Farm Income in India: Myths and Realities

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Abstract

India's agricultural sector is one of the largest in the world today in terms of production of foodgrains and other agricultural commodities. With over 60 million tonnes of buffer stock, India is not only a self sufficient country now but also an exporter of foodgrains to many countries. Although farmers have played decisive role in changing the farm sector to greater heights, their socio-economic conditions are reportedly in shambles today. Owing to poor income from crops cultivation that resulted in increased indebtedness, widespread suicides of farmers have been reported in different parts of the country. This has forced the researchers and policy makers to study the issue of farm income in an in-depth manner which has not received adequate attention till the early part of 2000s. Absence of reliable data on farm income has never deterred researchers from carrying out studies on farm income. Many researchers have come out with contested findings on farm income by making use of different sets of data. However, besides the issues pertaining to the estimate, many myths on farm income have not been adequately addressed with reliable data. In this paper, while making effort to unravel the myths surrounding the issue of farm income and its estimates, an attempt is made to bring out the real situation in farm income in India. After analysing the data on Cost of Cultivation Survey from 1971-72 to 2013-14 and also the Situation Assessment of Survey of farmers for the period 2002-03 and 2012-13, the study concludes that the farm income is not only very low but the year-on-year fluctuation is also very high. Mere increase of MSP for crops alone would not guarantee better income for farmers unless procurement infrastructures are sufficiently strengthened. Therefore, along with remunerative MSP for different crops, if procurement arrangements and other non-price (technology, credit and irrigation) incentives are packaged and sequenced appropriately, farm income can be increased in a sustained manner.

Keywords: Cost of cultivation; cost concepts, farm productivity, farm income, farm profitability in India
JEL Classification: Q12, Q13, Q15, Q18

Introduction:

The main purpose of this paper is to bring out the state of farm income in India and also to unravel some of the myths associated with it. The focus of Indian agriculture has been changing ever since the introduction of planning era (see, Deshpande, et al., 2004). Because of severe shortage of foodgrains production, an increased attention was given for augmenting productivity and production of foodgrains starting from late sixties to till eighties. Sustaining the growth of farm sector from the impact of WTO regime was the main focus during the nineties. As a result of production centered approach, the gross production of foodgrains and other agricultural commodities has increased significantly over the years;

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foodgrains production increased from just 51 million tonnes (mt) in 1950-51 to about 264 mt in 2014-15. Similar trend is noticed in many non-foodgrain crops as well (see, GOI, 2016). Today, India is not only a self sufficient country in foodgrains but also an exporter of foodgrains to many countries (see, Bhattacharya, 2004; Deshpande, et al., 2004).

Although over two-third of population are relying on agricultural sector for their livelihood, farm income related issues have somehow not received adequate attention in the policy circle till late nineties (see, Deshpande et al., 2004; Sen and Bhatia, 2004). Farmers were treated as mere agents of agricultural production over years. Their economic well-being never received due attention until late nineties, when farmer suicides and indebtedness became a widespread phenomenon. The scholars and policy makers began to take a serious note of this agrarian catastrophe only when the distress resurfaced again in the recent years in the farm heartlands of the country (see, Sainath, 2010). Serious deliberations on the issue of farm income and crop profitability have occupied the centre stage in the recent policy debates on agricultural sector especially from early 2000s. Experts across various quarters keep questioning on whether or not the income of the Indian farmers increased or are the farmers getting any profits from crops cultivation. As a major step towards understanding and studying the nature and causes of widespread farm suicides and to find out whether reduced income is the major reason for increased indebtedness among farm households, the Union Government appointed the Expert Group on Agricultural Indebtedness under the Chairmanship of Prof. R. Radhakrishna (GOI, 2007). Following this, many researchers also conducted detailed field level studies in this direction and have reported that decline in productivity, supply constraints in institutional credit, market irregularities, etc., are the major reasons for the sudden spurt in farm suicides and indebtedness (see, Deshpande, 2002; Deshpande and Prabhu, 2005; Reddy and Galab, 2006; Vaidyanathan, 2006; Narayanamoorthy 2006: 2007).

Comprehensive studies directly focusing on farm income at macro level in India were not available till the publication of Situation Assessment Survey (SAS) data (NSSO, 2005; 2005a). Because of the absence of data on farm income, most studies have used data from terms of trade computations between agriculture and other sectors to judge the performance of the sector (see, Kahlon and Tyagi, 1980; Gulati and Rao, 1994; Misra and Hazell, 1996; Misra, 1998). While some studies showed positive terms of trade, others found the same against the farm sector. The cost of cultivation survey (CCS) published by the Commission for Agricultural Costs and Prices (CACP) is another data source that was used by many scholars to understand the trends in farm income (Bhatia & Sen, 2004). CCS data in many ways are different from SAS data. While CCS data provides crop-wise cost and income details per hectare, SAS provided annual income from crop cultivation per household. A large number of scholars have studied the trends in farm income using CCS data over the years. For instance, with the help of CCS data from 1981-82 to 1999-2000, Sen and Bhatia (2004) concluded that the farm business income per farmer was miniscule and inadequate to pay even for the essentials (as cited by Chand, et al., 2015).

Assured prices appear to help the farmers for efficiently allocating the scarce resources among different crops (see, Schultz, 1964; Acharya, 1997; Deshpande, 1996; Rao, 2001). Studies have analysed the effectiveness of MSP on raising farm income using CCS

data. Gulati (2012) argued that hike in MSP is necessary to get positive returns and also to propel the agricultural GDP. But, Bhalla (2012) counter argued that increasing MSP of paddy is "dirty economics and dirtier politics". With the focus on the impact of MSP on farm income, Dev and Rao (2010) have studied the profitability of paddy and wheat in detail using CCS data from 1981-82 to 2007-08 and found that the value of output has been more than the costs in both paddy and wheat throughout the period of analysis at the all India level. Similarly, utilising data from CCS for the period 1975-76 to 2006-07 by covering six important crops, Narayanamoorthy (2013) found an insignificant increase in profitability of foodgrain crops at constant prices mainly because of substantial increase in cost of cultivation (cost C2). The National Commission on Farmers (NCF) that looked into various aspects of farming in detail has also underlined that the returns from crop cultivation are very poor and inadequate (NCF, 2006). After the publication of SAS data, quite a few studies have been carried out specifically focusing on farm income. For instance, Narayanamoorthy (2006) analysed the level of farm income using SAS data across the major states and found that the annual average income from crop cultivation for the country as a whole was only Rs. 11,628 per household. That is, the per day income of the farmers' household was just about Rs. 32 during 2002-03, which was much lower than the average agricultural wage rate that prevailed at that time in the country. The pitiable condition of the farm households has also been clearly narrated using SAS data by the Expert Group on Agricultural Indebtedness under the Chairmanship of Prof. R. Radhakrishna (GOI, 2007).

But, Chand, et al., (2015) have questioned the validity of the estimates made based on CCS data. Their contentions are "…….the cost of cultivation data is representative of crops or crop complexes in major growing states, but it does not cover the entire country or the entire agriculture sector. Even the productivity of sample crops reported in COC data show significant difference from state averages. COC data also does not cover horticultural crops and several minor crops that constituted 38% of the total value of the crop sector in 2011-12. Further, the importance of horticultural crops has been rising, and their productivity in India is more than four times that of other crops. Their exclusion makes a significant difference to the level and growth in farm business income. Also, the data on income from the livestock sector is not appropriately captured in the cost of cultivation schedules, which do not intend to do so. Because of these reasons, farm business income derived from the COC data is not an adequate measure of actual farm business income in the country or a state. At best, these can be used as indicators of income from selected crops" (p.140).

