office of the Economic Advisor. The instability in prices of major agricultural commodities was measured in relative terms by the Cuddy-Della Valle index computed for WPI of selected agricultural commodities for two phases *i.e.* 2005-2010 and 2011-2016. This has been

used in recent years by a number of researchers as a measure of variability in time series data. The formula suggested by Cuddy-Della is used to compute the index of instability.

$$\text{Cuddy-Della Vella Instability Index (CV*)} = \text{Coefficient of variation} \times (1 - R^2)^{0.5}$$

The index value of Cuddy Della Vella between 0 to 15 characterizes low instability; whereas the values between 15 to 30 and above 30 imply medium and high instability in the data, respectively.

The compound annual growth rates in gross value added of household and corporate sector in food processing were computed to analyse the trends in processing for various food categories.

Chapter 3

Performance of Agriculture in India

Agriculture continues to be the source of livelihood for the majority of Indian population; the sector contributed about 13 per cent to the gross domestic product (GDP) of the country in 2014-15. The agricultural sector grew at the growth of around 3.7 per cent per year during 2004-05 to 2014-15 and the growth was quite impressive as compared to 2.3 per cent per annum during the previous decade (1995-96 to 2004-05). Though the industry and service sectors grew at a much higher rate during last two decades (during 1995-96 to 2004-05) (industry at 4.9 per cent and service at 7.9 per cent per annum) and 2004-05 to 2014-15 (industry at 8.4 per cent and service at 9.0 per cent per annum); agricultural sector was able to improve its rate of growth leading to reduction in the relative growth gap (Table 1). The National Sample Survey Office (NSSO) survey on employment and unemployment also highlights the intriguing fact that the number of agricultural labourers declined from 9.27 crore in 2004-05 to 7.82 crores in 2011-12 indicating that every year around 22 lakh agricultural labourers have left the sector. This led to radical increase in the wage earnings by 16.14 per cent per year during 2004-05 to 2011-12. At the same time, the number of cultivators declined at the rate of 1.80 per cent per year during 2004-05 to 2011-12. Despite these achievements, interest of farming community in agriculture is reported to be declining and consequently, agricultural workers including both the cultivators and agricultural labourers are leaving the industry (NSSO Employment and Unemployment Surveys, 2004-05 and 2011-12). This reported shift is good provided the workers, who left the sector, are productively and gainfully employed in alternate sectors/industries.

3.1 Performance of various Sub-Sectors

Examination of the existing growth scenario becomes an essential condition for projecting the growth across various sub-sectors of agriculture. For this, the data of GDP along with value of production (VoP) of various sub-sectors and crop categories at 2004-05 prices were used. Chand and Parappurathu (2012) estimated the moving decennial growth rates by fitting a semi-log trend to the smoothened data. The moving decennial growth

rates were also computed in this study to examine the performance of various sub-sectors. The decennial growth rates indicate remarkable growth 2004-05 onwards for all the sub-sectors, *i.e.* crop, livestock and fisheries.

During the recent decade (2004-05 to 2014-15), crop, livestock and fisheries registered growth of 2.93, 6.11 and 5.13 per cent per annum, respectively. The pattern indicates that overall growth in agriculture is principally determined by the crop sector and the two growth rate series move in a parallel fashion. The same is also confirmed from the year-on-year fluctuations in different sub-sectors (Figure 1). Livestock sector is growing at an appreciable and sustainable rate and is ahead among all sub-sectors. It is remarkable to mention that livestock sector never attained

Table 1 : Performance of Indian agriculture: At a glance

Particular	1995-96	2004-05	2014-15	Growth during	
				1995-96 / 2004-05	2004-05 / 2014-15
GDP (Rs crore) @ 2004-05 prices					
Agriculture & allied Sector	447127	565427	814303	2.3	3.7
Agriculture (Crops and livestock)	376243	476634	693727	2.2	3.9
Industry	494262	829783	1649739	4.9	8.4
Services	794041	1576255	3675479	7.9	9.0
Overall	1737741	2971464	6139520	6.1	8.4
Share of (%)					
Agriculture & Allied Sector	25.7	19.0	13.3	-	-
Agriculture	21.7	16.0	11.3	-	-
Industry	28.4	27.9	26.9	-	-
Services	45.7	53.1	59.9	-	-
Agricultural Trade (Rs Billion)					
Total exports	1064	3753	18916	15.0	19.7
Agriculture exports	204	416	2395	8.2	21.5
Total imports	1226	5011	27339	16.9	20.7
Agriculture imports	59	228	1154	16.2	19.7
Price Indices (@ 2004-05 base)					
CPIAL	-	100	261	-	11.2
WPI	-	100	225	-	9.4
Employment (Numbers in crore)					
Cultivators	14.39*	16.61	14.62**	1.3	-1.8
Agricultural Labourers	9.56*	9.27	7.82**	-0.3	-2.4

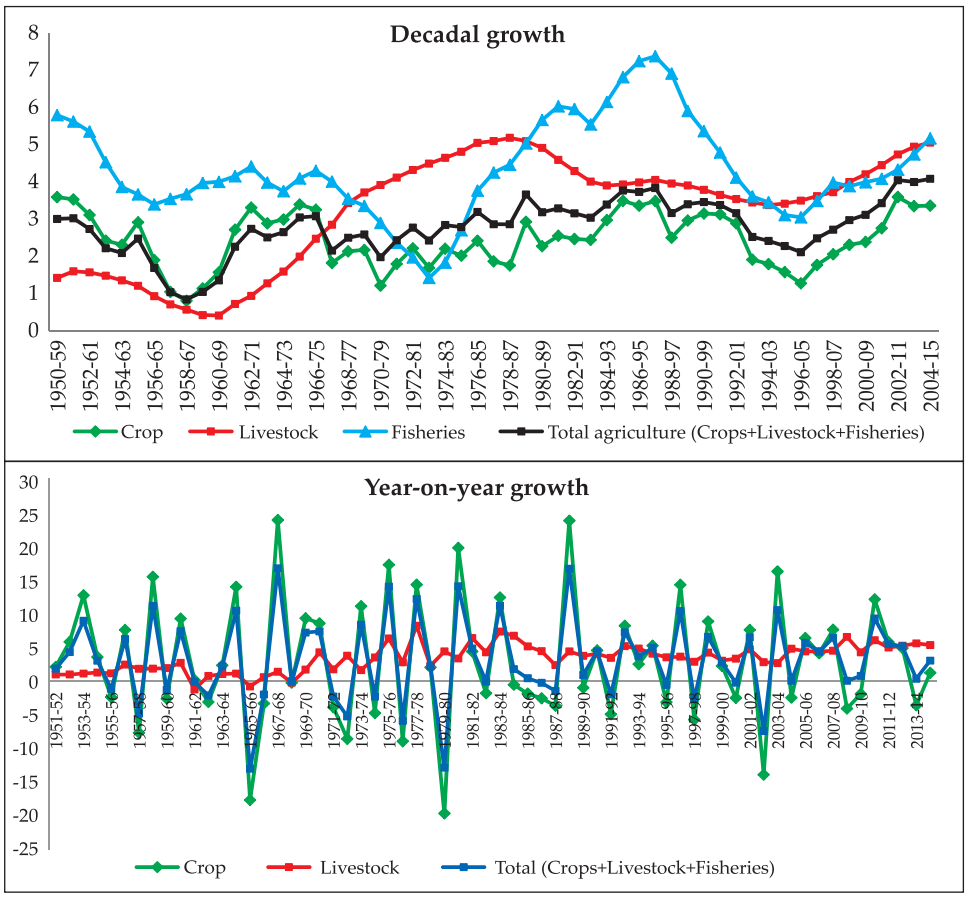
Source: Computed by authors.

Note: *Agricultural workers data pertains to 50th round of NSSO (1993-94) and ** agricultural workers data pertains to 68th round of NSSO (2011-12) on employment and unemployment.

a negative growth in any of the years during the span of last 34 years; the lowest growth rate attained in the sector was just one per cent in the year 2003-04. Thus, the livestock sector can be relied upon for risk mitigation to the farmers in case of even worst outcomes from other sub-sectors. The studies have reported that livestock is the source of sustained income and generates income more frequently than the crop sector (Hegde, 2006; 12th Five year plan - 2012-17).

Table 2 provides the existing growth rates for different crop categories based on VoP at 2004-05 prices. The historical growth rates have been provided for six phases as Pre-green revolution period (PGR)–1960-61 to 1968-69, Early green revolution period (EGR)–1968-69 to 1975-76, Period of wider technology dissemination (WTD)–1975-76 to 1988-89, Period of diversification (DIV)–1988-89 to 1995-96, Post-reform period (PR)–1995-96 to 2004-05 and Period of recovery (REC)–2004-05

Figure 1 : Growth rates in GDP across sub-sectors at 2004-05 prices



Source: National Accounts Statistics, various years.

to 2010-11 as delineated by Chand and Parappurathu (2012). We have extended the recovery period up to 2014-15. If we examine the trajectory of growth across phases, it is evident that highest growth is observed during the recovery phase, *i.e.* 3.61 per cent per year during 2004-05 to 2014-15; the same is evident for almost all crop categories. Except floriculture, fruits & vegetables, condiments & spices and sugar, performance of all other crop categories was found to be decelerating and discouraging during the post-reform period (1995-96 to 2004-05). Livestock sector's performance was found best during the recovery phase. Pulses achieved a growth of 2.63 per cent during the recovery phase. Fibres, condiments & spices, fruits & vegetables, floriculture performed quite well during 2004-05 to 2014-15 in the crop category.

Table 2 : Historical growth rates of crop categories, livestock and fisheries in India, based on VoP at 2004-05 prices

Crops	Pre-green revolution period (1960-61/ 1968-69)	Early green revolution period (1968-69/ 1975-76)	Wider technology dissemination (1975-76/ 1988-89)	Period of diversification (1988-89/ 1995-96)	Post-reform period (1995-96/ 2004-05)	Recovery period (2004-05/ 2014-15)
Cereals	1.42	2.06	2.60	1.63	0.40	2.42
Pulses	-2.23	0.26	0.79	-0.86	0.22	2.63
Oilseeds	0.40	2.99	3.49	3.38	-0.78	1.45
Sugar	1.48	1.64	1.68	3.05	3.70	2.69
Fibres	-0.71	1.52	1.68	4.21	-0.28	5.28
Drugs & narcotics	3.04	2.39	2.16	1.39	2.65	4.80
Condiments & spices	0.65	3.62	4.24	3.24	4.95	5.58
Fruits & vegetables	5.44	5.16	3.08	4.07	3.38	4.85
Floriculture	4.60	5.70	3.41	5.29	10.15	6.44
All crops	1.14	2.15	2.57	2.04	1.78	3.10
Livestock	0.35	2.98	4.87	4.12	3.41	4.92
Fisheries	3.98	4.37	3.63	7.11	3.11	3.59
Overall	1.07	2.37	3.09	2.73	2.27	3.61

Source: Computed by authors.

3.2 Sectoral Growth across States

The sectoral growth across states has been analysed using the data of gross state domestic product (GSDP). During the recent years, states like Bihar, Goa, Madhya Pradesh and Uttarakhand have shown impressive performance and grew at the rate of more than 9 per cent per year during 2010-11 to 2014-15. The trend of declining share of agriculture in total output

has continued till recent times (Table 3). In Tamil Nadu & Maharashtra, agriculture output share in total output during TE 2014-15 is just 7 per cent and in Kerala and Uttarakhand, it is around 10 per cent. Highest share of agriculture doesn't exceed one-third of state output. To the highest extent, agriculture in Madhya Pradesh contributes 28 per cent of its total output. In Punjab, Uttar Pradesh and Andhra Pradesh, they range between 20 per cent and 25 per cent. The pattern is not just being recorded for the said year, but has continued since past. Between TE 2006-07 and TE 2014-15, output share has declined in Bihar and Punjab by 10 per cent, from 30 per cent to 20 per cent, and from 31 per cent to 21 per cent respectively. The decline has been 9 per cent in Uttarakhand, and 7 per cent in Jammu & Kashmir, Kerala, Haryana and West Bengal.

Not just agriculture reflects declining contribution but the manufacturing sector as well. Despite higher share than agriculture, in many of the states, share of manufacturing has also declined during this period. For example, share of manufacturing has declined from 48 per cent to 37 per cent in Jharkhand, 33 per cent to 28 per cent in Haryana and 31 per cent to 27 per cent in Karnataka. Service sector has captured the momentum and compensated the decline in output in agriculture and manufacturing. During the TE 2014-15, Kerala has produced 70 per cent its output through service sector, followed by West Bengal (65 per cent), Tamil Nadu and Maharashtra (64 per cent both). To ascertain, none of the states have recorded a negative change in output share. During the period TE 2006-07 to TE 2014-15, output share has grown by more than 10 per cent in Haryana, Jammu & Kashmir and Jharkhand, and by more than 9 per cent in Uttar Pradesh, Kerala and West Bengal. Such trends and patterns clearly indicate transformation across states and increasing dependence on non-farm sector for growth.

Output composition within agriculture sector showed mixed trends. Seven out of twenty major states have reduced their output in crop and livestock sector, nine have increased. Output shares in forest sector in most of the states have not seen major changes. Fisheries sector has gradually picked up, albeit very marginally. Andhra Pradesh and Kerala have reduced their output share from crop and livestock sector. Andhra Pradesh has marginally shifted towards fisheries sector (Table 4). While output share in crop and livestock sector has declined by 7 per cent TE 2006-07 to TE 2014-15, output in fisheries sector has increased by 7 per cent. Kerala, rather, has produced more from forestry than in fisheries. A decline of 4 per cent output share in agriculture and livestock has been compensated by a 3 per cent increase in fisheries. On the other hand, Jharkhand, Madhya Pradesh, Chhattisgarh and Bihar have expanded their output primarily through agriculture and livestock sector.

Table 3 : Performance of agriculture, manufacturing and service sector across states (Rs. billion @ 2004-05 prices)

States	Agricultural Sector				Manufacturing Sector				Service Sector				Overall			
	GSDP		Growth in GSDP		GSDP		Growth in GSDP		GSDP		Growth in GSDP		GSDP		Growth in GSDP	
	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II
Odisha	187.9	233.7	3.67	0.32	289.3	464.5	9.02	3.16	364.8	705.4	10.48	5.99	841.9	1403.5	8.54	4.07
Jammu & Kashmir	77.0	86.6	1.95	-1.69	82.1	113.1	4.23	5.38	130.2	248.2	8.88	6.41	289.3	447.9	5.84	4.46
Punjab	321.2	367.9	1.98	1.38	276.7	485.0	11.55	2.13	443.5	887.0	8.47	9.43	1041.3	1739.8	7.45	5.48
Uttar Pradesh	794.2	1029.1	2.67	3.69	679.5	1004.0	7.64	1.68	1322.6	2631.9	9.50	7.91	2796.3	4664.9	7.22	5.53
Kerala	210.8	201.1	-1.46	1.59	298.3	456.4	6.80	2.53	798.4	1537.8	10.44	7.73	1307.4	2195.3	7.93	6.01
Andhra Pradesh	402.4	595.9	4.71	6.43	323.2	498.8	7.88	2.45	721.4	1376.9	9.28	7.28	1447.1	2471.6	7.73	6.05
Karnataka	329.3	477.8	5.97	2.98	564.2	863.7	7.96	2.64	952.2	1877.1	9.44	8.78	1845.6	3218.5	8.38	6.11
Tamil Nadu	277.3	347.7	4.04	1.46	793.6	1397.6	9.36	3.11	1449.4	3068.2	11.28	8.18	2520.3	4813.4	9.96	6.12
Rajasthan	336.2	511.1	5.54	1.77	437.7	813.3	8.40	6.34	613.5	1260.0	10.17	8.09	1387.4	2584.4	8.55	6.17
Chhattisgarh	111.9	183.2	5.42	5.19	229.1	403.5	9.15	6.15	178.5	369.5	10.68	7.37	519.6	956.1	8.94	6.43
Himachal Pradesh	63.7	82.8	1.88	6.53	102.2	177.6	10.23	3.63	96.3	198.3	10.12	9.35	262.2	458.7	8.34	6.52
Maharashtra	499.8	657.1	4.78	0.07	1462.6	2600.3	9.62	4.92	2774.5	5676.7	10.39	8.16	4736.9	8934.2	9.61	6.55
West Bengal	510.4	608.1	2.39	2.72	475.4	709.5	5.27	5.52	1245.9	2408.9	9.05	8.16	2231.7	3726.5	6.83	6.70
Haryana	228.8	301.4	4.01	2.25	343.5	555.2	7.32	4.56	483.5	1148.2	13.07	9.43	1055.8	2004.8	9.42	6.89
Gujarat	376.5	534.0	4.35	5.47	922.1	1698.2	10.96	4.81	1003.2	2111.8	10.93	9.44	2301.8	4343.9	9.97	7.08
Jharkhand	95.2	182.6	6.48	11.05	280.5	408.7	3.40	3.64	213.7	504.0	12.23	9.72	589.4	1095.4	7.25	7.49
Uttarakhand	54.8	71.2	2.23	3.63	88.7	279.4	19.04	11.45	140.8	362.3	16.34	7.34	284.4	713.0	14.83	8.50
Madhya Pradesh	329.7	650.5	4.28	17.99	334.1	599.9	10.64	3.42	542.1	1062.3	8.98	7.95	1205.8	2312.7	8.24	9.20
Goa	10.9	10.3	-1.80	2.49	64.7	98.1	8.36	0.66	62.5	184.2	12.22	16.79	138.1	292.6	9.52	9.84
Bihar	244.4	355.3	3.77	3.74	120.2	320.4	16.96	6.18	445.7	1064.7	9.94	13.46	810.3	1740.4	9.41	9.89
North east																
Mizoram	6.4	10.1	9.09	-0.91	5.3	8.7	10.30	2.48	16.8	35.2	11.58	6.51	28.5	54.1	10.80	4.36
Assam	139.8	179.7	3.16	3.30	143.6	199.5	2.90	6.03	271.3	487.8	8.16	7.03	554.6	867.0	5.61	6.00
Nagaland	20.7	28.9	3.56	4.25	8.8	15.5	9.25	8.99	34.5	69.5	9.49	7.63	64.0	113.9	7.64	6.91
Manipur	12.7	16.2	4.16	5.51	19.9	21.3	1.78	2.65	21.3	43.4	7.64	11.15	53.9	80.9	4.85	7.57
Arunachal Pradesh	12.4	17.9	3.51	4.38	11.4	17.4	7.93	3.62	12.4	23.6	11.23	5.63	36.1	58.8	7.73	4.62
Tripura	23.4	40.0	8.73	4.66	24.0	41.6	7.69	9.10	47.6	97.9	8.85	11.68	95.1	179.4	8.54	9.39
Meghalaya	15.8	21.3	2.04	6.99	19.0	41.4	10.75	8.34	36.1	70.9	8.93	8.77	70.9	133.6	8.02	8.34
Sikkim	3.3	5.7	3.48	12.29	5.5	35.7	35.56	9.49	10.0	17.9	9.96	6.02	18.9	59.3	19.26	8.63

Period 1: 2004-05 to 2010-11; Period-II: 2010-11 to 2014-15.
The states have been sorted according to growth in GSDP (Ag) in ascending order.