Keeping in view the limitations of the existing estimates on farm income, Chand, et al., (2015) made an entirely new attempt to estimate the level of farm income for the country as a whole taking macro level data on National Income Accounting from 1983 to 2011-12. They estimated the farm income by deducting the GDP of agriculture and allied sectors from capital consumption and wage bill for hired labour employed in agriculture. As per this estimate, the real farm income earned by Indian farmers (at 2004-05 prices) increased from Rs. 2,11,000 crore in 1983-84 to Rs. 6, 25,536 crore in 2011-12. That is, per cultivator income increased from Rs. 16,103 to Rs. 42,781 during this period. Interestingly, the annual growth rate of per cultivator farm income increased at a rate of 7.29 per cent during 2004-05 to 2011-12, which is more or less equivalent to the overall growth of the

economy during this period. While these estimates appear to be systematic, one needs to look at it carefully whether the macro-level data based estimate can reflect the reality on farm income? This question arises due to three important reasons. First, the transaction cost involved in farming activities is huge (my field survey experience suggests that it will be around 20 percent of cost A2)[1], which never gets included in the macro level cost. Second, the whole sale cost of inputs at the macro-level used in the estimate would be much lower than the retail price of inputs. For instance, the retail price of fertiliser sold in the district headquarter is lower than the price of fertiliser prevailing in the retail shop located at a village or block. Third, the managerial cost (CACP considers 10% of C2 cost as managerial cost) is another big cost which may not have also been included in the macro level cost used by Chand, et al., (2015). If we include these costs in the estimate, then there is a possibility that the farm income estimated by them would exhibit a declining trend.

Besides the issues concerning the estimate on farm income, many puzzles and myths pertaining to the income of the farmers need to be answered to better understand its reality. First of all, given the contesting estimates from different scholars, we must find out what is the actual level of income that farmers get from crops cultivation? What is the variation in the level of farm income across the states in India? Has the farm income increased over the years? If yes, has it increased consistently in all regions and crops? There is a myth that the income reaped by the farmers belonging to irrigated regions is higher than its counterpart, the less irrigated regions. Is it true? Is there any difference in profitability of crops cultivated under irrigated and less irrigated condition? There is another myth which has emerged in the context of alleviating agrarian crisis is that the farm income can be increased by augmenting productivity of crops. In this context the question crops up whether the farmers of high productivity states reaping higher profits than that of less productivity states in different crops? Is it true that farmers are unable to reap profit consistently throughout across years? What is the role of new technologies/methods in increasing the farm income? We seem to be having inadequate answers to these questions in the available literature. Unless these questions are adequately answered one may not able to say clearly about the state of farm income in India. In this paper, therefore, while making effort to answer these questions, an attempt has been made to bring out the real state of farm income in India mainly using data available from two important sources namely SAS and CCS.

The paper is organised in six sections. The section two presents an analysis of the farm income for the period 2002-03 and 2012-13 using SAS data, which has income details by source for farmer households. The level of farm income per farm household across the states is analysed in section three. Utilising CCS data for different states covering period from 1971-72 to 2013-14, a detailed analysis on trends in farm income by crops is provided in section four. Further an analysis on the role of new technologies/methods on productivity and farm income is presented in detail in section five. The last section presents a few agenda points for increasing farm income in the future.

II. Has the Farm Income Increased?:

In the absence of comprehensive farm income related data, various scholars have employed different methodologies/data sources to estimate the farm income. As

mentioned earlier, many have used CCS data, while some have derived the farm income using agriculture GDP and related data. Divergent views are available from the existing studies on farm income, which has also been underlined earlier. While estimates of the existing studies have provided useful information, we have actual data on farm income fairly comparable[2] for two time points namely 2002-03 and 2012-13 from SAS published by NSSO (2005; 2014), which can reveal the reality about the state of farm income. SAS provides data on the annual income for farmer households by various sources namely wages, cultivation, farming of animals and non-farm business income. Using this data, the actual level of farm income reaped by the Indian farmers can be easily judged.

The concept of farm income has been used differently by different scholars. While questioning the validity of the income estimated through CCS data, Chand, et al., (2015) argued that farm income should include the income from the livestock sector as well. While their arguments is probably correct in a broader context, we must recognize the questions raised in the debate on farm income during the last decade or so. Farmers have been questioning the income realised from crops cultivation and not about the income from other sources. `Crop holiday' in paddy in Andhra Pradesh have also been declared a few years back citing low income from crop cultivation. Similarly, farmers in various parts of India are demanding higher income from crops cultivation, but not from livestock or other sectors. The National Commission on Farmers (NCF) has also primarily referred to farm income as the income received from the crop cultivation. Therefore, in order to understand the ground reality of farm income, it is necessary to consider the income from crops cultivation which is an issue discussed intensively today.

It is therefore essential to look into the changes in the income from crop cultivation vis-à-vis other sources between the two time periods mentioned above utilising SAS data which is presented at constant value (at 1986-87 prices) in **Table 1**. It is clear that the annual income per farm household from cultivation has increased from Rs. 3,645 in 2002-03 to Rs. 5,502 (at constant prices of 1986-87) in 2012-13, an increase of about 3.81 percent per annum. But, the question which needs to be answered here is whether the income from crop cultivation increased at a faster rate as compared to other sources of income of farmer household. The answer is very clear; the increase in income from crop cultivation was not very significant as compared to the income realised through farming of animals. This means that the farmers who are relying purely on cultivation income not only earn less income but their growth of income is also very less in India during the last one decade or so.

The other puzzle which refuses to die down in the debates is whether the farm income of the irrigated region is higher than that of less irrigated region. It is an established fact that the productivity of any crop cultivated under irrigated region is higher than that of the less irrigated or un-irrigated region (see, Vaidyanathan, et al., 1994). Temporal and spatial data on crop productivity published by the Union Ministry of Agriculture reinforces this fact. But, unfortunately, farmers belonging to the irrigated region have also committed suicides citing poor returns from crops cultivation in the recent years. Farmers in Andhra Pradesh belonging to highly irrigated region have even declared `crop holiday' specifically because of poor income from farming. Given this unpleasant developments, there is a need

to validate whether irrigated farmers reap higher profit than their less irrigated counterparts.

Data available for all the major states for two time points from SAS provides opportunity to look into this issue. Statistics provided in **Table 1** show that the average income from the cultivation for the States Having Above National Level Irrigation (SHANLI) is not substantially different from that of the States Having Below National Level Irrigation (SHBNLI) at both time points namely 2002-03 and 2012-13. During 2002-03, the average annual income of SHANLI was Rs. 4,636 per household, whereas the same was Rs. 4,115 for SHBNLI category, a difference of only about Rs. 521. Similar trend was also observed during 2012-13. Interestingly, quite a few states belonging to SHBNLI category were able to earn higher income from cultivation than that of the states coming under SHANLI category. This was not unexpected due to the fact that although the gross income from the crops cultivated under irrigated condition is higher because of higher productivity, increased cost of cultivation might have counterbalanced the net returns from crops cultivation (see, Narayanamoorthy, 2013).

III. Farm Income across States:

Although the issue of farm income has been discussed by researchers and policy makers extensively over one decade in India, the performance of various states in terms of farm income has not been adequately covered possibly because of data constraints. What is happening at the country level might not be the same across different states due to variations in cropping pattern, irrigation coverage, adoption of modern technologies, procurement policies, market arrangements, etc. It is always believed that the states with more area under commercial crops can generate higher farm income than the states with larger area under foodgrain crops. But, this issue could not be answered convincingly due to data constraints so far. Now, the data available from SAS reports for two time points permit us to study this issue.

The annual income from cultivation per farmer household varies substantially across the states in India, as expected. During 2002-03, it varied from Rs. 10,616 per household in Punjab to Rs. 1,264 in Orissa at 1986-87 prices. Similarly, the same income varied from Rs. 19,396 per household in Punjab to Rs. 1,748 in West Bengal during 2012-13. Besides substantial variation in farm income among the states, it is found to be very low in most states where paddy is cultivated predominantly during both time points. For instance, during 2012-13, the average cultivation income for the country as a whole was Rs. 5,502 per household. But, it was much lower than this in states like AP, Orissa, Bihar, Tamil Nadu, UP and West Bengal where paddy has traditionally been cultivated predominantly; these states together accounted for 53 to 56 percent of India's total paddy area during 2002-03 and 2012-13 (GOI, 2016). This in a way supports the rising dissent of paddy farmers who have been arguing over one decade from now that the income from its cultivation dwindled substantially. It is true about other crops as well.

Besides low income from cultivation, its growth is also not very appreciable among the major states between 2002-03 and 2012-13. The average growth of cultivation income

for the whole of India is estimated to be about 3.81 percent per annum between the two periods, but it was less than that of the India's average growth rate in 11 out of 18 states reported in the **Table 1**. In states like Chhattisgarh, Karnataka, MP, Haryana, Punjab and UP, the cultivation income grew at a faster rate over the rate of national level average. To our surprise, the growth rate of income from cultivation was negative in states like J&K, Jharkhand, Bihar and West Bengal. This poor growth in income from cultivation might have affected the livelihood conditions of the farmers living in these states. On the whole, the analysis based on the data available from SAS clearly shows that the income from cultivation per farmer household was very low and its growth rate was also nowhere nearer to the growth rate estimated by Chand et al., (2015).[3]

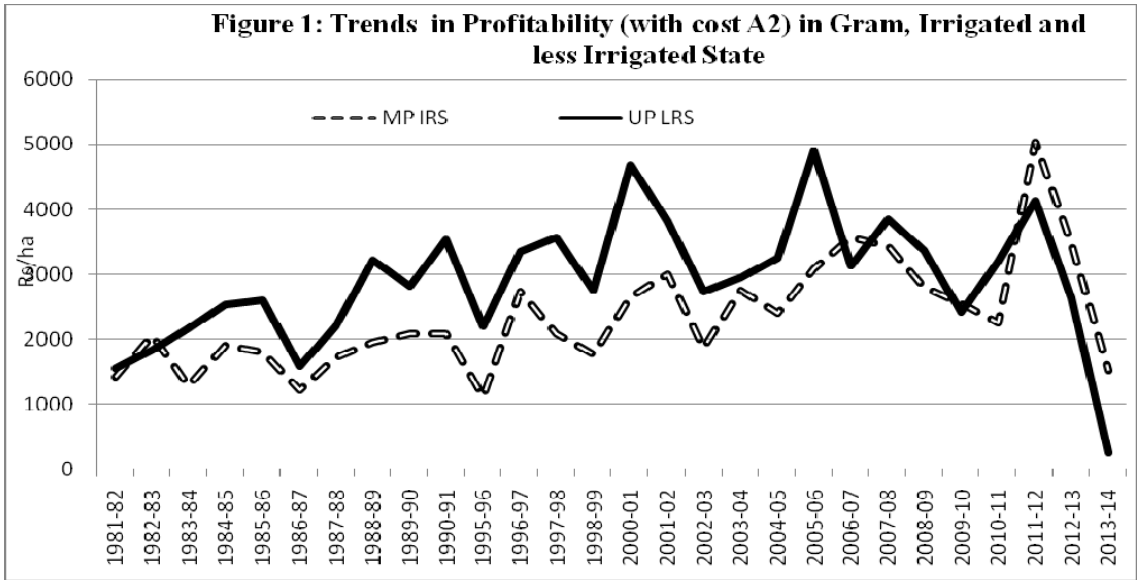
IV. Myths on Farm Income – Results of CCS Data:

Before the publication of SAS data, information on farm income was available only from the source of CACP, which has been publishing data for different crops since 1970-71 on operation-wise cost, productivity and income collected through a national level scheme called *Comprehensive Scheme for Studying Cost of Cultivation of Principal Crops*.[4] As the data on each aspect of crop cultivation has been collected directly from the farmers on regular basis, CCS data has been considered as an important source of information on cost and income. The announcement of minimum support price every year for various crops by the Union Government is also primarily made using CCS data (see, Sen and Bhatia, 2004). Therefore, it is necessary to study as to whether the farmers are able to generate any profit from the cultivation of different crops over the years using CCS data to understand the state of income in crops cultivation.

As mentioned earlier, an important issue that evaded analysts' attention is the level of profitability of crops cultivated under irrigated and less irrigated conditions? Many in academia and policy circles all along believe that the crops cultivated under irrigated condition generate significantly higher income than its less irrigated counterparts. They believe that since the productivity of crops is higher in irrigated area as compared to the same cultivated in less irrigated area, the profitability would also be higher. However, profitability of any crop is not determined by its productivity alone. Factors like cost of cultivation of the crop, market price of the produce, marketing facility from government agencies, etc., play an important role in deciding the profit. There is a possibility that because of increased supply (production) of agricultural output in irrigated region, the unit price of the crop can be lower than that of less irrigated region where reduced supply is common.

With the use of CCS data from 1970-71 to 2013-14, an analysis attempted here to verify whether any significant difference exists in farm profitability between irrigated and less irrigated region.[5] Jowar, bajra, maize, gram, groundnut and cotton are mostly cultivated with irrigated condition and also with very less irrigated condition in different states and therefore, these crops have been considered for the analysis. Profitability in crops cultivation has been calculated both in relation to cost A2 and C2.[6] Against the expectation of many, CCS data does not show any bright picture in favour of crops cultivated with higher coverage of irrigation in terms of profitability. Between TE 1973-74 and TE 2013-14, the

profit computed in relation to cost C2 is pathetically poor in both the regions except in the case of cotton crop, where the profitability of irrigated Gujarat was very high as compared to its neighboring state of Maharashtra (see, **Table 2**). In relation to cost A2 too, except for cotton crop, the profitability of crops cultivated under higher irrigation coverage is not consistently very high as compared to the same crops cultivated with less irrigated condition at all the time points. Even the quantum of profit realised in relation to cost was not very high in irrigated states, which is evident from the low ratio of value of output to cost A2 and C2. In fact, in crops like gram and groundnut, farmers from the less irrigated states have reaped higher profit in quite a few years than their irrigated area counterparts (see, **Figure 1**). How does this happen? One of the important reasons for this unusual tendency is due to increased cost of cultivation in the irrigated areas. With the increased irrigation coverage, farmers are encouraged to adopt the modern yield increasing inputs for crops cultivation which resulted in increased cost of cultivation. But, this seems to have not happened in the case of less irrigated crops possibly because of risk in getting expected yield and income. Therefore, it is not always correct to conclude that the farmers in the irrigated region reap higher profit than their less irrigated area counterparts.[7]

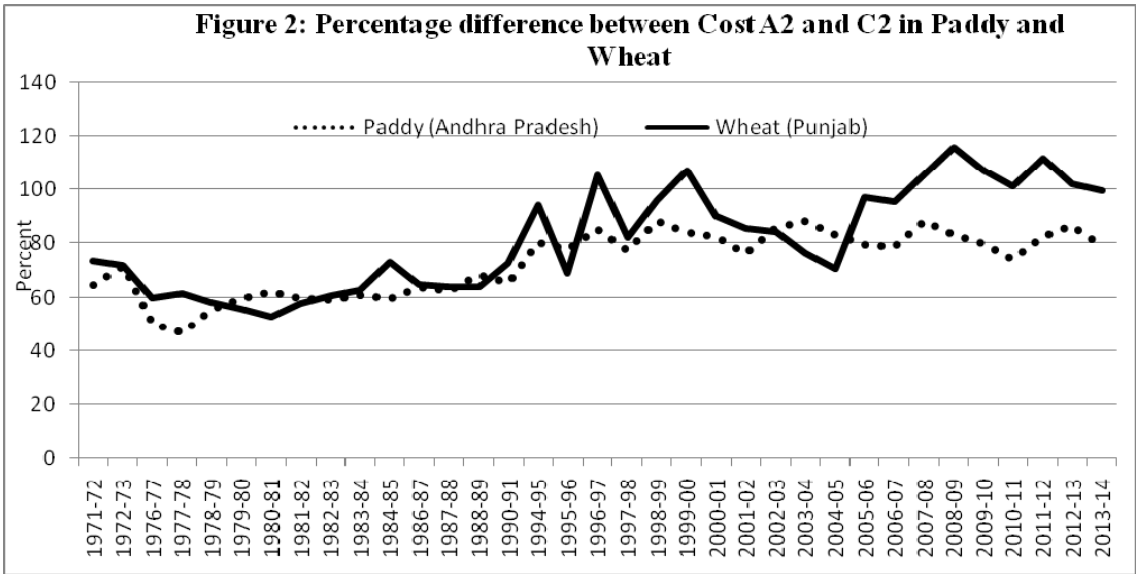


Another myth which needs to be studied and answered in the context of farm profitability is: can we increase the farm income by increasing the productivity of crops? It is often believed that the increased productivity would help the farmers to reap higher profit. An Occasional paper by NITI Aayog (2015) on "Raising Agricultural Productivity and Making Farming Remunerative for Farmers" has also stressed this point elaborately to have more income from farming. Although increased productivity is necessary for augmenting the farm income, many fail to understand that rising productivity alone would not help to increase the farm income since it depends upon many other factors. Well structured market is a key requirement for raising farm income. If procurement arrangements are not made adequately at appropriate time, any amount of increase in productivity would not benefit the farmers. Similarly, if the increase in cost of cultivation is higher than that of the income realised through increased productivity, then farmers would not get benefitted from

increased productivity. Therefore, it is necessary to study whether productivity of crops plays any significant role in deciding the farm profitability.