Table 4 : Performance of various sub-sectors agriculture, manufacturing and service sector across states (Rs. lakhs @ 2004-05 prices)

States	Crops and Livestock Sector				Forestry				Fisheries				Agriculture Total			
	GSDP		Growth in GSDP		GSDP		Growth in GSDP		GSDP		Growth in GSDP		GSDP		Growth in GSDP	
	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II	TE 2006/07	TE 2014/15	Period I	Period II
Jammu & Kashmir	61.6	71.6	2.64	-1.97	13.9	13.2	-1.49	-0.13	1.5	1.8	3.27	-1.69	77.0	86.6	1.95	-1.69
Maharashtra	391.2	517.9	5.59	-1.38	93.6	123.1	1.92	6.44	14.9	16.2	0.41	2.21	499.8	657.1	4.78	0.07
Odissa	150.2	189.1	4.07	-0.23	26.5	26.9	0.95	-0.85	11.1	17.6	4.26	8.95	187.9	233.7	3.67	0.32
Punjab	305.9	347.6	1.91	1.23	12.3	16.6	3.30	4.46	3.0	3.7	3.12	2.53	321.2	367.9	1.98	1.38
Tamil Nadu	238.4	298.0	4.12	1.20	17.2	21.0	1.83	3.63	21.7	28.6	5.10	2.73	277.3	347.7	4.04	1.46
Kerala	172.0	157.0	-2.25	1.35	21.1	25.3	2.80	2.66	17.7	18.8	0.57	2.08	210.8	201.1	-1.46	1.59
Rajasthan	287.7	455.1	6.08	1.77	47.5	54.2	1.78	1.56	1.0	1.8	8.80	7.77	336.2	511.1	5.54	1.77
Haryana	216.8	285.1	4.00	2.16	10.7	13.2	2.58	3.07	1.4	3.2	14.70	7.27	228.8	301.4	4.01	2.25
Goa	7.1	6.3	-2.74	0.34	0.8	1.1	2.69	9.28	3.0	2.9	-0.80	4.70	10.9	10.3	-1.80	2.49
West Bengal	406.5	471.1	2.10	1.86	24.2	35.5	1.98	13.86	79.6	101.6	3.96	3.20	510.4	608.1	2.39	2.72
Karnataka	280.6	405.7	6.07	2.97	41.9	59.4	4.49	3.31	6.8	12.7	10.54	2.06	329.3	477.8	5.97	2.98
Uttarakhand	40.7	51.9	2.14	2.52	14.1	19.2	2.46	6.76	0.1	0.1	6.84	1.14	54.8	71.2	2.23	3.63
Uttar Pradesh	718.3	934.9	2.65	3.82	65.6	77.7	2.13	2.19	10.3	16.5	7.29	3.66	794.2	1029.1	2.67	3.69
Bihar	206.3	314.2	4.57	3.75	26.7	22.8	-2.00	-1.88	11.4	18.3	1.79	12.61	244.4	355.3	3.77	3.74
Chhattisgarh	80.4	139.8	6.18	5.46	25.9	30.8	1.90	2.77	5.7	12.6	9.56	8.51	111.9	183.2	5.42	5.19
Gujarat	314.5	463.9	4.92	5.83	45.2	50.2	0.63	2.75	16.7	19.8	3.53	3.15	376.5	534.0	4.35	5.47
Andhra Pradesh	319.3	432.2	4.52	3.95	20.7	26.2	2.19	4.89	62.4	137.5	6.40	15.91	402.4	595.9	4.71	6.43
Himachal Pradesh	47.9	61.0	0.70	6.94	15.4	21.4	5.30	5.34	0.4	0.5	2.03	7.56	63.7	82.8	1.88	6.53
Jharkhand	72.7	150.6	6.90	12.79	20.9	27.7	3.98	2.95	1.6	4.4	18.13	12.62	95.2	182.6	6.48	11.05
Madhya Pradesh	292.8	607.6	4.61	19.43	34.1	38.5	1.58	0.91	2.8	4.3	1.47	12.85	329.7	650.5	4.28	17.99
North east																
Mizoram	3.7	7.3	14.40	-1.77	2.4	2.3	-0.57	0.43	0.3	0.5	0.97	7.01	6.4	10.1	9.09	-0.91
Assam	118.0	147.5	2.92	2.67	13.5	19.2	4.78	4.43	8.2	13.1	3.81	9.61	139.8	179.7	3.16	3.30
Tripura	19.3	27.1	6.44	1.83	2.6	8.2	18.20	9.42	1.6	4.7	16.05	15.43	23.4	40.0	8.73	4.66
Nagaland	16.2	22.5	3.16	4.41	4.2	5.9	4.58	3.70	0.3	0.5	11.15	3.46	20.7	28.9	3.56	4.25
Manipur	9.6	12.8	5.22	6.14	1.9	1.9	-0.23	-0.21	1.2	1.5	1.69	8.22	12.7	16.2	4.16	5.51
Meghalaya	11.5	16.7	2.55	9.14	4.0	4.2	1.07	-0.34	0.3	0.3	-4.65	6.17	15.8	21.3	2.04	6.99
Sikkim	2.9	5.4	4.13	13.14	0.4	0.3	-2.18	0.85	0.0	0.0	3.64	35.36	3.3	5.7	3.48	12.29

Period 1: 2004-05 to 2010-11; Period-II: 2010-11 to 2014-15.
The states have been sorted according to growth in GSDP (Ag) in ascending order.

Chapter 4

Farmers' Income and its Estimation

4.1 Earlier Efforts on Farm Income Estimation

Farm business income from cost of cultivation (CoC) data: The Comprehensive Scheme for Cost of Cultivation (CSCC) in India was started in the year 1970-71, which collects and compiles the data on costs and receipts of selected agricultural commodities. Farm Business income is calculated by deducting the relevant costs from the receipts by the farmers, *i.e.* value added in crop production less factor payments. This income provides a good indication at the region and commodity level; however, it may not be useful in estimating the aggregate farm business income for the sector as a whole. Farmers' welfare is closely linked to the level of farm incomes. Estimates of value added from crop production can, of course, be obtained for the sector as a whole without detailed cost of production studies – by combining estimates of physical crop production (from area estimates and results of crop cutting experiments on yields) with estimates of farm-gate prices to obtain the gross value of output, and then by deducting from it the use of inputs (Sen and Bhatia, 2004). They estimated farm business income using the data from the CSCC from 1981-82 to 1999-00 and included the farm business income both from crop cultivation and livestock. Though CSCC data are representative of crops in major growing states, but these do not cover horticultural crops and several minor crops. Horticultural sector is tremendously growing in India and exclusion of this sector ignores the major source of potential growth. The data on income from the livestock sector are not appropriately captured in the cost of cultivation schedules, which do not intend to do so, and the farm business income derived from the CSCC data is not an adequate measure of actual farm business income in the country or a state (Chand *et al.*, 2015).

Farm income using the National Sample Survey Office (NSSO) data: Chand *et al*. (2015) derived the farm income by deducting the capital consumption and wage bill for hired labour employed in agriculture from GDP. The wage bill for agriculture and allied sector was computed by multiplying the number of hired labourers employed in agriculture with per day agricultural wage earnings and the number of days of wage employment in a year in agriculture and allied activities based on

various rounds of NSSO on employment and unemployment and also the Rural Labour Enquiry Reports (RLER). The estimates of farm income were prepared for various points corresponding to six rounds of NSSO on Employment and Unemployment—1983 (38th Round), 1987-88 (43rd Round), 1993-94 (50th Round), 1999-00 (55th Round), 2004-05 (61st Round), and 2011-12 (68th Round). Farm income obtained at current prices was deflated by Consumer Price Index for Agricultural Labourers (CPIAL) to arrive at real farm incomes. This was the maiden attempt in India to estimate the aggregate farm income, which was also computed for per cultivator, per household and per unit of net sown area to reflect the scenario at the disaggregated level.

Farmers' Income on the basis of Situation Assessment Survey of NSSO: Besides the above approaches, NSSO carried out two separate rounds on Situation Assessment Survey (SAS) of Agricultural Households (59th and 70th Rounds), which included all possible dimensions for determining the socio-economic status of agricultural households. As per the SAS, the total income per average agricultural households grew annually at 11.75 per cent from Rs 25,380 in 2002-03 to Rs 77,112 in 2012-13, the income doubled in about 6 years; however, in real terms (after neutralizing the effect of inflation), the income growth was 5.24 per cent and at this rate doubling of income would take 14 years (Satyasai and Bharti, 2016). However, one needs to identify a proper deflator to convert the nominal income into real income. The doubling of income requires initial set of estimates of farmers' income which are to be doubled in a given timeframe. Thus, a Committee has been constituted by Ministry of Agriculture and Farmers' Welfare for developing the methodology and institutionalization of the strategy to double the income.

4.2 Current Status of Farm and Non-Farm Income

Chand *et al.* (2015) provided the farm income details for the income earned by a cultivator, per unit of net sown area per household/holding along with the income earned by a labour. Between 1983–84 and 2011–12, the farm income per cultivator deflated by CPIAL (base year 2004–05) rose 2.7 times, from Rs 16,103 to Rs 42,781; the farm income per holding doubled and per hectare of net sown area (NSA) trebled. In 2011–12, a cultivator earned an annual income of Rs 78,200 at current prices; while one hectare of net cultivated area generated an income of Rs 80,800 to a farmer (Table 5). The farm income in real terms increased at the rate of 3.67 per cent per year between 1983–84 and 1993–94. The annual growth rate of the income of farmers accelerated to 5.36 per cent after 2004-05. The number of cultivators declined from 16.7 crores in 2004–05 to 14.6 crores in 2011–12 leading to an impressive growth in the income.

Table 5 : Real and current farm income and wage earnings of agricultural labour (Rs)

Year/Period	Per cultivator	Per hectare net sown area	Per holding	Wage earning per labourer
Real income				
1983–84	16,103	14,798	22,603	5,513
1987–88	17,030	16,770	22,298	6,630
1993–94	21,110	21,345	27,147	8,168
1999–00	26,875	26,437	31,325	9,931
2004–05	26,146	30,755	34,103	10,043
2011–12	42,781	44,176	44,688	17,662
Income at current prices				
2011–12	78,264	80,817	81,753	32,311
Growth in farm income	**Total**	**Per cultivator**	**Per holding**	**Per hectare of NSA**
1983-84 to 1993-94	3.67	2.74	1.85	3.73
1993-94 to 2004-05	3.30	1.96	2.10	3.38
2004-05 to 2011-12	5.36	7.29	3.94	5.31

Source: Chand *et al*. (2015).

4.3 Disparities in Agriculture and Non-Agriculture Income

It is often felt that disparity between farm income and non-farm income is rising (Chand, 2008) and that those who work outside agriculture are progressing much faster than those who work in it. It is also alleged that labour in agriculture is becoming more costly and eating into the net income of farmers. In 1983–84, a cultivator earned three times what a labourer earned while a non-agriculture worker earned three times the income earned by a farmer or his family members engaged in agriculture as their main activity. The disparity in income of a cultivator and a non-agricultural worker increased from 1:3 to 1:4 between 1983–84 and 2004–05 (Chand *et al.,* 2015). After this, the disparity in farm and non-farm income declined to 1:3.15; and a non-agricultural worker earned 3.15 times the income of a cultivator in 2011–12 (Table 6). Acceleration in growth of agricultural output and a decline in the number of cultivators from 2004–05 to 2011–12 arrested and reversed the rising disparity in the incomes of farmers and non-farmers. The recent years have seen some narrowing of gap in the income earned by those who are engaged in agricultural activities and those who are engaged in non-agricultural occupations. Between farmer and agricultural labourer, the development process has benefited the latter a little more, but there still remains a large gap between the incomes of a cultivator and an agricultural labourer (Chand *et al.,* 2015).

Table 6 : Income earned by agricultural and non-agricultural workers (1983-84 to 2011-12)

Year	Farm income per cultivator (Rs) F	Wage earning per agricultural labour (Rs) L	Income per non-agricultural worker (Rs) N	Ratio L:F	Ratio N:F
1983-84	4286	1467	12786	0.34	2.98
1987-88	5653	2201	18036	0.39	3.19
1993-94	12365	4784	37763	0.39	3.05
1999-00	24188	8938	78565	0.37	3.25
2004-05	26146	10043	106688	0.38	4.08
2011-12	78264	32311	246514	0.41	3.15

Source: Chand *et al.* (2015).

4.4 Farmers' Income: Major Sources

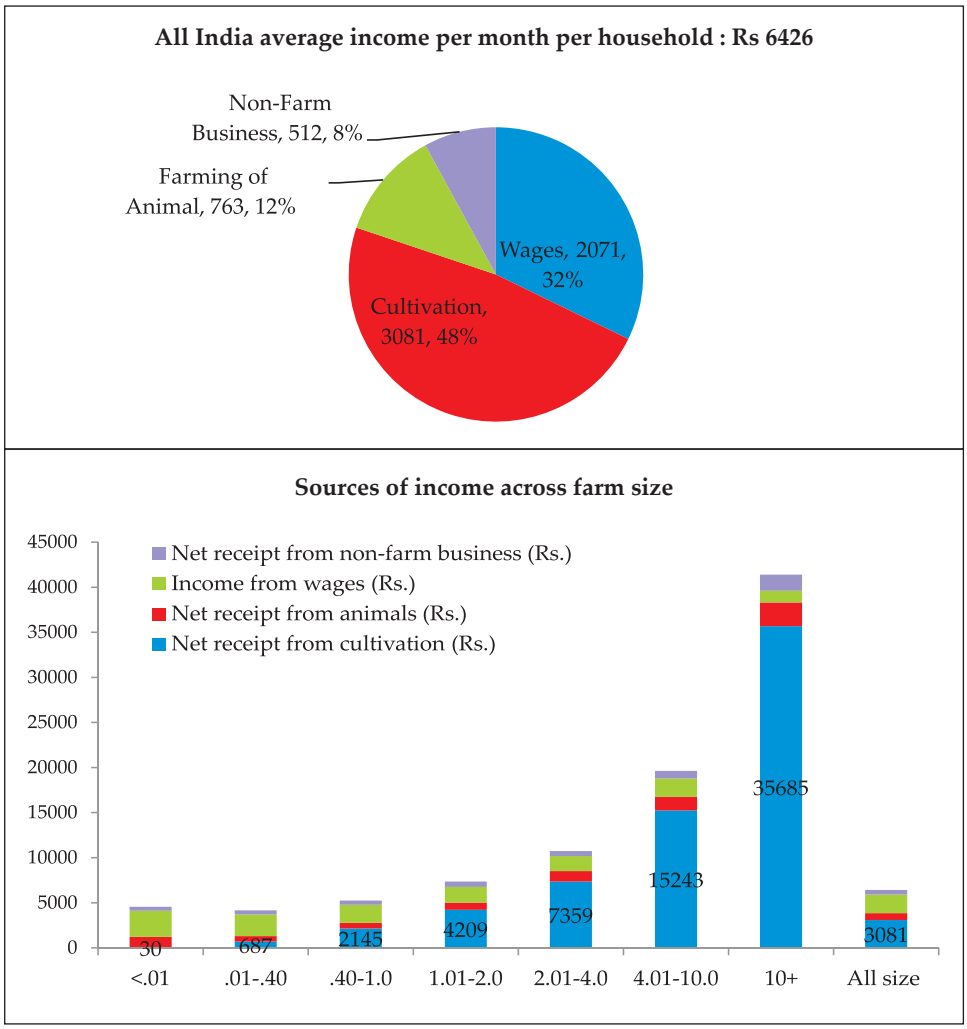
The recently conducted Situation Assessment Survey of Agricultural Households by NSSO provides the income details for four broad categories *i.e.* income from crop cultivation, farming of animals, income from wages and salary and income from non-farm sources. On an average, one household earns Rs 6,426 from all these four sources, out of which 60 per cent is derived from farm sources while remaining 40 per cent is derived from off farm and non-farm sources (Figure 2). As far as income across size classes is concerned, small farmers derive maximum share from non-farm sources. As we move up in the size class category, the share of income derived from crop cultivation improves significantly and the share of non farm activities, *i.e.* wages and salaries, and non farm business activities declines (Birthal *et al.* 2017). Thus, differential strategies are required for different size classes for doubling of income.