An analysis carried out with the help of CCS data does not clearly show that the increased productivity would help the farmers to reap higher profit. To clarify this issue further, an attempt is made to find out as to what extent the profitability of High Productivity States (HPS) is different from the Low Productivity States (LPS) for six important crops namely paddy, wheat, tur, groundnut, sugarcane and cotton. The results generated from 1971-72 to 2013-14 prove that the profitability of HPS is not significantly different from that of LPS in most crops presented in **Table 3**. HPS states have neither managed to reap profit in a consistent manner nor able to generate significantly higher profit than LPS category in all the time points considered for the analysis (see, **Table 4**). A question arises here is: why are the high productivity states not able to reap higher profit? We have answer for this question from CCS data itself. The cost of cultivation of HPS states in all the crops is not only substantially higher than that of the crops cultivated in LPS states but also increased at faster rate.[8] Although the value of output of the crops from LPS is substantially higher, the increased cost of cultivation has reduced the profitability. In fact, because of increased investment made by the farmers in agriculture, cost C2 has increased much faster in the recent years than in the 1980s and 1990s (see, **Figure 2**). In addition to low profitability, the year-on-year fluctuations in profitability are also found to be very high in HPS, which might be hurting the farmers.

Figure 2: Percentage difference between Cost A2 and C2 in Paddy and Wheat



Fully knowing the ground reality of the farm sector, the recent report by NITI Aayog on remunerative farming heavily stressed upon the productivity of crops for raising the farm income. It surmises that "To increase productivity, progress is required along three dimensions: (i) Quality and judicious use of inputs such as water, seeds, fertilizer and pesticides; (ii) judicious and safe exploitation of modern technology including genetically modified (GM) seeds; and (iii) shift into high value commodities such as fruits, vegetables, flowers, fisheries, animal husbandry and poultry. In the longer run, productivity enhancement requires research toward discovery of robust seed varieties and other inputs,

appropriate crops and input usage for a given soil type and effective extension practices" (NITI Aayog, 2015). Increase in productivity is surely not the solution and if we allow the market to have low prices during high productivity/production years. Therefore, this strategy alone would not help the farmers to get sufficient income from farming. Raising productivity might help the consumers and the country to further strengthen the food security with reduced food inflation. But, the farmers at large would not benefit through increased productivity unless efforts are made simultaneously to control the cost of cultivation and improve the procurement arrangements through state agencies, which are missing in the listed strategies. Farmers have been arguing in the recent years that increased cost of cultivation especially the wage cost has been seriously affecting the income from crop cultivation, which is also supported by CCS data (see, **Tables 5 and 6**). More fundamentally, it is not simply the high productivity but better prices that dictate the income trends. Increase in cost of cultivation was also cited as the main reason for declaring paddy 'crop holiday' in about four lakh hectares in the fertile area of Andhra Pradesh. Therefore, measures are urgently needed to cut down the cost of cultivation wherever possible while formulating policies for promoting productivity of crops.

V. Technology and Farm Income:

Can technology be useful in augmenting farm income? Although technical progress has been continuously taking place in Indian agriculture since the introduction of Green Revolution, three important new technologies/methods have been introduced after nineties specifically to conserve resources and to increase farm income. They are Drip Irrigation Technology (DIT), Genetically Modified (GM) crop in cotton (called as Bt cotton) and System of Rice Intensification (SRI). DIT was introduced primarily to conserve irrigation water and also to increase the yield of crop. Bt cotton, which is one of the GM crops approved for commercial cultivation in India so far, was introduced to increase the yield of cotton by protecting the bollworm attack, a major pest problem encountered by the cotton farmers around the world (see, Narayanamoorthy and Kalamkar, 2006; Gandhi and Namboodiri, 2006). A relatively young method known as SRI was introduced in paddy cultivation specifically to reduce the cost of cultivation, save water and to increase the yield of paddy. While the cost of cultivation involved in adopting these three technologies/methods vary widely[9], it is useful to understand as to what extent these technologies are beneficial to farmers in terms of profitability.

Drip irrigation technology has been in use for crop cultivation since late eighties but its popularity has increased only after the introduction of Central Scheme with generous subsidy component during early 1990s. INCID (1994) report mentions that DIT can be used efficiently for cultivating over 85 crops in India; not only wide spaced horticultural crops but also suitable to many narrow spaced crops like pulses, oilseeds, cotton, sugarcane and even in paddy. Because of very attractive promotional schemes introduced by the Central as well as some state governments, the area under DIT has increased many folds over the years; from 70,589 hectares in 1990-91 to 3.38 million hectares in 2014-15 in India. Today, India stands as one of the largest adopters of DIT in the world.

Since the introduction of DIT in India, a large number of studies have been carried out to understand the intricacies of crop cultivation. Reduced cost of cultivation, substantial saving of water and energy and significant increase in productivity of crops are often reported as the main benefits of drip irrigation technology. As per the farm level data based studies, crops cultivated using DIT are able to reduce water consumption to the extent of 30-60 percent per hectare, while increasing the productivity of crops to the extent of 30-50 percent (see, Narayanamoorthy, 1997; 2003 and 2008). DIT requires fixed investment and therefore, some studies have explored the economic viability including profitability of this technology under with and without capital subsidy scenarios. Studies undisputedly proved that the crops cultivated under DIT can generate significantly higher income for farmers than those crops cultivated under conventional method of irrigation (see, **Table 7**). While the information on who are the farmers extracting profits by adopting DIT is not clearly available, existing results show that the farm income can be increased substantially by adopting DIT in various crops cultivation. In spite of huge benefits, the spread of this technology as of today is only about 12.50 percent of its total potential of 27 million hectares estimated by the Task Force on Micro-Irrigation (TFMI, 2004).[10] Along with the capital subsidy, state agencies must take sustained efforts to create awareness about this technology to benefit the farmers. Efforts are also needed to reduce the capital cost of the system so that the small holders can also adopt this technology to increase their income from crop cultivation.

An important technological breakthrough that has taken place recently in agriculture is GM seed, which promises to increase the yield of crop significantly with reduced cost of cultivation and pesticides consumption. Although GM seeds available for a few crops in the world, Bt cotton is the only GM crop so far permitted for commercial cultivation in India. Despite of strong opposition from different quarters, the response from the farmers on adopting this crop has been overwhelming since its commercial introduction during 2002. There are of-course a large number of critics about the GM crops but rarely the critics substantiated their points with concrete data. As per the report of NITI Aayog (2015), the coverage of area under Bt cotton has reached to about 11.60 million hectares, which was over 95 percent of India's total cotton area in 2014. As a result of widespread adoption of Bt cotton seed, the yield of cotton has increased substantially from just 186 kg/ha in 2001-02 to a level of 532 kg/ha in 2013-14, an increase of about 186 percent. The impact of adoption of Bt cotton on productivity is not only noticed at the macro-level but also seen in major cotton growing states like Maharashtra, Andhra Pradesh, Gujarat and Tamil Nadu.

Studies conducted using farm level data in various states proved that Bt cotton can increase the income of farmers substantially with marginal increase in cost of cultivation. Most studies reported in **Table 8** reveal that cotton productivity can be increased 40-50 percent with around 20 percent increase in cost of cultivation by adopting Bt varieties. Profit realised by the adopters of Bt cotton is substantially higher as compared to non-Bt cotton in almost all the states where from credible studies are available. Despite substantial benefit from Bt cotton, GM seeds are not allowed to be cultivated commercially in any other crops in India. Can it be called as a right strategy? Bt brinjal, after going through all the required tests, has been cleared for the commercial adoption by the appropriate official bodies in 2010 itself, but has been blocked by the Union Ministry of Environment (NITI

Aayog, 2015). Bt brinjal can substantially reduce the consumption of pesticides while increasing the productivity that would ultimately benefit the farmers in terms of profitability. The effects on consumption of GM crops have not been well documented and countries like USA, Canada and China are having no hesitation in allowing marketing of GM crops. Higher cost of GM seeds is often used to oppose this technology by the activists because of poor purchasing power of majority farmers. In order to increase the benefit of GM crops to all the resource poor farmers, necessary arrangements should be made to promote the research and developmental activities through state agencies, which is lacking presently.

A new method of paddy cultivation popularly called as the System of Rice Production (SRI) and Aerobic rice cultivation was introduced sometime during 2000-01 specifically to increase the yield with less cost of cultivation. Paddy farmers in India have been facing problems in generating adequate profit from its cultivation for quite some time now because of increased cost of cultivation and reduced profit margin (see, Narayanamoorthy and Suresh, 2012). This sentiment was also reflected through declaring 'crop holiday' in paddy crop by farmers in Andhra Pradesh. But, the new method of paddy production appears to generate lot of benefits to farmers. SRI is not a new variety or hybrid, but it is only a new method of cultivation, where a set of innovative principles are followed for cultivating paddy. It was first developed in the 1980s by Henri de Laulanie, a French priest and farming practitioner living in Madagascar, and furthered in the 1990s by passionate farmers, scientists and researchers (see, Uphoof, 2004; World Bank, 2008). This method is proved to increase the yield of paddy significantly with less water, less seed as well as with less chemical inputs than the conventional method of paddy cultivation (see, WWF, 2007; Reddy, et al., 2005).

The available results on SRI method of paddy cultivation increasingly suggest that the farmers can increase their paddy productivity by more than two times with lesser of farm inputs and irrigation water. There are also systematic results about the Aerobic Rice cultivation. Using SRI method of paddy cultivation, countries like India, Indonesia, Cambodia, Vietnam, and the Philippines have recorded increase of rice yield from 60 percent to over 170 percent (see, World Bank, 2007). Studies carried out in different locations in India do suggest that the paddy cultivated using the method of SRI can significantly increase the productivity that too with reduced cost of cultivation. Farmers are able to reap over 50 percent of profit through SRI method of cultivation than that of the non-SRI method of paddy cultivation (see, **Table 9**). Although both the Central and State governments have introduced various promotional measures including subsidy scheme for popularizing this method in a big way, the progress has not been very encouraging except in states like Tamil Nadu, Bihar and Tripura (NITI Aayog, 2015). Extension programmes at a massive scale need to be introduced to popularize this new method of paddy cultivation wherever possible. On the whole, the available results on crops cultivated with the new technologies seem to be income enhancing.

VI. Future Agenda:

It is clear from the analysis of SAS and CCS data that the income realised by the farmers from different crops cultivation is very low over the years. Although the income

from crop cultivation alone (at 1986-87 prices) has increased from Rs. 3,645 in 2002-03 to Rs. 5,502 in 2012-13 per farmer household as per SAS data at the national level, it was found to be far less than the national level average in many states of India. In states like Andhra Pradesh, Bihar, Jharkhand, Orissa, Tamil Nadu and West Bengal, the annual income from cultivation per farmer household was pathetically low. In fact, the income realised from cultivation by the farmer household at current prices works out to be only about Rs. 101 per day during 2012-13. Can a farmer household satisfy the family consumption needs and other expenditures with this meagre income? Similar to SAS data, data on cost of cultivation surveys from 1971-72 to 2013-14 too reinforce the fact that the income from crop cultivation is very poor across different crops and states in India. The poor income from crop cultivation is not only seen with the crops cultivated under rainfed/less-irrigated condition but also among crops that are cultivated under increased coverage of irrigation. Against the common notion, the CCS data of different crops shows no significant and consistent difference in profitability between high productivity states and low productivity states. Farmers were unable to realise increased income consistently in any of the crops considered for the analysis. Besides low income, the year on year fluctuation in crop-wise income is also widespread in most crops since early 1970s, which also intensified during post 2000s.

Farmers have suffered losses or realised low income due to both increased cost of cultivation and insignificant increase in value of output due to market failure. Productivity and production increase can in no way be a solution as the simple law of market economics defeats the logic. Larger the arrival in the markets lower is the price of the product and hence the increase in production will be eroded by consequent fall in prices. This needs to be realized. The reduced margin of profit from crop cultivation would not provide any incentive to farmers to continue to engage in agriculture in an intensive manner (see, Swaminathan, 2008). As per SAS data (NSSO, 2005), about 40 percent of the farmers are reportedly willing to quit agriculture because of poor remuneration from farming. The income from crop cultivation is not even enough to meet the annual cultivation expenditure in many states, which is also proved by SAS data. No single programme can help increase the income of the farmers on a continuous basis. Farmers need sustained support in the form of increased returns from their crop cultivation. Therefore, along with price incentives, concerted efforts need to be taken to strengthen the non-price incentives such as the procurement system and market infrastructure, public investment in agriculture, irrigation infrastructure and institutional credit.

Although the awareness about the Minimum Support Price (MSP) is very low among the farmers[11], it is plays a key role in deciding the market price of agricultural commodities (NITI Aayog, 2016). It is alleged by the farmers that MSP for the crops are not fixed in consonance with cost of cultivation in most cases. The analysis on CCS data also seems to support this point. Without reasonable profit margin from crop cultivation, farming cannot be sustained and the expected growth in agricultural sector would also be difficult to achieve. Therefore, as a first step towards increasing farm income, MSP should be fixed keeping in view the market trends in produce as also input prices. The National Commission on Farmers (NCF, 2006) and the Working Group on Agriculture Production (Business Line, 2010) have suggested that the MSP for crops at 50 percent more than the actual cost of

production (cost C3), albeit without giving any rationale to that incremental percentage. Prices fixed based on cost A2 do not cover the entire cost of cultivation, which is also proved by our analysis presented in the paper. Due to changing nature of agriculture, cost on fixed investment, rent and supervisory cost has increased substantially over the years. For instance, in Punjab, the difference between cost A2 and C2 was only about 60 percent during TE 1982-83, but this difference increased to about 105 percent in TE 2013-14 for wheat crop. Similar situation is seen in paddy in Andhra Pradesh and sugarcane in Maharashtra as well. The cost A2 does not include these important items, which cannot be justified by economic logic. Therefore, MSP should be fixed based on cost C2, after working out real cost of cultivation through credible data. In addition to this, in order to protect the farmers from the inflationary pressure, the MSP announced every year for various crops can also be fixed by linking with the wholesale price index of produce as also the inputs, as followed for salaried classes by way of dearness allowance (DA).

Mere announcement of MSP would not help the farmers but along with MSP, there is also a need to strengthen the procurement infrastructure. Even in paddy and wheat, except for a few states like Andhra Pradesh, Punjab and Haryana, the procurement level by the state agencies has all along been very poor (see, Narayanamoorthy and Suresh, 2012). At the country level, the procurement of paddy and wheat to its total production was only about 30 percent and about 32 percent respectively during 2014-15. Farm income especially from paddy crop is found to be very low or negative in all those states (for example, West Bengal and Orissa) where procurement level is pathetically low. Procurement arrangements are also very poor in non-foodgrain crops such as oilseeds, pulses, which is clearly evident from SAS data as well. This has allowed the private market agents to scrupulously exploit the farmers and then the consumers. Studies carried out across 236 districts in India show that density of market to cropped area and average distance to market play a significant role in deciding the per hectare value of output realized by the farmers (see, Narayanamoorthy, et al., 2013). Therefore, procurement as well as state managed market infrastructures must be strengthened across India for all the important crops.

Agricultural Produce Marketing Committee (APMC) Act of 2003 (Rules in 2007) should be implemented at war footing. As rightly mentioned in the 16th Report of Committee on Agriculture on `Pricing on Agricultural Produce', APMC "advocates inter alia provision for private markets and E-markets, contract farming, direct purchase of agricultural produce from farmers by processors/bulk retailers/wholesalers/ exporters nearer to the production centre, direct sale of produce by farmers to the consumers, etc. Such multiple options will enable the farmer to sell the produce for optimum returns without being compelled to make distress sale in local mandis." (GOI, 2014). The role of farmers in deciding the price should be promoted by directly involving them in the market activities extensively. Farmers' managed markets in states like Tamil Nadu and Andhra Pradesh have proved to be beneficial to them (see, Kallummal and Srinivasan, 2007). Therefore, producers' markets on the lines of *Ryatu Bazars* should be encouraged across every part of the country to improve the farm income and to eliminate middlemen as underlined in the National Agricultural Policy of 2000 (GOI, 2000). Without affecting the

poor consumers, online market sale of agricultural commodities also needs to be promoted to control the exploitation of middlemen in the market.