Table 7 provides income estimates and sources of income across states. It is difficult to demarcate and identify different categories on the basis of sources of income. Even the composition of different sources of income in the best performing state, *viz*. Punjab and the least performing state, *viz*. Bihar is quite similar.

The share of income derived from crop cultivation is relatively higher in Punjab, Haryana, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and Uttarakhand; while the least is noticed in case of Jammu & Kashmir, Tamil Nadu and West Bengal. The income from farming of animals occupies larger share in Haryana, Gujarat, Odisha, Jharkhand and Andhra Pradesh; while least is observed in Kerala, Chhattisgarh, Karnataka and West Bengal. It is surprising to note that Chhattisgarh derives total income only from crops and wages; thus, the state needs special consideration in terms of preparation of strategic plan of the state.

As far as non-farm and wages & salary as alternate sources of income are concerned, states like Kerala, Jammu & Kashmir, Himachal Pradesh, Tamil Nadu and West Bengal earn maximum from these two sources. As these states are special states in terms of the typology *i.e.* the states fall into either hilly or coastal typology and dominated by specialised horticultural and fishery products. Thus, farmers rely on alternate sources to ensure their livelihood. Again, these states need special attention and a customised strategic framework is required for doubling of income.

Figure 2 : Sources of farmers' income across size classes



Source: NSSO (2014).

Table 7 : Average monthly income per agricultural household during 2012-13 (Rs)

State/UTs	Income from wages	Net receipt from cultivation	Net receipt from farming of animals	Net receipt from non-farm business	Total income
Andhra Pradesh	2482	2022	1075	400	5979
Arunachal Pradesh	2076	6647	1310	836	10869
Assam	1430	4211	799	255	6695
Bihar	1323	1715	279	240	3558
Chhattisgarh	1848	3347	-19	1	5177
Gujarat	2683	2933	1930	380	7926
Haryana	3491	7867	2645	431	14434
Himachal Pradesh	4030	2876	1047	824	8777
Jammu & Kashmir	7336	3063	801	1483	12683
Jharkhand	1839	1451	1193	238	4721
Karnataka	2677	4930	600	625	8832
Kerala	5254	3531	575	2529	11888
Madhya Pradesh	1332	4016	732	129	6210
Maharashtra	2156	3856	539	834	7386
Manipur	3815	2924	1563	540	8842
Meghalaya	3776	6472	657	887	11792
Mizoram	3655	4561	864	19	9099
Nagaland	5393	3212	1384	59	10048
Odisha	1716	1407	1314	539	4976
Punjab	4779	10862	1658	760	18059
Rajasthan	2534	3138	967	710	7350
Sikkim	3113	1696	980	1009	6798
Tamil Nadu	2902	1917	1100	1061	6980
Telangana	1450	4227	374	260	6311
Tripura	2185	2772	311	162	5429
Uttarakhand	1069	2531	848	253	4701
Uttar Pradesh	1150	2855	543	376	4923
West Bengal	2126	979	225	650	3980
Group of UTs	5179	1864	213	1312	8568
All-India	2071	3081	763	512	6426

Source: NSSO (2014).

4.5 Delineating the Sources of Off-Farm and Non-Farm Income

The non-farm income contributes around 40 per cent of the total income earned by a farmer and is an important source in doubling of farmers' income. Providing a connect between the income generated from farm and the activities linked with farm as off-farm and non-farm activities is crucial in strengthening both the farm as well as other than farm income sources. Table 8 and Table 9 provide the details of off-farm and non-farm sources of income around the year. The details regarding the share in employment and average monthly income earned from different sources for three most important non-farm activities have also been provided based on 70th round of NSSO on Situation Assessment Survey of farmers in India.

Retail trade in cereals, pulses, spices etc. is the most prevalent activity across majority of the states and occupies the maximum share in employment. Such income earned by an average farmer ranges from Rs 1,115 in Jharkhand to Rs 6,430 in Himachal Pradesh. Retail of meat and meat products is the most prevalent activity in Assam which is also justified according to the habitat of the region. Similarly, retail of fresh and preserved fruits and vegetables is the dominant activity in Jammu & Kashmir.

It is observed that non-farm sources of income in general for majority of the states are an extension of farm activities and are part of the value chain and there is no disconnect between the two. Thus, impetus on addressing supply side constraints by creating the infrastructure like specialised storage, efficient transport, and maintaining the link in terms of product management skills among farm, off farm and non-farm sources emerge as two major critical interventions to strengthen the linkages, improving the product quality and creating a win-win situation for the producers as well as consumers.

Table 8 : Off-farm and non-farm economic activities across states (July-December, 2012)

State	First most Important off farm/non-farm source of Income			Second most Important off farm/non-farm source of Income			Third most Important off farm/non-farm source of Income		
	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)
Andhra Pradesh	Manufacture of gur	15.0	26100	Retail of cereals, pulses, spices etc.	11.2	2541	Repair and maintenance of pump	9.2	4000
Assam	Retail of meat and meat products	27.3	1673	Retail of cereals, pulses, spices etc.	11.6	4151	Structural wooden goods	7.8	3450
Bihar	Retail of cereals, pulses, spices etc.	52.4	3436	Flour milling	7.7	5009	Custom tailoring	7.1	4357
Chhattisgarh	Retail in non-specialized stores with food beverages etc.	60.4	-3000	Retail of bakery dairy etc.	23.9	1312	Custom tailoring	7.3	1300
Gujarat	Retail of cereals, pulses, spices etc.	21.3	4138	Motorized road freight transport	14.5	10632	Embroidery	9.5	350
Haryana	Retail of telecommunication	17.8	8758	Retail of cereals, pulses, spices etc.	17.4	4293	Cafeterias fast food restaurants	16.2	3500
Himachal Pradesh	Retail of cereals, pulses, spices etc.	23.9	6430	Sweet meats	8.5	3762	Non-motorized road freight transport	7.2	7797
Jammu & Kashmir	Retail of fresh and preserved fruits and vegetables	22.8	3000	Retail of cereals, pulses, spices etc.	21.7	3219	Buildings	9.8	-1208
Jharkhand	Retail of cereals, pulses, spices etc.	24.6	1115	Manufacture of bidi	22.5	2200	Other commission agents	13.6	3900

Table 8 : Continued

Karnataka	Retail of cereals, pulses, spices etc.	13.7	5278	Steaming and redrying of tobacco	9.1	14793	Custom tailoring	7.8	3321
Kerala	Taxi	24.2	10005	Retail of cereals, pulses, spices etc.	7.3	13016	Event catering	5.2	6056
Madhya Pradesh	Manufacture of bidi	31.0	527	Hair dressing and beauty	9.4	1527	NIC code could not be traced	7.8	590
Maharashtra	Retail of cereals, pulses, spices etc.	18.7	5166	Maintenance and repair of motor cycle etc.	9.6	8998	Retail in non-specialized stores with food beverages etc.	9.0	5403
Odisha	Retail of cereals, pulses, spices etc.	15.5	2091	Retail of fresh and preserved f&v	9.2	5868	Furniture	8.6	1149
Punjab	Retail of bakery dairy etc.	10.0	10000	Retail of household utensils	9.9	5000	Poultry and other slautering	9.9	6000
Rajasthan	Flour milling	17.9	2904	Tea coffee shops	6.2	9005	Buildings	6.2	9520
Tamil Nadu	Manufacture of bidi	10.2	1968	Wholesale n retail of used motor vehicles	9.9	2600	Commission agents or brokers	9.3	1174
Telangana	Retail of cereals, pulses, spices etc.	31.2	3369	Non-urban passenger land transport	12.1	3574	Medical practice	8.4	2300
Uttar Pradesh	Retail in non-specialized stores with food beverages etc.	10.6	483	Retail of cereals, pulses, spices etc.	7.1	2717	Custom tailoring	5.9	1483
Uttarakhand	Buildings	33.1	2160	Retail of cereals, pulses, spices etc.	32.5	3121	Retail in non-specialized stores with food beverages etc.	15.3	6600
West Bengal	Retail of cereals, pulses, spices	9.1	2947	Repair of household goods	8.9	1511	Zari work	7.2	672

Source: Computed by authors based on NSSO (2014).

Table 9 : Off-farm and non-farm economic activities across states (January-March, 2013)

State	First most Important off farm/non-farm source of Income			Second most Important off farm/non-farm source of Income			Third most Important off farm/non-farm source of Income		
	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)	NIC industry	Share in employ-ment (%)	Average monthly income of households engaged (Rs)
Andhra Pradesh	Retail of cereals and pulses etc.	13.9	2881	Repair and maintenance of pumps	11.9	1000	Retail in non-specialized stores	11.4	1567
Assam	Retail of meat and meat products	30.5	1476	Manufacture of wooden goods	9.2	4300	Retail of cereals and pulses etc.	7.3	3429
Bihar	Retail of cereals and pulses etc.	65.4	2408	Motorised road freight transport	4.8	6519	Flour milling	3.8	5564
Chhattisgarh	Custom tailoring	83.6	1900	Retail of electronic household goods	16.4	-20000	NA		
Gujarat	Retail of cereals and pulses etc.	19.4	4406	Motorised road freight transport	16.8	10841	Embroidery work and making of laces and fringes	9.6	465
Haryana	Retail of telecommunication equipment	24.4	12436	Cafeterias, fast-food restaurants	22.2	4250	Retail of cereals and pulses etc.	21.1	4435
Himachal Pradesh	Retail of cereals and pulses etc.	24.7	3231	Non-motorised road freight transport	7.3	3787	Manufacture of jewellery	7.2	1200
Jammu & Kashmir	Retail of fresh or preserved fruit and vegetables	24.3	3000	Retail of cereals and pulses etc.	20.4	3874	Construction of buildings	10.5	-1681
Jharkhand	Retail of cereals and pulses etc.	31.6	1447	Manufacture of bidi	29.0	2470	Retail of jewellery	9.6	3600

Table 9 : Continued

Karnataka	Retail of cereals and pulses etc.	11.0	4581	Interior and exterior painting	8.7	-5000	Custom tailoring	7.1	5225
Kerala	Taxi operation	22.8	12890	Retail of cereals and pulses etc.	8.6	14890	Retail of footwear	5.6	5133
Madhya Pradesh	Manufacture of bidi	37.4	583	Hairdressing and other beauty treatment	11.4	4941	NIC code could not be traced	9.7	290
Maharashtra	Retail of cereals and pulses etc.	25.1	6009	Maintenance and repair of motor cycles etc.	11.2	5476	Retail in non-specialized stores with food beverages etc.	10.9	5434
Odisha	Retail of cereals and pulses etc.	18.3	3059	Retail sale of fresh or preserved fruit and vegetables	12.1	6182	Manufacture of furniture made of wood	11.2	6984
Punjab	Retail of bakery products, dairy products and eggs	15.8	13000	Retail of cereals and pulses etc.	15.0	6388	Motorised road freight transport	11.9	10963
Rajasthan	Flour milling	22.0	3363	Tea/coffee shops	7.8	9000	Motorised road freight transport	6.3	18926
Tamil Nadu	Manufacture of bidi	11.3	2262	Commission agents, brokers	11.0	5889	Motorised road freight transport	7.1	5352
Telangana	Retail of cereals and pulses etc.	41.1	2827	Medical practice activities	11.1	3000	Poultry & other slaughtering,	10.9	11300
Uttar Pradesh	Retail in non-specialized stores	9.6	4101	Retail of cereals and pulses etc.	7.9	4308	Motorised road freight transport	6.5	20900
Uttarakhand	Retail of cereals and pulses etc.	43.6	2823	Construction of buildings	29.4	1581	Restaurants without bars	9.4	5500
West Bengal	Retail of cereals and pulses etc.	11.5	3675	Repair of other personal and household goods n.e.c.	9.6	2506	Zari work and other ornamental trimmings	7.1	1410

Source: Computed by authors based on NSSO (2014).

Chapter 5

Role of Technology and Diversification

5.1 Total Factor Productivity

A significant contributor to output growth would be the total factor productivity (TFP). A number of studies have been conducted on this subject, which dealt with disaggregated regions and crops, the summary is provided in Table 10. A recent exhaustive study completed at ICAR-NIAP established that annual TFP growth in agriculture was around 1.55 percent during 1980-81 to 2011-12 and it improved to 5.49 per cent during 2004-05 to 2011-12 (Jain and Chand, 2015). According to other studies, estimated TFP growth was 2.33 per cent per year for crop sector, 2.66 per cent per year for livestock sector and 2.41 per cent per year for crops and livestock combined during 1981 to 2001 (Avila and Evenson, 2004). Another study by the Reserve Bank of India establishes the TFP trend growth rate during 2000-08 at 0.7 per cent based on value added function framework (Goldar *et al.*, 2014). Chand *et al.* (2011) estimated crop-wise and state-wise TFP and the given growth ranged from as low as -0.69 in redgram to as high as 1.92 in wheat during 1975 to 2005.

As an illustration, Murali (2012) revealed that a comparison of the productivity in the pre-introduction of the variety Co86032 period with after introduction of variety Co86032 shown that more technological progress and hence more improvement in productivity was recorded after introduction of variety Co86032 than pre-introduction of variety Co86032 period. Co86032 variety is an early season variety which performs well in all soil types and extremely well in garden land condition, yielding good quality cane with higher yield having multi ratooning capacity and can be grown throughout the year. The annual TFP growth over the whole period is 7.6 per cent. The improvement was more due to technological progress rather than improvement in efficiency. The study indicates greater TFP changes after introduction of variety Co86032 than pre introduction of variety Co86032. Government schemes like *Rashtriya Krishi Vikas Yojana*, (RKVY), National Food Security Mission and *Pradhan Mantri Fasal Bima Yojana* (PMFBY) will facilitate attainment of desired growth in output as

Table 10 : Growth in total factor productivity

Author(s)	Commodity	Period	TFP Growth (%)	Author(s)	Commodity	Period	TFP Growth (%)
Evenson *et al*. (1999)	Crops	1956-1965	1.10	Jain and Chand (2015)	Agriculture	1980-1981 to 2011-2012	1.55
		1966-1976	1.39			2004-2005 to 2011-2012	5.49
		1977-1987	1.05	Chand *et al*. (2011)	Rice	1975-1985	0.90
Birthal *et al*. (1999)	Livestock	1951-1970	-0.04			1986-1995	0.74
		1970-1980	0.93			1996-2005	0.40
		1980-1995	1.79			1975-2005	0.67
Fan *et al*. (1999)	Crops and Livestock	1970-1979	1.55		Wheat	1975-1985	1.60
		1980-1989	2.52			1986-1995	2.51
		1990-1994	2.29			1996-2005	1.61
		1970-1994	1.75			1975-2005	1.92
Coelli and Rao (2003)	Crops and Livestock	1980-2000	0.90		Gram	1975-1985	0.06
Avila and Evenson (2004)	Crops	1961-1980	1.54			1986-1995	0.09
		1981-2001	2.33			1996-2005	0.34
	Livestock	1961-1980	2.63			1975-2005	0.16
		1981-2001	2.66		Groundnut	1975-1985	0.49
	Crop and Livestock	1961-1980	1.92			1986-1995	0.55
		1981-2001	2.41			1996-2005	1.30
Joshi *et al*. (2003)	Rice (IGP)	1980-1990	3.50			1975-2005	0.77
		1990-1999	2.08		Cotton	1975-1985	2.84
	Wheat (IGP)	1980-1990	2.44			1986-1995	0.92
		1990-1999	2.14			1996-2005	0.80
Kumar *et al*. (2008)	Wheat	1971-1986	1.28			1975-2005	1.41
		1986-2000	0.68	Rada (2016)	Grains	1980-2008	-1.83
	Pulses	1971-1986	0.52		Pulses		-4.03
		1986-2000	-0.39		Horticulture		2.45
	Oilseeds	1971-1986	0.14		Oilseeds		-0.12
		1986-2000	0.33		Specialty crops		-0.41
	Sugarcane	1971-1986	0.79		Animal products		1.18
		1986-2000	-0.10				

Source: Drawn from relevant studies mentioned in the Table.

these schemes aim at holistic development of agriculture and allied sector, aim at accelerating production of crops mainly responsible for ensuring the food security along with soil fertility, and compensating farmers for crop losses/damages along with ensuring credit flow to farmers. Chand (2016) opined that TFP growth, which is mainly contributed by agricultural R&D, extension services, new knowledge, efficient practices like precision farming, is required to follow annual increase of 3.0 per cent.

5.2 Addressing Yield Gaps

There exist huge yield gaps in agricultural sector. A study by Planning Commission outlined these yield gaps between 6 to 300 per cent in cereals, 5 to 185 per cent in oilseeds and 16 to 167 per cent in sugarcane in different states (GoI, 2007). Such gaps exist at two levels—one, between the best scientific practices and the best farm practices and second, between the best farm practices to the average farmer practices and are caused by a number of environmental factors. Technology adoption helps in reducing yield gap at farm level. The estimates of yield gap for major crops across states are given in Table 11. These estimates of yield gap were obtained for 2011-12 to 2013-14 based on the plot level data provided by the Ministry of Agriculture, Government of India. The crop yield at 90th percentile was used as bench mark in computing the yield gap estimates (YGE). The YGE show considerable gaps across states among different crops (Table 11). Yield gap in paddy varied around one-fourth to one third of the benchmark yield. The estimates with respect to the best performing farmers in major paddy growing states like West Bengal, Uttar Pradesh, Andhra Pradesh and Punjab are 33 per cent, 29 per cent, 29 per cent and 28 per cent, respectively.

In wheat, the yield gap estimates are slightly less. For Punjab and Haryana, the yield gap stands at 19 per cent and 23 per cent, whereas for Uttar Pradesh and Madhya Pradesh, the corresponding figures are 27 per cent and 33 per cent, respectively. There exist considerable yield gap in coarse cereals and pulses. The states like Maharashtra and Karnataka in Jowar, and Rajasthan in Bajra have yield gap of more than 50 per cent. Among pulses, while yield gap stands at 32 per cent in Madhya Pradesh for gram, it stands at 45 per cent in Rajasthan and Maharashtra.

In case of tur, YGE stands at 60 per cent in Maharashtra and Karnataka. Cash crops like maize and cotton as well indicate high yield gap estimates across states. The YGE for maize stands at 33 per cent in Andhra Pradesh, whereas it accelerated to 45 per cent and 58 per cent in Karnataka and Bihar, respectively. In Rajasthan, the YGE stands highest at 63 per cent. YGE for cotton stands at around 45 per cent in Gujarat and Maharashtra. In Andhra Pradesh, it is slightly less (38 per cent). The YGE for sugarcane, the other major cash crop are 25 per cent, 35 per cent and 41

per cent respectively for Uttar Pradesh, Karnataka and Maharashtra. The issue can be addressed by expanding irrigation, use of improved seeds in sowing and better credit access.

Table 11 : Yield gap estimates, adoption of improved and hybrid seeds along with area under irrigation for selected crops and states

Crop	State	Crop yield gap (%)	Adoption of improved & hybrid seeds (%)	Area under irrigation (% of cropped area)
Paddy	West Bengal	33	98	48.2
	Uttar Pradesh	29	100	83.1
	Andhra Pradesh	29	95	96.8
	Punjab	28	100	99.6
Wheat	Uttar Pradesh	27	98	98.4
	Punjab	19	100	98.9
	Madhya Pradesh	33	100	90.8
	Haryana	23	96	99.5
Jowar	Maharashtra	53	59	9.5
	Karnataka	56	66	11.5
Bajra	Rajasthan	50	78	3.3
	Uttar Pradesh	35	83	8.9
Gram	Madhya Pradesh	32	100	57.9
	Rajasthan	46	50	49.2
	Maharashtra	45	84	24.2
Tur	Maharashtra	61	70	1.5
	Madhya Pradesh	36	52	1.6
	Karnataka	59	23	5.1
Maize	Andhra Pradesh	33	99	49.5
	Karnataka	45	98	36.0
	Bihar	58	67	65.2
Cotton	Gujarat	47	-	58.7
	Maharashtra	45	-	2.7
	Andhra Pradesh	38	-	13.9
Sugarcane	Uttar Pradesh	25	-	95.1
	Maharashtra	41	-	100.0
	Karnataka	35	-	100.0

Note: Estimates of yield gap and seed use are obtained for 2011-12 to 2013-14. Yield at 90th percentile is used as bench mark in computing the estimates. Irrigation figures correspond to the year 2012-13.

Source: Yield gaps and seeds use are authors' estimates based on Ministry of Agriculture data (various years); irrigation coverage is based on Agricultural Statistics at a Glance, 2015.

The strategy of irrigation expansion holds true for maize as well. Area covered under irrigation in major states like Andhra Pradesh and Karnataka are 50 per cent and 36 per cent, respectively. The other major state, Bihar, also suffers from less use of improved seeds. Only two-third of the farmers use hybrids and improved seeds use, and the irrigation coverage is just 65 per cent. Being an input responsive crop, yield levels can be appreciably raised by better seed delivery and irrigation.

Irrigated cotton farms produce higher yield than the un-irrigated farms. The cotton yield margins in irrigated farms are 11 qtl/ha and 6 qtl/ha in Gujarat and Maharashtra, respectively. Sugarcane and wheat crops require special attention as almost entire area is irrigated and entire area under wheat is sown with improved and hybrid seeds. Still, there exist yield differences across and within the states. If these yield gaps are addressed through proper scientific and management interventions; there can be significant gain in output. Research and development organizations need to make concerted efforts to bridge such gaps.

5.3 Role of Diversification

Sustained economic growth and increasing urbanisation are fuelling rapid growth in the demand for high value food commodities like fruits, vegetables, milk, meat, eggs and fish and the producers are responding positively to the emerging demand patterns by altering their production portfolio (Rao *et al.*, 2006; Kumar and Gupta, 2015). Moving on to non-traditional areas for cultivation can provide a remunerative solution for further enhancing the farmers' income. Agricultural diversification towards high-value crops can potentially increase farm incomes, especially in a country like India where demand for high-value food products has been increasing more quickly than that for staple crops (Birthal *et al.,* 2007). The non-traditional areas may include shifting orientation from cereal dominance to high value crops like horticulture and livestock. Even, as pulses are becoming a high value commodity, shift in favour of pulses can meet the nutritional as well as income security. Studies have established that high value crops generate more revenue, provide employment and premium price to the market participants. Table 12 provides the details of crop productivity (in terms of value of output) across various commodities. It is revealed that fruits and vegetables provide significantly higher revenue over other commodities.

To examine how diversification towards fruits, vegetables and flowers provide gainful returns to the marginal and small farmers, we tried to see how the high value crops (HVC) bring returns over the traditional crops like cereals. Table 13 provides the ratio between the gross revenue earned in fruits, vegetables and flowers over the gross revenue in cereals.

Jammu & Kashmir and Himachal Pradesh, due to their agro-ecological typologies, are highly suitable for cultivation of horticultural crops and bring substantial gains in cultivation of HVC. A marginal and small farmer in Himachal Pradesh is able to earn 23 times returns in HVC as compared to cereals. Cultivation of vegetables is profitable (in terms of gross returns) for small and marginal farmers across majority of the states except Haryana and Uttarakhand. As flower cultivation requires sizeable investment and specialized environment and network, its cultivation is found more beneficial among relatively larger farm size categories.

Table 12 : Crop productivity across various crop segments (Value of output per ha of cropped area in Rs @ 2004-05 prices)

Crop Category	Crops	TE 1982-83	TE 1993-94	TE 2004-05	TE 2014-15
Cereals		8663	12413	14019	17675
	Paddy	11395	15739	16810	20744
	Wheat	12039	16370	18125	20441
	Jowar	4220	5310	4810	5611
	Bajra	2570	3385	4938	6110
	Barley	7357	10027	11801	14938
	Maize	6621	8732	10311	14148
Pulses		7334	8330	8818	11922
	Gram	9322	10711	11529	14392
	Pigeonpea	11915	11173	11359	14020
	Other Pulses	5155	6401	6828	8937
Oilseeds		12886	14147	15638	18486
	Linseed	5636	6301	8127	12166
	Sesamum	7360	6998	9251	10822
	Groundnut	13005	14824	16823	19993
	Rapeseed & Mustard	16208	14492	17661	20188
	Coconut	28935	37648	36320	46319
Sugarcane		40685	44707	42092	53616
Fibres		9934	14346	16070	26357
Kapas		9985	14459	16004	26803
Jute		11913	15965	18703	22015
Condiments & Spices		27913	34859	49046	81914
Fruits & Vegetables		100164	95591	114214	175387
Floriculture		-	322526	473719	470806
Value of Output from Agriculture		15435	19012	24014	31593

Source: Computed by authors.

Table 13 : Evidences on diversification: Ratio of gross returns to cereals in high value crops

State	Marginal farmers		Small farmers			All categories		
	Fruits	Vegeta-bles	Fruits	Vegeta-bles	Flowers	Fruits	Vegeta-bles	Flowers
Andhra Pradesh	0.83	0.96	2.21	1.66	1.22	5.71	2.49	2.41
Assam	1.71	1.69	2.46	1.08	0.00	1.24	1.21	0.00
Bihar	1.07	1.91	19.08	2.36	1.70	2.07	1.08	1.55
Chhattisgarh	0.00	2.74	2.38	4.07	0.00	6.74	0.00	0.00
Gujarat	1.93	1.83	1.92	2.60	0.00	2.32	2.01	0.00
Haryana	0.86	2.00	0.00	0.95	0.00	4.90	4.43	0.00
Himachal Pradesh	22.22	3.46	23.61	4.53	4.88	2.61	13.74	7.99
Jammu & Kashmir	28.45	1.36	10.36	1.93	0.33	1.88	0.00	0.33
Jharkhand	12.00	2.92	18.37	3.12	0.00	2.31	0.55	0.00
Karnataka	2.84	6.60	3.18	3.70	3.87	5.30	1.67	5.37
Kerala	2.56	1.65	2.13	1.68	0.00	4.70	0.00	0.42
Madhya Pradesh	0.00	2.53	0.00	2.54	1.84	3.13	2.13	1.68
Maharashtra	2.52	2.25	4.70	3.79	0.00	2.89	1.33	1.43
Odisha	9.89	2.79	2.29	2.58	0.00	8.57	1.76	18.92
Punjab	0.00	0.56	0.00	2.49	0.00	1.13	0.73	0.00
Rajasthan	0.00	1.27	0.00	1.00	0.00	2.22	2.32	0.00
Tamil Nadu	5.09	2.89	5.95	2.34	2.69	10.39	2.49	8.56
Telangana	0.00	2.52	0.66	3.58	0.00	3.22	2.24	0.00
Uttar Pradesh	1.81	1.93	3.14	1.64	1.59	2.97	1.32	6.24
Uttarakhand	3.73	2.14	0.00	0.73	0.00	0.83	0.44	0.00
West Bengal	3.64	2.17	4.41	2.37	12.24	2.87	1.82	6.65
Rest of the states	0.92	0.47	0.89	1.29	3.38	1.96	0.95	5.11
All states	6.08	2.06	4.46	2.05	3.29	3.30	1.86	5.68

Source: Computed by authors.

The diversification strategy requires strong emphasis on regional crop planning and preparation of optimum crop plans for identification of competitive crops which ensure reasonable income, nutrition along with sustainability to particular agro-climatic conditions. Scope also exists to raise farmers' income by diversifying towards other allied enterprises like forestry rather than depending primarily on crop cultivation (Chand, 2016).

Increase in crop intensity at the same rate as observed in the recent past has the potential to raise farmers' income by 3.4 per cent in 7 years

and 4.9 per cent in ten years; this can turn out to be much higher as the possibilities for taking second crop are brightening (Chand, 2016).

5.4 Impact of Irrigation on Crop Yield and Income

The irrigated area in the country increased by 11 per cent between TE 2006-07 and TE 2013-14. The irrigation intensity, expressed as the ratio of gross irrigated area (GIA) to gross cropped area (GCA), increased by 8 per cent during the above mentioned period. The states like Madhya Pradesh, Chhattisgarh, Karnataka, Bihar, Gujarat and Rajasthan have shown appreciable increase in GIA and thereby increase in irrigation intensity (DAC&FW). The growth performance in Gross State Domestic Product (GSDP) of these states has also been much ahead of other states. Based on the plot level cost of cultivation data for 2013-14, the difference in yield and income levels of farmers were examined for irrigated and unirrigated plots. The details are provided in Table 14.

Rice: In rice, there exists a huge potential to expand irrigation in West Bengal as just half of the rice area is irrigated, and yield differentials are significant. The irrigated fields, on an average, record 8 quintals/ha higher yield than the unirrigated fields. Odisha depicts considerable scope for improvement in yield levels under the unirrigated environment.

Wheat: All the major wheat producing states grow almost the entire crop under irrigation, hence, offer limited scope to expand irrigation. While Madhya Pradesh has 91 per cent area under irrigation; Uttar Pradesh, Punjab, Haryana and Rajasthan have more than 98 per cent area under irrigation. But the yield differentials are high, revealing scope to achieve higher production. The average yield levels in 2013-14 were around 50 quintals/ha in Punjab and Haryana; 30 quintals/ha in Uttar Pradesh and Rajasthan and around 24 quintals/ha and in Madhya Pradesh. Hence, an effort to achieve higher wheat production depends on factors other than irrigation.

Maize: Yield response to irrigation is high in maize. All major maize producing states depict enormous scope to expand irrigated area.

Gram: Madhya Pradesh, Maharashtra and Rajasthan together produce around 70 per cent of total gram production in the country. While Madhya Pradesh and Maharashtra have sizeable irrigation, just one-fourth of the gram area is irrigated in Rajasthan. In terms of yield gains due to irrigation, while Madhya Pradesh offers limited scope, Rajasthan and Maharashtra provide better output. The average gram yield in irrigated farms in Rajasthan and Maharashtra is 5.3 quintals/ha and 2.4 quintals/ha, respectively.

Table 14 : Evidences of gains from irrigation on crop yield and farmers' income (2013-14)

Crop	State	Yield (quintals/ha)		Proba-bility	Income (Rs/ha)		Proba-bility
		without irrigation	with irrigation		without irrigation	with irrigation	
Rice	West Bengal	40.18	48.11	0.00	51091	61369	0.00
	Uttar Pradesh	35.76	40.33	0.00	58659	59808	0.31
	Andhra Pradesh	55.55	52.96	0.00	78635	72053	0.00
	Punjab	48.51	58.55	0.01	96215	95995	0.50
	Odisha	28.38	52.85	0.00	33064	63423	0.00
	Bihar	39.20	23.02	0.00	42032	25879	0.00
	Chhattisgarh	30.69	37.25	0.00	38927	45595	0.00
	Tamil Nadu	51.15	50.67	0.25	72018	72821	0.22
Wheat	Uttar Pradesh	27.96	36.99	0.00	38327	50575	0.00
	Punjab	46.45	49.49	0.00	65031	69288	0.00
	Madhya Pradesh	32.95	31.68	0.13	47073	47118	0.49
	Haryana	45.60	45.90	0.60	63845	64252	0.40
	Rajasthan	44.15	39.51	0.00	68125	60598	0.00
Maize	Andhra Pradesh	49.16	66.62	0.00	59653	79664	0.00
	Karnatka	38.06	44.45	0.00	43414	51935	0.00
	Bihar	10.09	31.74	0.00	12450	37259	0.00
	Tamil Nadu	23.81	55.85	0.00	28125	71832	0.00
	Rajasthan	19.51	23.17	0.12	23694	30067	0.03
	Uttar Pradesh	19.25	21.71	0.08	21701	28261	0.00
Gram	Madhya Pradesh	9.08	9.07	0.51	24021	29949	0.00
	Rajasthan	7.27	12.55	0.00	20369	38853	0.00
	Maharashtra	10.47	12.88	0.00	30075	37155	0.00
	Karnataka	9.42	10.59	0.28	28238	32250	0.27
	Uttar Pradesh	7.29	5.48	0.03	25549	18473	0.03
Pigeonpea	Maharashtra	23.76	26.79	0.15	90280	102608	0.13
	Karnataka	11.78	7.04	0.00	48824	27425	0.00
	Gujarat	6.17	15.03	0.00	23608	57681	0.00
	Uttar Pradesh	8.37	7.39	0.18	32715	27628	0.09
Cotton	Gujarat	0.38	22.54	0.00	71094	109089	0.00
	Maharashtra	17.81	20.03	0.01	81735	91764	0.02
	Andhra Pradesh	16.91	17.42	0.38	69778	72545	0.35
	Haryana	19.11	15.97	0.09	98088	80628	0.07
	Karnataka	14.78	16.63	0.19	70639	81113	0.15
	Punjab	17.20	17.40	0.40	89168	89148	0.50

Source: Computed by authors based on Cost of Cultivation plot level data (2013-14).

Pigeonpea: In pigeonpea, the share of irrigation in yield gain is almost negligible. Maharashtra and Gujarat do depict significant positive responses to irrigation.

Cotton: Major share of cotton comes from Gujarat, Maharashtra and Andhra Pradesh. While around 60 per cent of area under cotton is irrigated in Gujarat, it is just 3 per cent in Maharashtra. While positive yield differentials on irrigated plots are small in cotton, expanding the irrigation in Maharashtra on a larger scale could help in achieving higher production. Andhra Pradesh has no major yield difference between irrigated and non-irrigated cotton, but the difference is high in Gujarat. The expansion of irrigation could be a better choice for Gujarat, and the strategy could be combined with other yield improving factors for Maharashtra.