In order to protect the farmers from the distress sale during the glut periods, the price behaviour of sensitive commodities needs to monitored closely for making swift intervention through the 'Market Intervention Scheme' (MIS), as suggested by Expert Group Committee on Indebtedness led by Prof. Radhakrishna. While regulating the output markets, it is also necessary to simultaneously regulate the input markets effectively to improve the pathetic income level of the farmer households. Use of spurious inputs is also partly responsible for crop failures and increased use of pesticides in crops like cotton. Sale of spurious inputs (seeds, fertilisers and pesticides) has been reported widely in media in the recent years, which is also an important reason for increased cost of cultivation and low output. The sale of spurious inputs must be stopped by all possible means to protect the farmers' welfare.

With the aim to increase the income of farmers by augmenting productivity of crops, many new technologies/methods such as micro-irrigation methods (drip and sprinkler), GM seeds and system of rice intensification (SRI) have been introduced. While these technologies proved to be useful in increasing the income of the farmers, steps need to be taken to make these technologies easily accessible to marginal and small farmers. Prices of GM seeds need to be brought down for which R&D of the government sector should be promoted (see, Narayanamoorthy and Alli, 2014). One of the very promising technologies introduced during the 1990s was drip irrigation technology, which proved to have increased the income of the farmers significantly that too with reduced consumption of water and cost. However, owing to poor awareness about this technology and requirement of high capital cost, the spread of this technology is not very high even after 25 years of its introduction. While every arrangement is needed to cut down the capital cost required for installing DIT, special arrangements are to be made to provide quality extension services with the specific motto of creating awareness about the importance of this new irrigation technology.

Besides price incentives, the policy makers should also focus on the non-price incentives to increase the productivity of crops and also to reduce the cost of cultivation. Increased capital formation from public account is essential to reduce the transaction cost for private farmers. Except in the recent years, the fixed capital formation by public sector in agriculture has been continuously declining both in absolute term and also in relation to the agricultural GDP. Efforts should be made to increase the public investment so that the cost of cultivation can be reduced. The other important non-price incentive needed for the farmer is the assured supply of institutional credit. Non-availability of institutional credit often forces the farmers to rely on non-institutional sources of credit to meet their credit requirements for crop cultivation that ultimately increases the cost of cultivation. The Rangarajan Committee on Financial Inclusion (GOI, 2008) made it clear that the bulk of small and marginal farmers do not have access to institutional credit. By providing adequate credit in time with low interest rate, the cost of cultivation can be reduced substantially. Therefore, farmers' friendly policies need to be framed to provide adequate credit in time to increase the farm income.

One of the reasons for increased cost of cultivation and reduced income from crops cultivation is the increased reliance on groundwater irrigation in the recent years. Not only the fixed cost requirement for establishing groundwater irrigation structures has increased over the years, but the recurring cost on using the same water for crops cultivation has also increased. CCS data clearly shows an increasing trend in the cost on account of irrigation in most crops especially in the recent years. This is because of stagnation in the expansion of public sector managed surface irrigation facilities such as canal and tank since the mid-nineties.[12] Surface irrigation is a low cost source of irrigation that can reduce the private cost of the farmers substantially. Therefore, adequate allocation of funds required for completing the on-going irrigation projects with better monitoring by State agencies need to be focused, as underlined in the report of the Working Group on Major and Medium Irrigation for the 12th Plan (see, Planning Commission, 2012).

Many hold the myth that the income of the farmers can be increased by augmenting the productivity of the crops. There is no doubt that any increase in productivity of crops would definitely benefit the farmers. However, augmenting productivity of crops is only a necessary condition but not a sufficient condition to increase the farm income. Without adopting new technologies in crops cultivation, productivity of crops cannot be increased significantly. Farmers would hesitate to adopt the new technologies unless they are capable of generating increased income with reduced cost. Increased cost of cultivation (not only costs A2 but C2 as well) has been the major issue encountered by the farmers in the recent years, which needs to be controlled by all means. Even if MSP is announced in consonance with the cost of cultivation (cost C2) for crops, it would not guarantee better income for farmers unless procurement infrastructures are strengthened sufficiently. Therefore, along with remunerative MSP for different crops, government should also strengthen farmers' friendly market infrastructure with other non-price incentives such as adequate credit and improved surface irrigation facility. There is no doubt that the income of the farmers can be increased adequately, if procurement arrangements and other non-price (technology, credit and irrigation) incentives are packaged and sequenced appropriately along with revision of MSP in consonance with the cost of cultivation.

Notes:

1. Detailed studies on transaction cost involved in crops cultivation are seldom available on Indian context. A study on transaction costs in agriculture from the planting decision to selling at whole sale market carried out in Sri Lanka estimated a 15 percent of transaction cost in the total cost of production among the small-holder farmers (see, de silva et al., 2008).

2. It is necessary to mention here that the definition of farmer households followed in 70th round of NSSO is bit different from that of 59th round of NSSO (SAS data). The major differences in definitions are summarised as under: "a) Possession of land was an essential condition for defining a person as farmer (farmer household) in 59th round, but an agricultural household as defined in NSS 70th round may or may not possess land. b) In 59th round, farmers having insignificant farming activities, like kitchen garden, etc. were excluded from the survey coverage. In order to eliminate households pursuing agricultural activities of insignificant nature in 70th round, households with at least one member self-employed in agriculture either in principal status or subsidiary status and having total value of produce during last 365 days more than Rs. 3000 were only considered for inclusion in the survey coverage" (NSSO, 2014).

3. As per the study of Chand, et al.,(2015), the farm income per cultivator grew at a rate of 1.96 percent per annum during 1993-94 to 2004-05, but it registered growth of 7.29 percent per annum during 2004-05 to 2011-12, which is not borne out from the estimate of SAS data. The other dimensions of growth (per cent/annum) in farm income estimated by Chand, et al., are presented below for ready reference:

Period	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

4. The details of methodology used for collecting data under the scheme of CCS can be seen from the website of CACP (www.cacp.dacnet.nic.in).

5. Published data on cost of cultivation is available only up to 2013-14 and therefore, we could not perform any analysis beyond this time period in this paper. Over the years, CCS data has been published with time lag of three to four years, but in the recent time some improvements have taken place in publishing the data, thanks to the pressures put forth by the farmers' organisations.

6. One of the issues debated seriously in the analysis on profitability or income is what is the appropriate cost to calculate profitability of crop? Recently, Narayanamoorthy (2013) observed that "Many scholars have considered cost A2 for calculating profit despite the fact that cost A2 does not cover interest on value of owned capital assets and rent for land, which would form substantial share in modern agriculture today. Moreover, there is also a growing concern that farmers should also get income for performing managerial functions in agriculture, as has been followed in other professions where managing director or CEO gets hefty salary for performing managerial operations. The cost A2 also does not include the cost for performing managerial operations in agriculture (See the definition of CACP)". Since cost A2 is only partial cost of cultivation, in this study, we work with two cost concepts namely cost A2 and cost C2 to find out the profitability (returns over cost of cultivation) of different crops selected for the analysis. Profit of the crop is calculated by deducting cost A2 and C2 from the value of crop output of the respective crop.

7. A detailed analysis using CCS data on profitability in different crops cultivated under irrigated and less irrigated areas can be seen in Narayanamoorthy, et al., (2015).

8. Due to brevity of space, data on cost of cultivation (A2 and C2) is not presented in the tables. A detailed analysis on the increase of cost of cultivation can be seen from Narayanamoorthy (2013).

9. Costs of these three technologies are not the same. While the requirement of capital cost is relatively high for DIT because of installing of well structured system in the field, SRI method does not involve any large additional cost to adopt it in paddy cultivation. However, the cost of GM seed is significantly costlier than hybrids and high yielding varieties, which is also one of the major reasons why activists oppose for GM technology in India. More details on the cost of these three technologies can be seen in Narayanamoorthy (2005), Narayanamoorthy and Kalamkar (2006) and Palanisamy et al., (2013).

10. Detailed estimate on crop-wise potential for drip and sprinkler irrigation can be seen from the Report of the Task Force on Micro-Irrigation (GOI, 2004).