Considering the potential of micro-irrigation in saving of water and nutrients along with productivity enhancement, a lot of emphasis is being given to micro-irrigation in the country. Micro-irrigation can bring substantial increase in productivity and also result in water saving (GoI, 2009; 2014). According to the report of Task Force on Irrigation, an increase in productivity on adoption of micro-irrigation ranged from 3 per cent each in cow pea and cabbage to 27 per cent in gram. At the same time, micro-irrigation resulted in water saving of 16 per cent in lucerne to 56 per cent each in bajra and barley. According to another study, only 9.2 per cent of potential area of 42.23 million hectares is currently covered under micro-irrigation (Palanisami and Raman, 2012). Therefore, strategies for enhancing irrigation coverage would be beneficial in enhancing the productivity and income of the farm household and need special attention. Other schemes recently started like soil health card will also bring change in output through qualitative and quantitative growth in output.

Chapter 6

Food Processing and Post-Harvest Management

6.1 Food Processing in India

Even after holding important position in the production of many agricultural commodities like fruits, vegetables, dairy products; the country still lags in food processing behind many other agriculturally important nations. Out of the total production of fruits and vegetables, wastage and losses account for 20 to 22 per cent; only 2 per cent of vegetable production and 4 per cent of fruit production are being processed, whereas the extent of fruit processing is very high in some countries such as Brazil (70 per cent), Malaysia (83 per cent), Philippines (78 per cent) and Thailand (30 per cent) (FAO, 2014).

Overall manufacturing sector in the country has shown impressive growth performance. However, the performance of food processing has not been commensurate with this performance. For corporate sector, the food processing comprises 7-8 per cent share in the gross value added (GVA) manufacturing; the share is found higher in household sector though household sector contributes only 20-25 per cent of the GVA food processing (Table 15). Food processing takes place in the corporate as well as household sector. The added gains from food processing can be arrived at by changing the orientation of farming community and households towards small scale food processing.

This requires that farmers are provided facilitating environment in terms of "skills" and "schemes". There is need to inculcate entrepreneurial skills in the farm households to process regionally important products, which have greater demand outside the region. Skills alone will not bring desired changes in income, farmers need to be provided support to create infrastructural capacity for meeting their requirement. This will be kind of "Essential Condition" as most of the farmers are small and marginal. Specific policy linked to consolidation of produce and then changing its forms would facilitate small scale operations. Women self-help groups

need to be provided with marketing support. This will not only enhance the income from non-farm source but also ensure income security to combat with any exigency in the primary activity, *i.e.* farming. Trade oriented value addition and processing, considering the requirement of foreign customers, will provide premium price to the farmers and enhance their incomes.

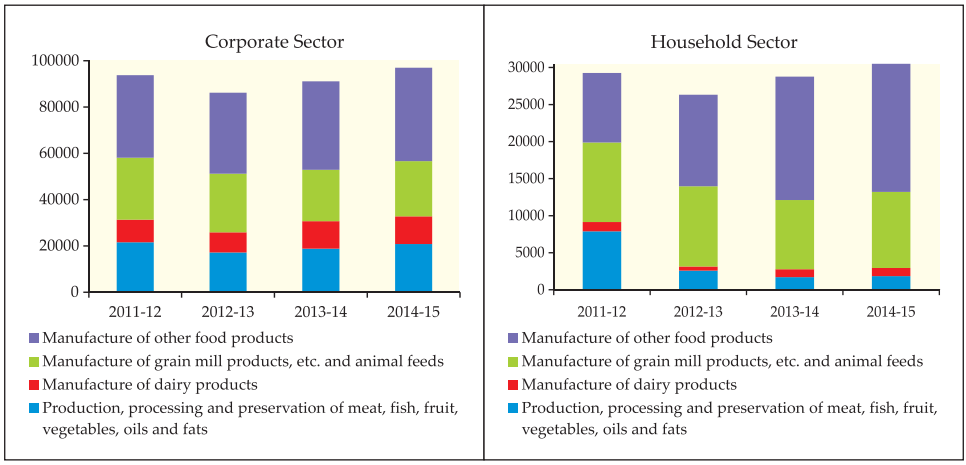
Table 15 : Performance and contribution of food processing sector

	Unit	2011-12	2012-13	2013-14	2014-15	Growth (2011-15)
Corporate sector						
GVA manufacturing (1)	Rs Crore @ 2011-12 prices	1230439	1295964	1360746	1441832	5.38
GVA Manufacture of food products, beverages & tobacco (2)		137024	126856	125707	132535	-1.08
GVA Food processing (3)		93799	86198	91117	97009	1.58
Share of 2 to 1	%	11.1	9.8	9.2	9.2	
Share of 3 to 1	%	7.6	6.7	6.7	6.7	
Household sector						
GVA manufacturing (1)	Rs Crore @ 2011-12 prices	179546	199304	218975	225236	8.05
GVA Manufacture of food products, beverages & tobacco (2)		38255	37702	38955	40759	2.25
GVA Food processing (3)		29263	26328	28763	30498	2.15
Share of 2 to 1	%	21.3	18.9	17.8	18.1	
Share of 3 to 1	%	16.30	13.21	13.14	13.54	

Source: National Accounts Statistics (2016).

Food processing usually takes place in the form of grain processing, manufacturing of animal feed, dairy processing, meat, fish fruits, vegetables and oil processing (Figure 3). Grain milling and processing along with other food products account for the major chunk of processing in both household and corporate sector. Extent of horticulture and livestock processing remains quite low in both corporate as well as household sector.

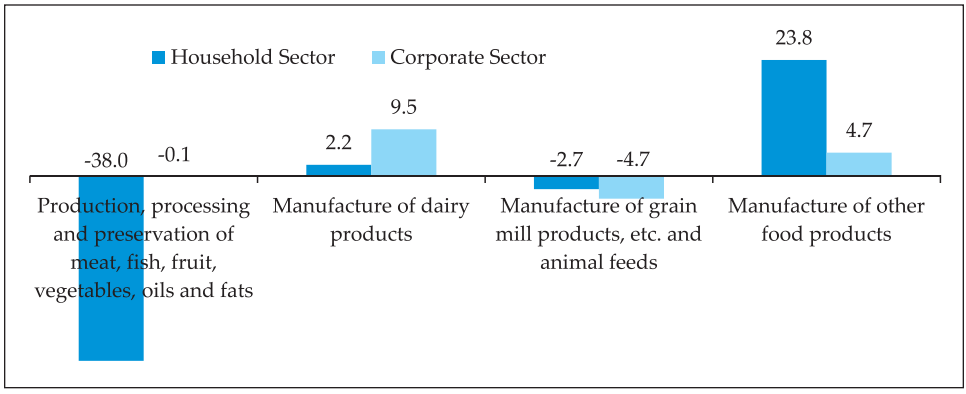
Figure 3 : Components of food processing (Value added in Rs crore at 2011-12 prices)



Source: National Accounts Statistics (2016).

It is emerging that livestock and horticulture are the two major sub-sectors which can drive maximum potential growth required for doubling the farmers' incomes. Horticulture sector contributed around 30 per cent in the value of output of agriculture sector in the country in the year 2013-14. However, the growth (in GVA during 2011-2015) in processing of livestock (meat etc.) and horticultural sector has significantly declined (Figure 4). Stringent efforts need to be made to promote the value-addition of livestock (including dairy) and horticultural products.

Figure 4 : Growth in value added across various components of food processing in household and corporate sector (2011-15)

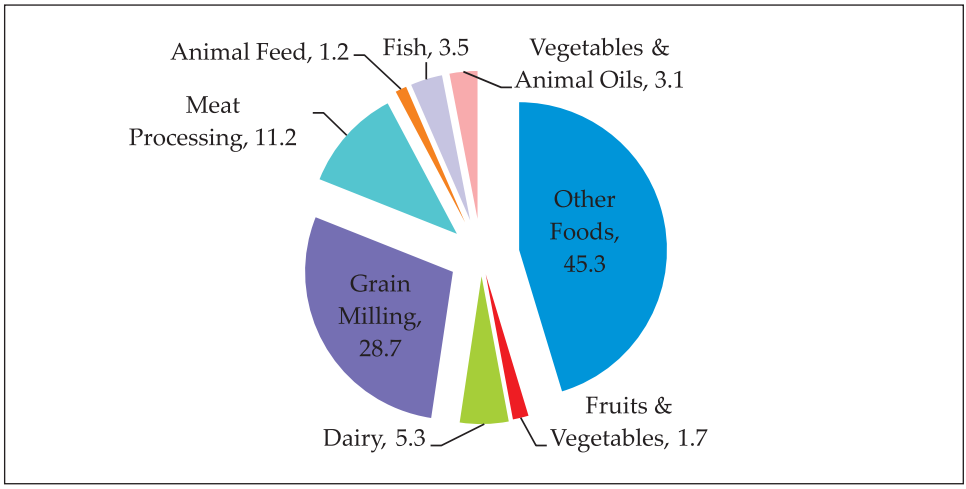


Source: Computed by authors.

The employment and un-employment survey data of NSSO (2011-12) were examined to understand the status of workers engaged in food manufacturing. The employment data were analysed at 5-digit NIC-

2008 codes given under National Industrial Classification and are given in Figure 5. It is observed that only 1.7 per cent of such workers only are involved in manufacturing of fruits and vegetable based products. Agro-processing still remains one of the highly untapped sectors and can provide further boost to rural economy if taken in a progressive manner.

Figure 5 : Share of workers employed in various food manufacturing industries (2011-12)



Source: Computed by authors from NSSO data, 2011-12.

Table 16 provides the details of workers employed in different food manufacturing and processing industries. Grain-milling, which has been a traditional processing area, employs around 29 per cent of food manufacturing workers. Less than lakh workers are employed in processing and preservation of fruits and vegetables as against 5.82 lakhs in processing and preservation of meat and 2.55 lakhs in manufacturing of dairy products and 1.89 lakhs in fish processing. It establishes the lack of emphasis and attention to such an important sector which holds tremendous potential due to specific agro-climatic endowments and niche area attributes. Many studies report that lot of horticultural produce is wasted/dumped due to lack of effective procurement and marketing arrangements. Even smaller initiatives like creating farmers' associations and groups with required seed capital can be very helpful. The horticultural product endowed areas might not even require very sophisticated kind of infrastructure as nature has already bestowed these areas with favourable climate in terms of temperature.

Many processing activities require specific kind of skills and are highly gender oriented. Industries like manufacturing of starch products, fish processing, fruits and vegetable processing, textile manufacturing etc., are highly female dominated industries, whereas animal feed and wine

industries are completely in the hands of male workers. Thus, customised financial support and proper marketing arrangements need to be ensured for sustenance and growth of such female dominant industries. The extent of female participation is around 10 per cent in dairy processing which may be further enhanced. Many self-help groups (SHGs) are emerging in dairy processing in different areas which may be scaled-up with proper policy and infrastructure and institutional support. Saxena and Srivastava (2012) reported that proper identification of markets and marketing of dairy products remain the major challenges for female SHGs based on case study of Anmol Women Milk Cooperative in Haryana.

6.2 Reducing Post-Harvest Losses

Post-harvest management in crops, livestock and fisheries is highly crucial as it is responsible for maintaining quality and quantity of the produce. It becomes further critical in case of perishable commodities. A recent estimate has been given that the country lost the output worth approximately Rs 92,651 crore during 2012-13 at 2014 prices (Jha *et al.,* 2015). Box 2 provides the decomposition of these losses across commodities. Such losses basically happen on account of ineffective post-harvest management at critical stages of value-chains. Fruits, vegetables and livestock account for about 54 per cent of these losses. Such losses need to be saved through effective post-harvest management, improved marketing and value chain networks.

Box 2 : Extent of post-harvest losses across commodity groups

Crop/commodity	Monetary losses (production of 2012-13 and prices at 2014, Rs crore)	Major crops/segments in term of monetary losses (%)
Cereals	20698	Paddy (50), Wheat (38), Others (12)
Pulses	3877	Chickpea (63), Pigeonpea (25), Others (12)
Oilseeds	8278	Soybean (65), Mustard (18), Others (16)
Fruits	16644	Mango (43), Banana (23), Citrus (9), Apple (8), Others (16)
Vegetables	14842	Potato (34), Tomato (25), Onion (16), Cauliflower (8), Others (18)
Plantation crops	9325	Sugarcane (60), Coconut (22), Others (18)
Livestock Produce	18987	Milk (23), Marine fish (23), Poultry meat (21), Inland fish (20), Others (13)

Source: Jha *et al.* (2015).

Mission for Integrated Development of Horticulture (MIDH) is a Centrally Sponsored Scheme for the holistic growth of the horticulture

Table 16 : Number and share of persons employed in various food and manufacturing industries in India, 2011-12

Processing and preserving of meat		Processing and preserving of fish, crustaceans and molluscs and products thereof		Processing and preserving of fruit and vegetables		Manufacture of vegetable and animal oils and fats	
5.82 Lakh workers employed		*1.89 Lakh workers employed*		*0.96 Lakh workers employed*		*1.64 Lakh workers employed*	
Poultry and other slaughtering, preparation	44.8	Processing and canning of fish	39.7	Manufacture of pickles, chutney etc.	36.9	Vegetable oils and fats excluding corn oil	64.1
Mutton-slaughtering, preparation	38.7	Sun-drying of fish	39.4	Manufacture of fruit or vegetable juices and their concentrates, squashes and powder	29.4	Hydrogenated oil and vanaspati ghee	17.9
Production, processing and preserving of other meat and meat products	8.4	Processing and preserving of fish crustacean and similar foods	14.2	Preservation of fruit and vegetables	22.4	Non-defatted flour or meals of oilseeds, oil nuts or kernels	9.1
Pork-slaughtering, preparation	4.5	Radiation preservation of fish and similar food	4.5	Manufacture of sauces, jams, jellies and marmalades	6.7	Other vegetable oil, animal oil and fats	4.3
Beef-slaughtering, preparation	3.1	Production, processing and preservation of other fish products	2.2	Canning of fruits and vegetables	3.9	Edible animal oils and fats	3.2
others	0.5			others	0.7	others	1.5

Table 16 : Continued

Manufacture of dairy products		Manufacture of grain mill products, starches and starch products		Manufacture of other food products		Manufacture of prepared animal feeds	
2.55 Lakh workers employed		*15.12 Lakh workers employed*		*25 Lakh workers employed*		*0.61 Lakh workers employed*	
Pasteurized milk	35.5	Flour milling	41.8	Sweetmeats including dairy based sweetmeats	19.0	Cattle feed	64.4
Other dairy products	21.7	Rice milling	34.8	Manufacture or refining of sugar (sucrose) from sugarcane	11.8	Poultry feed	35.6
Baby milk foods	14.6	Cereal breakfast foods obtained by roasting or swelling cereal grains	11.0	Biscuits, cakes, pastries, rusks etc.	9.9		
Cream, butter, cheese, curd, ghee, khoya etc.	12.5	Dal (pulses) milling	5.0	Processing of edible nuts	9.6		
Ice-cream, kulfi etc.	12.3	Other grain milling and processing	3.1	Papads, appalam and similar food products	8.7		
Milk-powder, ice-cream powder and condensed milk except baby milk food	3.3	Grain milling other than wheat, rice and dal	2.0	Processing and blending of tea including manufacture of instant tea	8.0		
		others	2.3	Other bakery products	7.0		
				Bread	6.4		
				Prepared meals and dishes	3.5		
				Other processed products	16.2		

Source: Computed by authors.

Note: Figures in parentheses are percentages to the workers employed to the total workers in the respective industry.

sector and it aims at regionally differentiated strategies in accordance with comparative advantage of various agro-climatic regions, encourages aggregation of farmers, enhances horticulture production, augments farmers' income and strengthens nutritional security along with skill development and employment generation in horticulture and post-harvest management (Government of India, 2014). Along with this, the schemes like Rural Godown Scheme aim to facilitate storage of cereal crops by building storage capacity at farmers' doors. Ensuring public-private partnership can provide further boost to effective post-harvest management especially in rural areas.

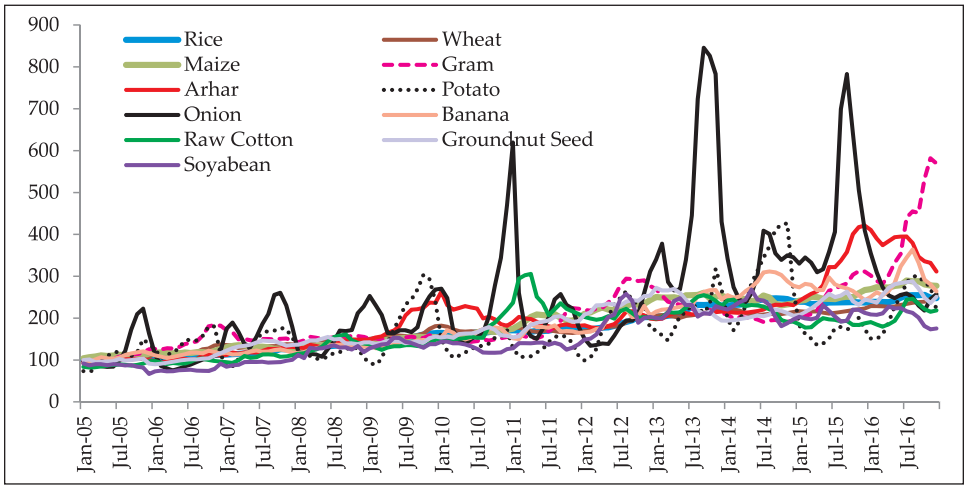
Chapter 7

Commodity Prices, Price Volatility and Farmers' Gains

7.1 Price Behaviour of Agricultural Commodities

Recently, the prices of many agricultural commodities have shown a high degree of volatility. There is enough evidence to show that prices of agricultural commodities are more volatile than those of the non-farm commodities (Chand and Parappurathu, 2011). The issue of high price volatility in agricultural commodities in domestic as well as international market has assumed critical importance. Figure 6 depicts the trends in wholesale price index (WPI) for various food commodities. The changes have been depicted on the basis of monthly series of WPI. Fruits and vegetables seem to exhibit highest price volatility among all agricultural commodities. Some commodities in this category, like onion, have created crisis situation in the economy many a times due to the extreme volatility in their prices. Onion is a highly sensitive commodity in fruits and vegetables category, whose WPI has touched the highest peaks of 619 in January, 2011 and 846 in September, 2013 and 782.8 in September, 2015. Year 2017 has also witnessed some price aberrations in onion.

Figure 6 : Trends in wholesale price indices of food commodities



Source: Office of the Economic Adviser.

7.2 Price Realisation and Farm Size

It has been established that prices will be one of the major sources of growth even if the status quo in the production is maintained. It does not imply here that prices need to be increased essentially; it implies that we need to improve farmers' share in consumer price and need to minimize during the chain costs, margins and inefficiencies. Table 17 and Table 18 provide the details of price realisation by the farmers for selected crops based on the SAS of Agricultural Households. We also examined whether the price realisation varies across farm size for major agencies

Table 17 : Prices received for major kharif crops, 2012 (Rs/kg)

Agency	Category	Paddy	Jowar	Bajra	Maize	Arhar	Urad	Moong	Sugar-cane	Cotton
Local Private	Marginal	12	13	11	12	36	29	37	2	37
	Small	11	4	10	11	38	28	38	3	39
	Semi-medium	14	9	11	12	31	28	41	2	39
	Medium	14	9	11	12	36	27	34	3	40
	Large	11	11		12	35		40	3	37
Mandi	Marginal	13	6	10	12	37	28	38	3	37
	Small	13	13	11	12	36	29	35	2	40
	Semi-medium	16	12	11	12	37	30	32	3	39
	Medium	14	14	10	12	34	28	38	4	40
	Large	15	12	13	12	38	27	44	3	37
Input dealers	Marginal	11	13	10	12	34	29	46	2	37
	Small	12	12	11	13	33	29	47	2	41
	Semi-medium	13	14	11	12	33	30	40	2	37
	Medium	12	13	12	12	32	28	53	2	40
	Large	14	-	10	11	-	26	-	2	38
Cooperative & Government Agency	Marginal	13	20	15	-	-	25	-	2	37
	Small	14	24	13	13	40	12	50	3	36
	Semi-medium	13	12	11	12	-	32	27	2	38
	Medium	13	14	13	13	36	-	31	5	37
	Large	14	15	-	13	-	-	-	-	42
Processors	Marginal	12	-	-	13	-	-	-	3	37
	Small	13	-	-	14	-	-	-	2	39
	Semi-medium	13	-	-	11	-	-	-	3	38
	Medium	14	-	-		-	-	-	3	34
	Large	15	-	-		-	-	-	3	38

Source: Computed from NSSS Unit Record Data on Situation Assessment Survey (2014).

to which the produce is sold. In general, medium and large farmers received higher price as compared to relatively marginal farm size categories. The major quantity of output at farm level flows through the local private and mandi. It was interesting to note that marginal and small farmers received comparatively higher price from cooperative and government agency in both season crops. The prices show minor difference across farm sizes in case of paddy, maize and sugarcane. However, pulses depict large variation in prices across farm categories, where medium farmers are receiving a high price of Rs 53 from input dealer to semi-medium receiving Rs 27 from cooperative and government agency from moong crop.

Table 18 : Prices received for major rabi crops, 2013 (Rs/kg)

Agency	Category	Jowar	Wheat	Barley	Gram	Lentil	Rapeseed/ Mustard
Local Private	Marginal	20	13	10	28	44	29
	Small	14	13	12	30	41	30
	Semi-medium	20	13	12	31	41	31
	Medium	15	13	10	33	43	30
	Large	12	13	11	35	39	29
Mandi	Marginal	14	14	13	28	33	31
	Small	14	14	10	30	35	31
	Semi-medium	15	14	12	30	37	31
	Medium	17	14	11	31	33	31
	Large	14	14	-	28	33	31
Input dealers	Marginal	25	12	-	30	46	29
	Small	14	12	13	30	35	30
	Semi-medium	14	13	13	29	34	31
	Medium	16	14	11	31	35	31
	Large	-	14	-	38	-	29
Cooperative & Government Agency	Marginal	-	14	-	30	-	-
	Small	-	14	-	28	-	30
	Semi-medium	-	14	-	-	-	-
	Medium	-	14	-	32	-	32
	Large	-	14	-	-	-	-
Processors	Marginal	-	16	-	-	30	20
	Small	-	13	-	-	-	28
	Semi-medium	-	11	-	-	-	20
	Medium	-	14	-	-	-	28
	Large	-	-	-	-	-	-

Source: Computed from NSSS Unit Record Data on Situation Assessment Survey (2014).

7.3 Farmers' Share in Consumer Price: Selected Cases

The studies have reported that farmers' share in consumer price remains very low, this share has been reported to be especially very low in case of horticultural commodities. A case study reported that farmers' share in consumer price varied from 25.5 per cent in apple, 39.9 per cent in banana, 41.1 per cent in onion, 41.7 per cent in tomato, 43.2 per cent in mango and 58.6 per cent in potato in Ahmedabad market during 2004 (Table 19). Producers stand to gain when improved marketing efficiency increases demand and prices for their products (Landes, 2010). Bhat and Aara (2012) reported that farmers' share is around 50 per cent in case of Delicious and American Apple (Channel: Producer-Commission Agent-Wholesaler Retailer-Consumer) except for Maharaji apple which is 35 per cent. The farmers' share are quite close in a different channels ranging from 48-51 per cent (Channel: Producer-Pre-harvest Contractor-wholesaler-Retailer-Consumer) for all three categories of apple.

Table 19 : Marketing cost, marketing margins and farmers' share for major fruits and vegetables in Ahmedabad and Chennai markets

Commodity	Ahmedabad			Chennai		
	Marketing Cost	Marketing Margin	Farmer's Share	Marketing Cost	Marketing Margin	Farmer's Share
			Vegetables			
Potato	8.4	32.9	58.6	28.9	9.7	61.4
Onion	18.3	40.6	41.1	25.4	20.6	54.0
Tomato	8.0	50.3	41.7	17.3	34.5	48.2
Cabbage	11.1	43.2	45.8	42.9	16.7	40.4
Cauliflower	5.5	37.0	68.5	49.3	9.0	41.8
Brinjal	9.1	48.1	42.9	29.7	22.1	48.3
Lady's finger	7.5	36.3	56.1	27.0	34.3	38.7
			Fruits			
Mango	17.9	38.9	43.2	18.7	13.7	67.6
Apple	5.0	69.4	25.5	37.5	21.8	40.8
Sapota	13.6	33.1	53.2	27.8	11.9	60.3
Banana	14.5	45.6	39.9	32.9	9.6	57.5
Sweet Orange	11.0	54.5	34.5	15.8	35.6	48.6
Pineapple	11.2	46.1	42.7	19.9	21.0	59.2
Pomegranate	11.7	48.5	39.8	23.2	33.8	43.0

Source: Gandhi and Namboodiri (2004).

As has been established, output growth only will not drive sufficient growth for farmers; rather it will be through efficient marketing arrangements that the income of farmers would be enhanced. Many innovative marketing arrangements have shown that farmers' share can be magnified and the marketing costs and margins of the chain can be handled efficiently. For gathering the temporal and spatial evidence of how the price realization across various commodities and regions, we conducted the meta-analysis of selected studies conducted at regional level and published in various journals. The summary results are presented in Box 3. The price realization to farmers, expressed as share in consumer rupee, indicates that it is lowest for fruits and vegetables after pulses. It varies according to the marketing channel selected even within a given geography for the selected commodity.

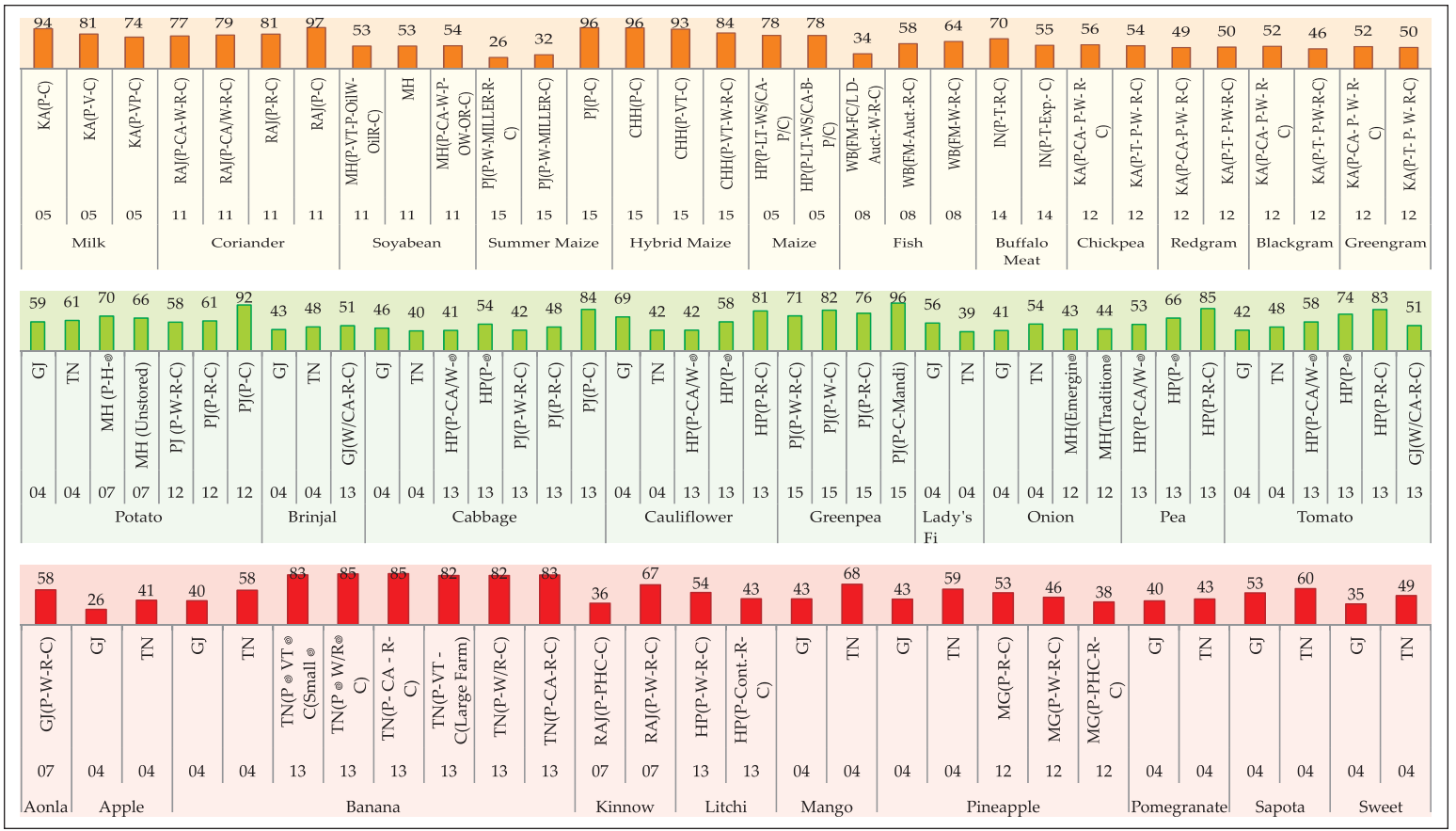
It is surprising to note that the farmers' share in onion remains around 43-44 per cent despite being the highest and quality producer of the onion in the country. Banana trading seems to be efficient as only 15-18 per cent of the consumer rupee is wiped away during marketing.

7.4 Participation of Paddy Farmers in Minimum Support Price Scheme (MSPS): Inclusiveness across Farm Categories

The idea behind MSP was to give guaranteed prices and assured market to the farmers and save them from the price fluctuations. The volatile and unstable behaviour of market prices in agricultural produce in India tends to create a situation of uncertainty in the mind of farmers. This calls for the assurance of remunerative and stable price environment for farmers and price policy in the form of minimum support price announced by the government is one of the initiatives in this direction. The efficacy of any program depends upon its powerful implementation and its widespread coverage. The successful implementation of any scheme can be achieved only if the targeted population is aware and participates in it.

Table 20 presents the percentage of aware farmers participating in MSPS. It was worked out that total 16 per cent farmers are aware of MSP for paddy crop and out of that 16 per cent only 3.8 per cent farmers participated in the sale of paddy crop under MSPS. This may be due to two reasons that either the market prices are lucrative or the procurement process is not fully supportive like the procurement agency is not available. Across the farm size, medium and large farmers are among the highest participating in MSPS, whereas the proportion of marginal farmers selling the produce at MSP is lowest. In Uttarakhand half of the farmers are selling their paddy produce through MSPS, whereas overall participation was highest among Chhattisgarh, Punjab and Haryana farmers.

Box 3 : Farmers' share for various commodities, years, channels and states (As per cent of consumer price)



Source: Drawn from various studies on commodity marketing channels and price spread.

Table 20 : Participation of paddy farmers in MSPS (% of paddy growers-cum-sellers)

States	Size Classes					
	Marginal	Small	Semi-medium	Medium	Large	All size classes
Andhra Pradesh	0.3	0.4	3.0	0.4	0.5	0.9
Assam	0.1	0.1	0.1	2.7	0.0	0.1
Bihar	0.7	1.8	4.0	7.6	0.0	1.0
Chhattisgarh	22.9	30.4	27.6	28.8	0.0	26.0
Gujarat	0.6	1.8	2.4	0.7	3.7	1.2
Haryana	19.2	21.8	14.5	16.6	20.0	18.0
Himachal Pradesh	0.0	1.2	3.6	6.7	0.0	0.3
Jammu and Kashmir	0.4	1.0	2.2	7.7	0.0	0.5
Jharkhand	0.1	0.0	0.4	0.2	0.0	0.1
Karnataka	1.3	4.5	6.8	1.1	4.2	3.1
Kerala	0.5	2.9	8.2	3.0	4.4	1.2
Madhya Pradesh	3.4	4.2	7.0	17.5	28.5	5.9
Maharashtra	2.2	3.3	2.4	3.5	3.5	2.8
Odisha	2.3	7.3	16.7	32.7	43.6	4.4
Punjab	13.7	27.3	30.8	31.4	29.8	25.0
Rajasthan	0.9	0.9	1.7	3.2	0.8	1.4
Tamil Nadu	2.4	3.0	5.0	5.6	1.9	3.0
Telangana	18.5	17.7	9.0	14.5	0.0	15.9
Uttar Pradesh	2.9	6.8	9.0	7.5	22.0	4.1
Uttarakhand	3.4	31.6	24.2	22.4	50.0	5.8
West Bengal	1.5	0.7	1.7	1.8	0.0	1.5
All India	2.5	5.3	6.6	8.7	10.4	3.8

Source: Computed from NSSS Unit Record Data on Situation Assessment Survey (2014).

7.5 Price Volatility across Different Crops

The food inflation has remained a matter of concern for the policymakers. In the case of products like onion, potato, tomato and some other horticultural products; prices have shown violent rise and also sharp fall even during a short period. Low price elasticity of demand and low income elasticity and inherently instable production are considered as important factors for high volatility in food prices. The volatility has turned much more severe after year 2009; due to uncertainties in weather conditions, pests and diseases, floods etc. which negatively affect the production of food commodities.

Table 21 provides the extent of price volatility across various commodities based on the wholesale price index (WPI) of selected commodities. We have tried to compare the volatility among the selected commodities based on whether there exists the MSP price support scheme or not. The volatility remains low in commodities where, support exists in terms of MSP and organized mechanisms exist for procurement and logistics. On the other hand, instability in prices of fruits and vegetables remains a matter of concern. This is due to the nature of commodities in terms of their perishability and further no price support scheme exists for these commodities. Farmers find it difficult to decide a gainful cropping plan as prices go sky rocketing one year and suddenly dump next year. Such volatility in prices needs to be addressed through proper market information and intelligence efforts. Also, the role of procurement agencies like NAFED is also very important to provide assured sale to the farmers for their produce at reasonable prices. Effective utilisation of the Price Stabilisation Fund for monitoring and Surveillance of price volatility is the need of the hour. Increased investment and enhancement of storage capacity at farmers' field will be very helpful in increasing the price realization and will be beneficial for both the producers and consumers.