11. Awareness about the MSP has been poor among the farming community in India. Only about 19 percent of farmers had understood the scheme of MSP as per the SAS data of 2002-03. This level of understanding has not changed much even today. As per the latest data of SAS pertaining to the period January -June 2013, where awareness of the households about MSP is provided for some specific crops, the awareness was only 31-39 percent even in paddy and wheat. In crops like pulses and oilseeds, the awareness about MSP was abysmally low, hovering 5-10 percent (see, NSSO, 2005 and 2014). A recent study on *"Evaluation Study on Efficacy of Minimum Support Prices (MSP) on Farmers"* carried out by NITI Aayog (2016) also reported the prevalence of low awareness about MSP among the farmers in different states.

12. Even after making massive investment on surface irrigation development since 1990-91, the area irrigated by surface source is almost stagnant over the last two decades. A comprehensive analysis on the development and composition of irrigation by source across the states over the years is provided in Narayanamoorthy (2011).

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Table 1: Average Annual Income per Farmer Household by Source across major Sates during 2002-03 and 2012-13

(Rs/ha at 1986-87 prices)

State	2002-03					2012-13					Compound Growth Rate (percent/annum)				
	Wages	Cultivation	Farming of Animals	non-Farm Business	Total	Wages	Cultivation	Farming of Animals	non-Farm Business	Total	Wages	Cultivation	Farming of Animals	non-Farm Business	Total
1. Andhra Pradesh	2419	2795	350	583	6147	4432	3611	1920	714	10677	5.66	2.36	16.74	1.86	5.15
2. Assam	3660	6741	530	959	11891	2554	7520	1427	455	11955	-3.22	1.00	9.41	-6.55	0.05
3. Chhattisgarh	2667	3051	-11	380	6087	3300	5977	-34	2	9245	1.95	6.30	00	-38.57	3.87
4. Gujarat	3480	4379	1712	527	10097	4791	5238	3446	679	14154	2.95	1.64	6.57	2.33	3.12
5. Jammu & Kashmir	7749	9126	1437	2332	20645	13100	5470	1430	2648	22648	4.89	-4.55	-0.04	1.16	0.85
6. Jharkhand	3476	3205	324	779	7783	3284	2591	2130	425	8430	-0.52	-1.91	18.69	-5.36	0.73
7. Karnataka	3954	4762	493	632	9841	4780	8804	1071	1116	15771	1.74	5.74	7.32	5.31	4.38
8. Kerala	7572	4213	579	2697	15062	9382	6305	1027	4516	21229	1.97	3.73	5.34	4.80	3.17
9. Madhya Pradesh	2107	3747	-854	380	5379	2379	7171	1307	230	11089	1.11	6.08	00	-4.45	6.80
10. Maharashtra	3006	4751	542	967	9265	3850	6886	963	1489	13189	2.28	3.43	5.36	4.01	3.26
11. Orissa	2155	1264	60	515	3995	3064	2513	2346	963	8886	3.25	6.44	39.52	5.84	7.54
12. Rajasthan	3502	1350	19	764	5635	4525	5604	1727	1268	13125	2.36	13.81	50.81	4.72	7.99
Average of SHBNLI	**3812 (40.91)**	**4115 (44.16)**	**432 (4.63)**	**960 (10.30)**	**9319 (100)**	**4953 (37.06)**	**5641 (42.20)**	**1563 (11.70)**	**1209 (9.04)**	**13367 (100)**	**2.41**	**2.91**	**12.41**	**2.12**	**3.33**
13. Bihar	1870	3182	997	760	6809	2363	3063	498	429	6354	2.15	-0.35	-6.11	-5.07	-0.63
14. Haryana	4770	5620	-888	1339	10841	6234	14048	4723	770	25775	2.46	8.69	00	-4.91	8.19
15. Punjab	5500	10616	888	1655	18658	8534	19396	2961	1357	32248	4.08	5.63	11.57	-1.79	5.10
16. Tamil Nadu	4157	2479	414	745	7794	5182	3423	1964	1895	12464	2.02	2.98	15.21	8.86	4.36
17. Uttar Pradesh	2103	3145	199	696	6143	2054	5098	970	671	8791	-0.22	4.49	15.46	-0.33	3.31
18. West Bengal	3337	2772	290	1422	7821	3796	1748	402	1161	7107	1.18	-4.11	3.02	-1.83	-0.87
Average of SHANLI	**3623 (37.43)**	**4636 (47.90)**	**317 (3.27)**	**1103 (11.40)**	**9678 (100)**	**4694 (30.37)**	**7796 (50.44)**	**1920 (12.42)**	**1047 (6.77)**	**15457 (100)**	**2.38**	**4.84**	**17.80**	**-0.47**	**4.35**
All India	**3081 (38.72)**	**3645 (45.82)**	**342 (4.30)**	**888 (11.16)**	**7956 (100)**	**3698 (32.23)**	**5502 (47.95)**	**1363 (11.87)**	**914 (7.97)**	**11475 (100)**	**1.67**	**3.81**	**13.38**	**0.27**	**3.39**

Sources: NSSO (2005a; 2014).

Notes: SHANLI - States having above national level of irrigation coverage in 2002-03; SHBNLI-States having below national level of irrigation coverage in 2002-03; Figures in brackets are percentages to total income.

Table 2: Profitability in different Crops Cultivated in Irrigated and Less Irrigated States

(Rs/ha at 1986-87 prices)

Crops	States	Category of states	Profit in relation with cost A2					Profit in relation with cost C2				
			TE 1973-74	TE 1983-84	TE 1993-94	TE 2003-04	TE 2013-14	TE 1973-74	TE 1983-84	TE 1993-94	TE 2003-04	TE 2013-14
Jowar	Karnataka	IRS	1027	784	568	-96	124	389	103	91	-838	-176
	Madhya Pradesh	LRS	NA	514	446	102	569	NA	-203	-614	-1119	-673
Bajra	Gujarat	IRS	625	1023	1247	445	1914	-212	-106	-51	-988	-248
	Rajasthan	LRS	443	389	378	594	563	17	-123	-376	-796	-1181
Maize	Andhra Pradesh	IRS	NA	NA	NA	1471	4152	NA	NA	NA	-810	646
	Rajasthan	LRS	1189	866	546	333	1538	204	-520	-1019	-2039	-1831
Gram	Madhya Pradesh	IRS	NA	1588	1869	2547	3343	NA	626	396	734	1161
	Uttar Pradesh	LRS	NA	1855	NA	3161	2341	NA	406	NA	1049	148
Groundnut	Tamil Nadu	IRS	1279	1726	NA	1121	3373	13	43	NA	-2244	-212
	Gujarat	LRS	1157	1131	1584	3594	2657	234	-184	-37	1298	-81
Cotton	Gujarat	IRS	NA	2459	3452	3789	6502	NA	676	1332	1264	2637
	Maharashtra	LRS	NA	991	NA	1533	3963	NA	125	NA	-501	236

Source: Computed using data from CACP (various years).

Notes: IRS – Irrigated state; LRS – Less irrigated state.

Table 3: Profitability in Crops Cultivation among High and Low Productivity States

(Rs/ha at 1986-87 prices)

Crops	State	Category of states	Profit in relation with cost A2				Profit in relation with cost C2			
			TE 1983-84	TE 1993-94	TE 2003-04	TE 2013-14	TE 1983-84	TE 1993-94	TE 2003-04	TE 2013-14
Paddy	Andhra Pradesh	HPS	1904	NA	4110	5134	-112	NA	91	723
	Orissa	LPS	1326	NA	1186	1566	-2436	NA	-1327	-1615
Wheat	Punjab	HPS	2283	3016	4327	5976	414	588	1102	2109
	Madhya Pradesh	LPS	1380	1516	1849	4207	180	-186	-252	1189
Gram	Madhya Pradesh	HPS	1588	1869	2547	3343	626	396	734	1161
	Haryana	LPS	809	1851	1326	2935	-165	524	-296	522
Tur	Uttar Pradesh	HPS	NA	4456	3212	2977	NA	2269	534	-915
	Madhya Pradesh	LPS	NA	1747	2057	3243	NA	625	248	1044
Groundnut	Gujarat	HPS	1131	1584	3594	2657	-184	-37	1298	-81
	Karnataka	LPS	1604	NA	558	1502	561	NA	-536	-569
Sugarcane	Tamil Nadu	HPS	11768	NA	11821	18505	7708	NA	4481	11093
	Maharashtra	LPS	7951	6833	3999	18663	3544	2633	-2348	9566
Cotton	Gujarat	HPS	NA	2459	3452	3789	NA	676	1332	1264
	Maharashtra	LPS	991	NA	1533	3963	125	NA	-501	236

Source: Computed using data from CACP (various years).