Table 21 : Extent of volatility across commodities

Commodity	Mean WPI			Range		Instability Index (%)		
	2005-10	2011-16	2005-16	2005-10	2011-16	2005-10	2011-16	2005-16
Under Price Support Operations								
Rice	131.1	216.6	173.9	101-171	167-255	4.0	5.3	9.4
Wheat	138.6	204.4	171.5	96-182	164-252	4.0	4.5	8.0
Maize	134.7	241.2	187.9	104-172	175-297	3.0	5.5	10.9
Gram	143.4	254.7	199.0	98-183	152-582	11.2	28.5	15.8
Pigeonpea	144.9	250.9	197.9	89-263	176-421	14.0	16.4	16.0
Groundnut	131.4	227.4	179.4	90-178	154-288	7.3	11.2	13.7
Soybean	108.3	198.7	153.5	67-153	125-268	12.7	14.6	15.4
Cotton	121.5	216.3	168.9	82-220	177-306	10.6	11.2	14.9
No Price Support								
Potato	139.4	206.7	173.0	72-304	99-427	31.5	34.4	16.4
Onion	165.6	325.9	245.8	75-469	134-846	33.7	49.3	25.3
Banana	128.9	242.1	185.5	93-178	150-364	6.1	10.0	15.5

Source : Computed by authors.

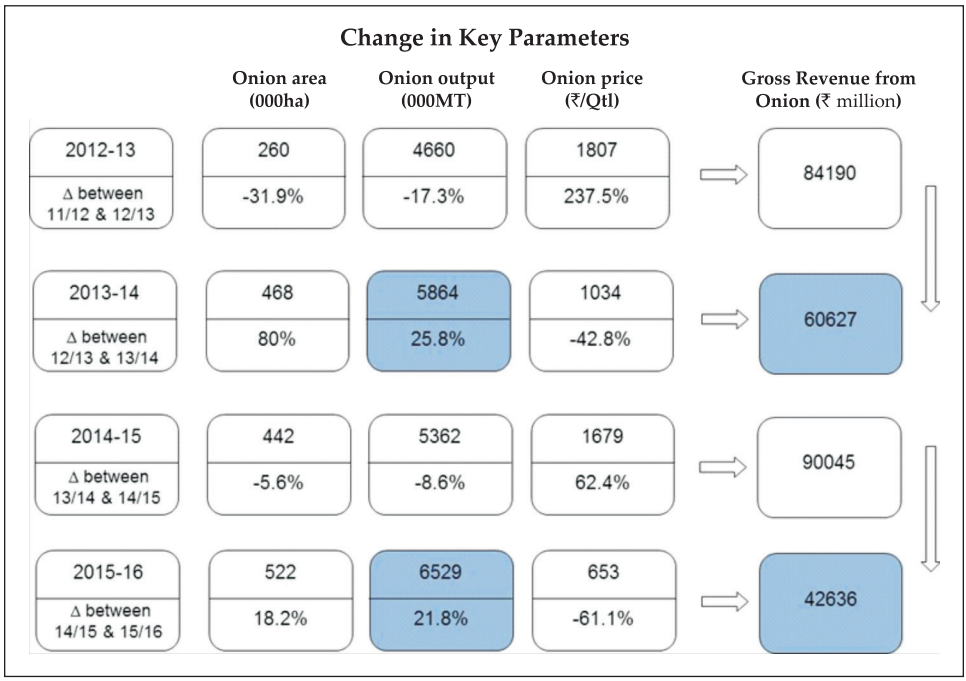
7.6 How Volatility Wipe away the Gains from Farmers?

The country has witnessed two major onion price shocks during the last five years, which have affected the producers as well as consumers. Volatility in onion prices continues to be a matter of concern not only in domestic markets but also for export market. It is important to understand the production-price linkages to understand the recurring price shocks in the country. As evident, onion production has witnessed profound changes during the recent years. However, the growth in production reveals that previous year's growth during the crisis preceding years plays a determining role. This becomes evident from close examination of the sequence of change in production, market arrival and prices during the crisis year and in the year preceding the price shocks using the evidence from the state of Maharashtra (Box 4), which is the largest onion producing state and market leader for onion.

A very strong and signifying association is seen between the production in year T and market arrivals in the state in the year T+1. The production decline in any year was followed by the decline in market arrivals in the subsequent years. The consequent change was observed in prices. In year 2012-13, the production declined by 32 per cent leading to 238 per cent increase in prices in 2013-14. Following this, acreage increased by 80 per cent next year and production increased by 26 per cent; however, prices declined by about 43 per cent. This led to decline in the gross revenue for onion declined by 28 per cent. The similar cycle repeated during the next two years. An extreme situation was observed in 2016-17 followed by the hike in prices in 2015, when increase in production by 22 per cent led to an extreme decline in prices by 61 per cent. This led to decline in gross revenue by 53 per cent. The traders and farmers in Nashik region revealed that production decline not only resulted in the decline in market arrivals but also the quality as the production shock resulted mainly due to untimely rains and thunderstorms. This further affected the storability of rabi onion and reduced the shelf life of the crop.

The farmers suffered on two counts: a) the decline in gross income from onion due to decline in its prices, b) the loss also occurred due to shift in acreage from the other competitive crop which otherwise would have provided remunerative returns to farmers. Thus, the price instability needs to be checked and minimised through suitable interventions to ensure stable and required returns to the farmers. Effective procurement strategies by NAFED and proper use of Price Stabilisation Fund would be useful in this regard.

Box 4 : Losses to farmers from price volatility: Case of onion in Maharashtra



Source: Computed by authors.

This is extremely important that concerted efforts are continued to achieve this objective. The e-NAM is latest initiative which will provide national unified agricultural markets to farmers and bring better price realization through connectivity, transparency and enhanced integration. However, an ex-ante analysis may be conducted in those *mandies* which have already been connected through the e-NAM. Ensuring private sector participation can bring competition and will provide added gains to the farmers. Effective post-harvest management will yield not only in terms of increased availability rather it may help farmers fetch remunerative prices for their produce. The gains from trade can further be much larger. Objective conditions and policies need to be imposed for the commodities having significant trade potential. For this, networking is required among academic, research institutions and practicing organizations for proper technical supervision and guidance.

Chapter 8

Contribution of Agricultural Research and Development [1]

ICAR Institutes developed a number of cost-effective technologies, techniques and products, not only to enhance the productivity of various crops and commodities, but also the quality of produce, for enabling remunerative agriculture and enhancing farmers' incomes.

8.1 Varietal Development

Role of ICAR is extremely crucial in developing and spreading the use of better yielding varieties suitable for different typologies which can contribute to farmers' incomes. Besides, the development of improved varieties/hybrids of food crops and their cultivation are central to increased farm production and consequently national food and nutritional security. During 2015-16, high-yielding varieties of cereals (21), oilseeds (16), pulses (8), forage crops (6) and commercial crop (3) were released from ICAR institutions for cultivation in different production ecologies of the country. Biofortified rice variety CR Dhan 310 was commercialized successfully in the Indo-Gangetic Plains belt and Swarna Shreya, a new rice variety for drought–prone conditions was released. To ensure a faster spread to farmers' fields, 978, 17562, 12847, 14000, and 3418 tonnes of breeder, foundation, certified, truthfully labelled seed and planting material, respectively, were produced.

Pusa Basmati 1121: Pusa basmati 1121 was released in the year 2003 and recommended for Punjab, Haryana, western Uttar Pradesh, and Uttarakhand along with other Basmati growing areas. The crop has the productivity of 4.0-4.5 t/ha and matures in 140-145 days, a fortnight earlier than Taraori basmati. The grain is longer (8 mm) with cooked grain length of approximately 20 mm and it is better in cooking compared to that of Taraori basmati. It requires low input and provides high yield with better quality rice for export.

[1] This section has been drawn from the ICAR Annual Report and the Annual Reports of respective ICAR Institutes developing the technologies.

8.2 Integrated Farming Solutions

Integrated farming is one of the solutions for enhancing the income and gains to farmers. An integrated farming system (1 ha) model comprising cropping systems (0.52 ha) + horticulture (0.32 ha) + dairy including bio-gas and vermi-compost unit (0.08 ha) + fish cum poultry (0.1 ha) + mushroom developed in western Himalayas, provided round the year improved production (21.52 tonnes REY (rice equivalent yield)/year), profit (3.06 lakh/year) and employment (731 man days/year).

By rice-wheat-mungbean or rice-potato-mungbean cropping system, an increase of 12-15% in total productivity and a net profit of Rs. 15000 to 22000/ha can be obtained as compared to rice-wheat cropping system. Cotton-wheat, pigeonpea-wheat, maize-vegetable pea/potato-sunflower, soybean-vegetable pea/potato sunflower and groundnut-wheat-mungbean cropping systems are economically acceptable and environmentally sustainable option for rice-wheat system. African mustard/Indian mustard based intercropping systems with potato (1:3 replacement series), wheat (1:4 or 1:6), linseed (1:6), and chickpea (1:4 or 2:8) are more productive and profitable than their sole stand. African mustard at 90 cm + 2 rows of peas, coriander, fenugreek or radish are more productive and remunerative compared to their sole stand. Horticulture will also assure substantial gains to the farmers. Nutrient management schedule for organic production of Grand Naine and Nendran banana; the technology for production of iron-fortified oyster mushrooms (Hypsizygus ulmarius); fertilizer adjustment equation for targeted yield (690–1140 kg/ha) of Appangala 1 and Green Gold varieties of cardamom and integrated nutrient management schedule with improved corn yield of turmeric variety Sudarsana, were developed. An integrated cropping system having coconut + cocoa + banana + pineapple with net income of 3.77 lakh/ha was developed and successfully demonstrated at Aliyarnagar, Tamil Nadu.

8.3 Protected Cultivation

Protected cultivation is a cropping technique for growing horticultural crops under protective structures to shield them from pests and weather for assured, climate-resilient and enhanced production of quality products. Protected cultivation can be undertaken in the following structures:

Naturally ventilated polyhouse technology: This is a special structure made of G.I. pipes, insect proof nets and transparent plastic sheets, which protect the crops from adverse climatic conditions, insect-pests and different viruses. In this type of polyhouse, all four sides of the greenhouse are covered with an insect-proof, 40 mesh nylon net. Rollable plastic curtains from the ground are used to cover sides. During summer, this plastic curtain

is rolled up and down in winter for proper cross ventilation with the help of a pipe. The roof is covered with 200 micron thick, transparent polythene film. This kind of polyhouse does not require electricity. For irrigation, low pressure drip irrigation system is used. This type of structure is suitable for peri-urban areas where high value vegetables like tomato, capsicum, parthenocarpic cucumber etc. and flowers like rose, chrysanthemum and gerbera can be grown easily.

***Integrated Pest Management (IPM)*:** The major contributions relate to validation and dissemination of IPM in the targeted crops (rice, cotton, pulses, oilseeds, vegetables and fruits). During 2008 to 2014, area covered under IPM programmes in different target crops increased from 658 to 1587 ha. The e-Pest Surveillance and Advisory System covering 14 States with emphasis on Maharashtra and Odisha were established; this resulted in reduction in the use of insecticides for pest management without compromising the productivity of crops. The IPM module developed by the Centre for pest management in basmati rice was found to be very effective in Uttarakhand, Haryana and Uttar Pradesh. IPM practices helped in increasing cotton productivity by 20-25 per cent. The IPM modules developed for cotton also gave significant reduction in mealybug infestation in Punjab. IPM also showed good promise in pulse production. A major impact of IPM was observed in improving productivity of pigeonpea in Karnataka. A GIS-based automated crop pest mapping system has been developed for major pests and diseases of soybean, cotton, chickpea and pigeonpea.

8.4 Resource Conservation Technologies

Resource use efficiency may also contribute significantly to the savings on cost front and thus enhancing the revenues to farmers. Land resource inventory on 1:10,000 scale was prepared taking Landscape Ecological Unit (LEU) consisting of landforms, land use and slope as the base map while bio-climatic map of India was revised. Electronic atlas of water resources, developed for Odisha and Himachal Pradesh, is a useful tool for catch assessment and developing GIS based Decision Support System. The information will help planners to concentrate efforts, allocate resources and deploy manpower according to the distribution of fishery resources.

Zero–Tillage Technology: In zero tillage (ZT) technology, soil is not ploughed, but sowing of crop is done by using a specially designed zero-till seed-cumfertilizer drill/planter, which disturbs soil to the least possible extent. At the time of seeding, fertilizers are simultaneously placed beneath the seeds. Several modern seeding machines, such as happy seeder, turbo

seeder, multi-crop planter, rotodouble disc planter are necessary for sowing in residue-laden conditions. Zero tillage proves better for direct-seeded rice, maize, soybean, cotton, pigeonpea, mungbean, clusterbean, pearlmillet during kharif season and wheat, barley, chickpea, mustard and lentil during rabi season. Wheat sowing after rice can be advanced by 10-12 days by adopting this technique compared to conventionally tilled wheat, and wheat yield reduction caused by late sowing can be avoided. ZT provides opportunity to escape wheat crop from terminal heat stress. Zero tillage reduces cost of cultivation by nearly Rs 2,500-3,000/ha through reduction in cost of land preparation, and reduces diesel consumption by 50-60 litres per hectare. Zero tillage reduces water requirement of crop and the loss of organic carbon by oxidation. Zero tillage reduces Phalaris minor problem in wheat. The carbon status of soil is significantly enhanced in surface soil (0-5 cm), particularly under crop residue retention with zero tillage.

Raised Bed planting technology for enhancing crop productivity: Raised bed planting is a promising technique of crop establishment during kharif season. It increases the productivity of crops like cotton, maize, pigeonpea, green gram, soybean, cowpea, vegetables, etc., which are grown in kharif and prone to water logging. Raised bed planting increases grain yield and economic returns, improves resource use efficiency and reduces weed problem. Bed planting system helps in efficient use of water under rainfed as well as irrigated conditions because of optimum water storage and safe disposal of excess water. Furrow irrigated raised-bed system (FIRBS) of wheat usually saves seed by around 25 per cent, water by 25-30 per cent and nutrients by 25 per cent without affecting wheat grain yield. It reduces weed populations on the top of beds and lodging of wheat crop. The productivity of cotton-wheat, pigeonpea-wheat and maize wheat systems is higher under ZT bed planting with crop residue. Cotton-wheat cropping system under ZT broad bed with residues of both crops gave higher system productivity and net returns than that in the transplanted rice-conventional till wheat cropping system. Therefore, it can be an alternative option for rice-wheat system under irrigated conditions.

Direct-Seeded Rice: Direct-seeded rice (DSR) avoids water required for puddling and reduces overall water demand compared to conventional puddled transplanted rice (TPR). DSR is a labour, fuel, time and water saving technology, which gives comparable yield as that of TPR. Soil health is maintained or improved, and fertilizer and water-use efficiencies are higher in DSR (saving of 30-40% irrigation water). Therefore, DSR is a technically and economically feasible alternative to TPR. In North Indian conditions, summer mungbean can be adopted before DSR. It gives grain

yield of 0.8-1.0 t/ha and usually adds 40-60 kg N/ha in soil, reducing N requirement for the subsequent crop.

8.5 Livestock Technologies

Livestock sector is supposed to contribute significantly among all sub-sectors to the farmers' incomes. India has been holding the position of leading milk producing nation in the world for the last several years with sustainable increase in the annual milk production wherein the research developments played a crucial role. Studies showed that average first lactation 305 days milk yield of cows was 3,703.6±31.3 kg and average age at first calving was 1,036.6±10.2 days. Under Conservation and Genetic Improvement of Indigenous Cattle Breeds, the milk yield showed an increasing trend among the progenies of different sets, and average 305 days milk yield increased from 1,958 kg in first set to 2,604 kg in 10th set.

Certain pockets in the country are dominated by the existence of small ruminants, proper management of which may contribute significantly to the incomes. The implementation of goat husbandry technologies in famers' flock provided average employment ranging between 80 and 140 man days in a year; and income improved from 67 to 257 per cent of investment in Assam hill goat.

Peste des Petits Ruminants (PPR) and Foot and Mouth Disease (FMD) Vaccine: PPR or goat plague is the most important disease of sheep and goats causing an economic loss to the tune of Rs 1,800 million/annum. The mass scale use of PPR vaccine developed by IVRI resulted in reduction of more than 75 per cent disease incidence (< 300 outbreaks as against 1,200 outbreaks/annum) thus saving an annual loss of about Rs 1,200 million. The application of this vaccine has a very high impact on livelihood security of poor people, who depend on sheep and goat rearing. The technology has been transferred to four industries. FMD is the most important infectious disease of cattle and buffaloes causing an economic loss of Rs 20,000 crores/annum. FMD vaccine production technology in India was first implemented at IVRI, Bangalore campus in late 1970s. About 52 million doses of trivalent vaccine has been produced and supplied till date for FMD prophylaxis throughout the country. The reduced incidence of the disease has ultimately impacted on livelihood security of poor people, who depend on these animals for milk and draught purposes.

Mineral Mixture Supplementation: The mineral deficiency is manifested in the form of loss of hairs, skin disorders, anaemia, loss of appetite, bone abnormalities and suboptimum production and reproductive problems. Thus, supplementation of minerals is inevitable

to achieve optimum health and production. The technology is available for the formulation of mineral mixtures as per the recommendations of Bureau of Indian Standards for different species *i.e.* cattle, buffalo and goat to supplement major and trace minerals like Ca, P, Mg, Fe, Zn, Mn, I and Co etc. There are two types of formulations of mineral mixture, one is with salt and the other is without salt. It should be mixed in the concentrate mixture @ 2kg per 100 kg (without salt) and @ 3 kg/100 kg (with salt). Supplementation increases the feed intake, feed conversion efficiency and productive performance of animals in terms of growth, reproduction and milk production. Mineral supplementation was found to enhance productive and reproductive performances of ruminant species, particularly to those who are deficient in particular types of minerals.

Fisheries Sector: ICAR has extended support for multiple breeding of Indian major carps for year round seed production. The technologies related to intensive carp culture and production levels of 10-15 tonnes/ha/yr along with improved rohu (Jayanti) with 17 per cent higher growth realization per generation after eight generations through selective breeding have been developed. Besides these, the breeding, seed production and culture technology for important brackishwater and marine finfishes such as milkfish (Chanos chanos), pearlspot (Etroplus suratensis), Asian seabass (Lates calcarifer), cobia (Rachycentron canadum)and Silver pompano (Trachinotus blochii), etc. have also been developed.

8.6 Agricultural Education

Agricultural education will facilitate proper awareness, adoption and utilization of existing resources, technologies and processing activities. Higher agricultural education, financial and monitoring support was provided for Niche Area of Excellence (28), Experiential Learning Units (21 new), besides refurbishing and maintenance of educational structures, student and faculty amenities, course curricula revision/improvement, strengthening of libraries with ICT and modernization of teaching with multimedia learning resources.

8.7 Agricultural Extension

Extension services are important in spreading the technologies and the associated benefits. Kisan mobile advisory (KMA), an initiative by the ICAR, sent 93,949 short text messages, 14,788 voice messages and 1,180 both SMS and voice messages to benefit 223.94 lakh farmers on various aspects of agriculture based on input provided by 557 *Krishi Vigyan Kendras* (KVKs). The processes of technology assessment and refinement are as important as the technology generation prior to transfer at the field level. During 2015-16, 2,652 technology interventions were assessed across 4,003

locations by laying out 27,008 trials on the farmers' fields. In all, 228.75 lakh quality planting materials of elite species of different crops were produced and provided to 18.38 lakh farmers.

For doubling of farmers' incomes, it is important that existing pool of agricultural knowledge regarding technologies and processes is channelized and implemented for the benefits of its stakeholders. The strategies covering various policies and strategies related to technology development, refinement and spread/adoption; effective implementation of marketing reforms; expansion of value addition and processing capacity; inculcating entrepreneurial skills among the educated farm youth and effective trade policies need to be prepared.

Chapter 9

Conclusions and Strategies

The Prime Minister's call to double farmers' income by 2022 has brought renewed interest among entire stakeholders in the country, ranging from the agricultural research community, policy executives, state authorities, extension agencies, private players, and more importantly among farmers. Major approaches include re-orienting focus from intensification to diversification, from sustenance to commercialization, and turning the agricultural units to enterprises. Different central and state level programs have been floated to execute and monitor the outreach of technologies, soil health, farm credit and market to the farmers. Price supports are triggered for many of the crops, entrepreneurship is inculcated to the farming community.

Despite of all strengths, an inherent drawback in these approaches has been that many of them operate in isolates, lacking a unified framework that numerically explain various factors that contribute to the doubling goal. Of course, strategies could only be region-specific, and could operate only under given agro-climatic forces. The sources would ultimately vary at disaggregated geographies, demanding numerous approaches at different environments. Still, the macro forces that explain the short-future, at least till the target year 2022, and possible contributions of factor productivity, labor transformation, terms of trade and market volatility demands high place in achieving the goal. The present study attempts to devise strategies to double farmers' income, balancing both macro and meso environments. The study covers possible contributions of different sources at both national level and at state level. The study also bypasses the other major hurdle: obtaining income estimates of the farmers, and generating methodology of estimation.

It highlights the role of TFP growth that emerges from agricultural R&D, extension services, new knowledge and practices in achieving the goal. It brings to our focus that technology dissemination than generation still provides us a promising scope to increase income at farm level. The estimates portray that yield gap vary from one-fourth to one-third within the paddy farms. Jowar farms in Maharashtra and Karnataka, and bajra farms in Rajasthan still exhibit yield gap as high as 50 per cent. The estimates for gram in Madhya Pradesh stands more than 30 per cent, and by 45 per

cent in Rajasthan and Maharashtra. Cash crops, which are input intensive, also exhibit yield gap of around 30-50 per cent. These scenarios offer us to increase output, thereby income, by using the existing technologies itself. Tapping this potential depends on expanding irrigation, and delivering better quality seeds. The yield differences in irrigated fields produce around 8 quintals/ha of higher paddy, 2-5 quintals/ha of higher gram, 5-15 quintal/ha of higher maize and 3 quintal/ha of higher cotton. Even when prices turn poor, higher output from the same land could offer increased income to the farmers.

The other major strategy to follow is to encourage processing by the household sector. Against the corporate sector, which contributes by around 7 per cent, household sector contributes by around 13 per cent of the output of food processing sector. Fruits and vegetables, and livestock processing especially provide high scope. This would turn to reality under optimal skill delivery to the farm households. Special schemes could be introduced that cater processing by the farmers and simultaneously link the processed food to the urban market. Equally, encouraging Farmer Producer Organizations and other private sector to invest more in processing would complement the effort.

The market trends display relative price stability to the cereal sector against high volatility for the vegetables and fruits. For example, the WPI for onion for the year 2011 was 619, and has peaked to 783 during 2015. Further, cob-web phenomenon as well turn proved through this study. Market prices remain high, but as a contrary, farmers share remain low for these high value crops. While paddy, wheat and gram growers fetch by around 60-80 per cent, fruits and vegetable growers report around 25-40 per cent only. This demands attention of the researchers and policy makers while proposing farmers to diversify. It demands for improved market efficiency and price policies more in favour of high value crops, and creating localized market infrastructure that could store fruits and vegetables to reap market gains.

The study brings out region-specific issues and constraints in holistic but detailed sphere, ranging from production to processing and marketing; meanwhile provides appropriate strategies as solutions. Moving our steps towards suggested directions would foster the efforts to double income of the farmers in the stipulated year.

STRATEGIES

9.1 Reducing Dependence on Agriculture

The agricultural workforce in the country, which can be classified into cultivators and agricultural labourers, decreased from 25.84 crores

in 2004-05 to 22.44 crores in 2011-12. The cultivators declined from 16.6 crores in 2004-05 to 14.6 crores in 2011-12. At the same time, a decline of 15.63 per cent was noticed in case of agricultural labourers during 2004-05 to 2011-12. This indicates that cultivators are leaving farming due to its unprofitable nature or better non-farm opportunities. The 59th NSSO survey on Situation Assessment of Agricultural Households revealed that 40 per cent of the farmers would like to take up another profession. Even some micro studies have revealed that the cultivators lease out the cultivable land to contractors/leases due to some inherent constraints in cultivation process.

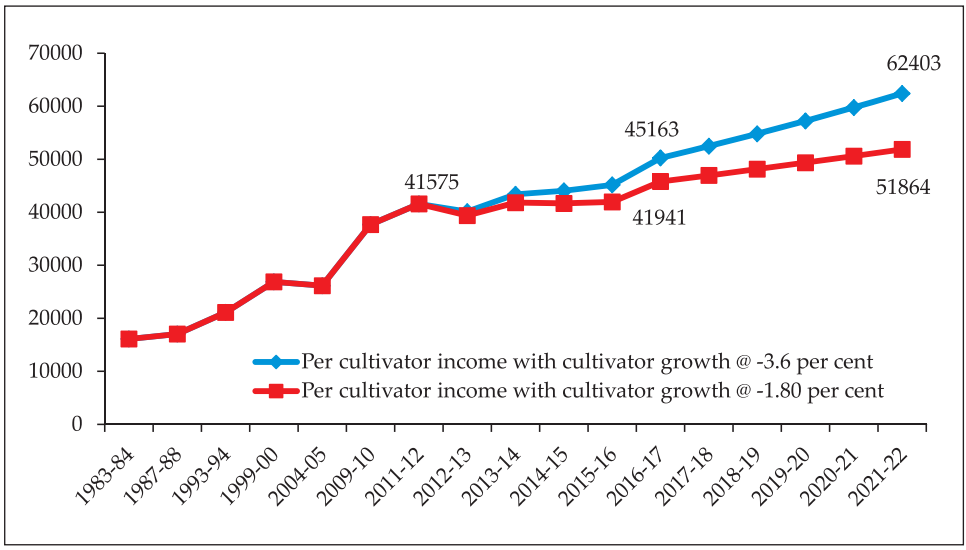
To examine the impact of decline in number of cultivators on increase in per cultivator income, we computed per cultivator income by assuming different rates of decline in number of cultivators following the farm income methodology given by Chand *et al.* (2015). During 2004-05 to 2011-12, the number of cultivators in agriculture declined at the rate of 1.8 per cent per year. One may assume the same rate for next six years also and that would tantamount to 24 per cent increase in cultivators' income between 2015-16 and 2021-22. However, it has been witnessed during last few decades that non-farm sector grew at much appreciable rate as compared to farm sector. It may be noted that agriculture (including allied activities), manufacturing and service sector grew at CAGR of 3.7, 8.4, and 9.0 per cent, respectively, during 2004-05 to 2014-15. Thus, the non-farm sector is providing better employment opportunities to the cultivators' young and educated family members. Further, policies related to continuous emphasis on land consolidation may also yield some impact on the current state of holdings and cultivators.

Moving on this premise, we assumed the double rate of decline in cultivators, *i.e.* -3.6 per cent per year as compared -1.80 per cent per year during 2004-05 to 2011-12. This may be particularly true for those cultivators who are at a marginal and very small level and has been assumed for next 6 years. The premise of 3.6 per cent decline per year in number of cultivators shall increase farm income from Rs 45,163 in 2015-16 to Rs 62,403 in 2021-22 (Figure 7), which is contributing to approximately 38 per cent increase in farmers' income. As we move ahead with interventions in other critical areas, we might bring the remaining increase in farmers' income. This may seem to be a soft approach and people may argue that this increase in income by just reducing the denominator, *i.e.* numbers of cultivators is not plausible. There, it may be noted that it is not simply pressing the denominator rather it is a graceful shift to more earning avenues in agriculture as well as non-agriculture sector.

The increasing emphasis on agri-business requires that agriculture units do not remain isolated cultivating units rather are transformed into

agri-enterprises performing more functions at the same time rather than simply the cultivation function. Encouraging processing and building value chains would help create nonfarm jobs in rural areas (Gulati and Saini, 2016). This demands inter-sectoral as well as intra-sectoral integration in terms of functions and activities along with manpower.

Figure 7 : Assuming different growth in number of cultivators: Impact on cultivators' income (Rs per annum)



Source: Computed by authors.

9.2 Value Chain Approach

The technological interventions will increase the profitability, but as has been experienced in the past that producers become the victims of increased supply and loose significantly and, thus, suitable, procurement, logistics and marketing interventions will help optimise the revenues to farmers. For illustration, the case of onion has been explained in detail in previous section. The producers borne the losses despite significant increase in production in Maharashtra. The time has come when things are to be dealt in totality not in isolation. Neither the productivity centric nor the marketing and price centric approach are going to work in isolation. Every commodity has to be dealt in a holistic value chain approach when suitable interventions are required at all the critical stages.

9.3 Review of Current Programmes and Schemes

A number of schemes and programmes have already been in existence for number of years in the country. The schemes were started with good

ideas and intended to deliver with welfare motives. Hon'ble Prime Minister has already taken initiative to review and revamp the existing irrigation schemes. Other mega initiatives and schemes on crop insurance, soil health card, promotion of organic agriculture are already in vogue and will yield the intended benefits in due course of time.

Agri-entrepreneurship needs to be provided boost to cater to the emerging needs of the sector and enhance the agribusiness potential. Agriclinics and Agribusiness Centres Scheme of Government of India was started in the year 2002-03 with the financial support of NABARD. The mid-term evaluation report of the scheme the scheme has been successfully implemented in 25 states across the country and generated employment for 4,152 graduates, post graduates and doctorates, which in turn created further 25,000 jobs across segments, thus, benefiting more than one lakh farmers in more than 7,000 villages across the country. Such programmes, if implemented on a mega scale, can change the face of Indian agriculture, increase farmers' incomes and enhance overall welfare of the rural economy. Such programmes, in long run, will accelerate the inclination towards farming and orient the agriculture educated youth towards agribusiness.

Consensus among stakeholders is necessary to promise and deliver the targeted growth for each sub-sector; strategic framework may be formulated for achieving the targeted growth. Wide-scale sensitization of stakeholders is required across the country to put them on the targeted growth.

9.4 Infrastructure Development

As established in the studies, marketing infrastructure plays crucial role in increasing the efficiency of the agricultural transactions. Such efficiency and gains, if aggregated on a larger scale, may provide fruitful gains to the farmers. The Central sector scheme on Agricultural Marketing Infrastructure-Grading and Standardization was launched in 2004 for general or commodity specific marketing infrastructure for agricultural and allied commodities and for strengthening and modernization of existing agricultural markets, including those of wholesale, rural, periodic in nature. As per the schemes documents, the scheme intended to provide additional agricultural marketing infrastructure to cope up with the large expected marketable surpluses of agricultural and allied commodities including dairy, poultry, fishery, livestock and minor forest produce. Such schemes need a mid-term and ex-post impact analysis and examine the operational constraints for effective implementation and optimum benefit realization.

9.5 Linkages among the Organisations and Stakeholders

It would be prerequisite that the implementation of DFI Plan should be with a clear visionary framework and strategic plans need to be formulated for all sub-sectors. This requires linkages among the high-powered think tanks like NITI Aayog, Ministry of Agriculture and Farmers' Welfare, Ministry of Food Processing Industries, Ministry of Commerce and Industry and other relevant organizations working in this direction. National Bank for Agriculture and Rural Development (NABARD) is playing pivotal role in refinancing initiatives, building producer groups and association, capacity building of the stakeholders and establishing linkages. Role of Indian Council of Agricultural Research would be extremely important to initiate and launch various technological breakthroughs for required transformation. Organisations dealing with data warehouses and repositories like, Ministry of Agriculture and Farmers' Welfare, Ministry of Statistics and Programme Implementation, Labour Bureau and other relevant organizations will establish a connect among the implementing and development agencies.

9.6 Prioritisation of Areas for Investment

Prioritization of areas for investment based on the potential to contribute to the targeted growth can be attempted by identifying and prioritizing the constraints. It will not be the responsibility of public sector alone rather the specific modes of interventions need to be identified through public, private or participatory approach. Some areas may require only the attention of public sector, like building of roads, markets and other infrastructure.

9.7 Centre-State Linkages

Centre-State linkages would be extremely important in mainstreaming and channelizing the policies and investment to the targeted goals for development. A crucial role would be played by the state and state development agencies in formulating state plans and strategic framework for fulfilling the objective. Farmers' associations and non-government organizations will put forth farmers' interests and their voices on the fore-front. Emphasis on women self-help groups should improve the micro and small industries.

9.8 Making the Farmers Party to the Mission

A relevant approach would be making the farmers party to the mission and ensure their participatory approach so as to awaken them and put them on the wheel of growth. According to the Hon'ble Prime

Minister, agriculture has to stand on three pillars-*Paramparagat Kheti* (traditional agriculture), diversification into agroforestry by planting trees on the boundaries of farmers' fields, and encouraging livestock and beekeeping, duly supported by food processing; these pillars will reduce the risks in farming, and augment farmers' incomes. The educated youth from farming families can be the change agents. The skill development and capacity building of these young members would help in adoption of improved technologies and modern farm and marketing practices.

9.9 Agricultural Credit and Other Reforms

Role of agricultural credit is extremely important in meeting the crop cultivation, animal rearing and other sub-sectors' requirements in agriculture. The Government of India has initiated several policy reforms to ensure the timely and required availability of credit to the farmers with the purpose to have progressive institutionalization with an inclusive approach. A notable reform initiated recently is Kisan Credit Card Scheme to enable the farmers to purchase agricultural inputs and draw cash to meet their consumption needs. National Bank for Agriculture and Rural Development is extensively promoting the micro-finance and the Farmer Producer Organizations. Some state governments and NABARD are also promoting FPOs; however, the number and network of FPOs is very small and it needs to be expanded to enable farmers to reduce transaction coasts, access technology, raise bargaining power and integrate with value chains (Chand 2017). Credit expansion across regions and farm size classes would further help in enhancing efficiency and farmers' gains.

As most of the farmers in the country lie in the marginal and small category with very small holding size which makes the diffusion of advanced technologies difficult. The holdings are tiny and scattered particularly in the hilly areas. Thus, land consolidation coupled with other suitable reforms need to be effectively implemented. Further, the climatic risks are resulting in decline in productivity and creating distorting impact on prices. Thus, risk management is an essential component to be studied in detail.

Doubling of farmers' income requires not only the interventions and development in the agricultural sector but also requires the strong linkages with manufacturing and service sector to transform the '*agricultural units to agricultural enterprises'*. Thus, it is not going to be an isolated game that would transform the face of Indian agriculture. Rather, it will be putting all forces together for the holistic development of this sector to provide it more modern and professional orientation.

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