Notes: HPS – High productivity state; LPS - Low productivity state.

Table 4: Number of Years Profit (ratio > 1 to cost) Reaped or Loss (ratio < 1 to cost) incurred by Farmers in various Crops from 1970-71 to 2013-14

Crop Name	State	Ratio >1.00 (VOP to cost A2)			Ratio >1.00 (VOP to cost C2)		
		1970-71 to 1994-95	1995-96 to 2013-14	1970-71 to 2013-14	1970-71 to 1994-95	1995-96 to 2013-14	1970-71 to 2013-14
Paddy	Punjab	14/14	18/18	32/32	13/14	18/18	31/32
	West Bengal	16/16	20/20	36/36	09/16	00/20	09/36
Wheat	Punjab	23/23	20/20	43/43	17/23	19/20	36/43
	Madhya Pradesh	19/19	20/20	39/39	11/19	15/20	26/39
Gram	Madhya Pradesh	16/16	20/20	36/36	15/16	18/20	33/36
	Haryana	15/15	17/17	32/32	10/15	10/17	20/32
Tur	Uttar Pradesh	09/09	18/18	27/27	09/09	16/18	25/27
	Madhya Pradesh	10/10	20/20	30/30	10/10	19/20	29/30
Groundnut	Gujarat	16/16	19/20	35/36	11/16	12/20	23/36
	Karnataka	12/12	17/17	29/29	9/12	01/17	10/29
Rapeseed and Mustard	Rajasthan	11/11	20/20	31/31	11/11	20/20	31/31
	Assam	11/11	20/20	31/31	11/11	02/20	13/31
Sugarcane	Tamil Nadu	04/04	17/17	21/21	04/04	17/17	21/21
	Maharashtra	15/15	20/20	35/35	15/15	14/20	29/35
Cotton	Punjab	19/19	20/20	39/39	17/19	13/20	30/39
	Maharashtra	09/09	18/18	27/27	07/09	10/18	17/27

Notes: Numerators are number of years profit reaped; Denominators are total number of years for which data was available.
Source: Computed using data from CACP (various years).

Table 5: Increase in Labour and other Inputs Cost in Selected Crops, TE 1982-83 and TE 2013-14

(Rs/ha at 1986-87 prices)

Crop	State	Operations	TE 1982-83	TE 2013-14	% Change
Paddy	Andhra Pradesh	Human Labour	1264	3335	163.84
		Fertilizer	1081	914	-15.45
		Cost A2 + FL	3319	5339	60.86
	West Bengal	Human Labour	1413	3873	174.10
		Fertilizer	345	698	102.32
		Cost A2 + FL	2284	4366	91.16
Wheat	Punjab	Human Labour	729	780	7.00
		Fertilizer	1073	737	-31.31
		Cost A2 + FL	3179	3694	16.20
	Uttar Pradesh	Human Labour	724	1276	76.24
		Fertilizer	640	613	-4.22
		Cost A2 + FL	2810	3353	19.32
Gram	Madhya Pradesh	Human Labour	351	826	135.33
		Fertilizer	25	223	792.00
		Cost A2 + FL	1003	2270	126.32
	Rajasthan	Human Labour	378	1143	202.38
		Fertilizer	11	89	709.09
		Cost A2 + FL	829	1488	79.49
Tur	Karnataka	Human Labour	414	1219	194.44
		Fertilizer	109	312	186.24
		Cost A2 + FL	875	2297	162.51
	Madhya Pradesh	Human Labour	647	1043	61.21
		Fertilizer	163	178	9.20
		Cost A2 + FL	959	1641	71.12
Groundnut	Gujarat	Human Labour	697	1891	171.31
		Fertilizer	508	662	30.31
		Cost A2 + FL	2459	4640	88.69
	Andhra Pradesh	Human Labour	754	3484	362.07
		Fertilizer	312	704	125.64
		Cost A2 + FL	2132	5837	173.78
Sugarcane	Tamil Nadu	Human Labour	3764	12227	224.84
		Fertilizer	1932	1856	-3.93
		Cost A2 + FL	9312	14714	58.01
	Maharashtra	Human Labour	4118	6831	65.88
		Fertilizer	3254	2718	-16.47
		Cost A2 + FL	11431	14737	28.92
Cotton	Maharashtra	Human Labour	676	3320	391.12
		Fertilizer	523	1321	152.58
		Cost A2 + FL	1773	6431	262.72
	Gujarat	Human Labour	1305	3195	144.83
		Fertilizer	942	1024	8.70
		Cost A2 + FL	4379	5159	17.81

Source: Computed using data from CACP (various years).

Table 6: Compound Growth Rate in Cost A2, C2 and Value of Output in Selected Crops

(percent/annum)

Crop	State	Cost A2		Cost C2		VOP	
		1970-71 to 1995-96	1995-96 to 2013-14	1970-71 to 1995-96	1995-96 to 2013-14	1970-71 to 1995-96	1995-96 to 2013-14
Paddy	Punjab	5.59	6.78	6.08	7.29	7.96	8.47
	West Bengal	10.21	9.40	9.71	8.83	9.15	8.06
Wheat	Punjab	8.76	6.39	8.79	7.33	8.57	8.99
	Madhya Pradesh	11.67	7.38	12.92	7.97	10.42	8.97
Gram	Madhya Pradesh	8.81	8.40	8.59	8.21	8.79	8.17
	Haryana	6.81	9.73	8.07	8.56	8.26	6.06
Tur	Uttar Pradesh	3.84	6.78	2.85	7.93	3.43	3.78
	Madhya Pradesh	3.51	8.75	4.27	7.67	4.31	6.67
Groundnut	Gujarat	8.68	9.57	9.17	9.67	8.51	11.53
	Karnataka	7.31	7.80	7.70	7.88	8.61	9.15
Rapeseed & Mustard	Rajasthan	6.77	8.32	6.66	8.16	8.16	6.89
	Assam	7.60	9.37	7.82	8.91	5.90	8.24
Sugarcane	Tamil Nadu	4.72	6.41	4.70	6.10	5.38	5.73
	Maharashtra	7.10	8.12	6.71	8.58	5.52	9.52
Cotton	Punjab	10.56	8.50	10.17	8.06	10.99	8.71
	Maharashtra	9.09	10.76	9.26	10.83	10.50	10.48

Source: Computed using data from CACP (various years).

Table 7: Impact of Drip Irrigation Technology on Crops Productivity and Profitability: Results of Selected Studies

Sl. No	Author (year)	Study Area	Crop Name	Sample Size	Productivity (Qtls/ha)			Cost of Cultivation (Rs/ha)			Profit (Rs/ha)		
					Drip	Non-Drip	% over non-Drip	Drip	Non-Drip	% over non-Drip	Drip	Non-Drip	% over non-Drip
1	Narayanamoorthy (2003)	Maharashtra	Banana	50	679.54	526.35	29.10	51436	134506	-61.76	82607	50196	64.57
			Grapes	50	243.25	204.29	19.07	52738	147915	-64.35	113310	63123	79.51
2	Narayanamoorthy (2005)	Tamil Nadu	Sugarcane	CS	850.00	550.00	54.55	80612	74387	8.37	85711	33233	157.91
3	Narayanamoorthy (2006)	Maharashtra	Sugarcane	100	1383.6	1124.4	23.05	41993	48539	-13.49	64373	36948	74.23
4	Narayanamoorthy (2008)	Maharashtra	Cotton	CS	45.62	21.25	114.68	42982	43510	-1.21	53207	1704	3022.48
5	Jalajakshi and Jagadish (2008)	Tamil Nadu	Sugarcane	40	1430	1215	17.70	98625	114750	-14.05	53955	13798	291.03
		Tamil Nadu	Banana	20	330.50	237	39.45	62530	78313	-20.15	221270	116438	90.03
		Madhya Pradesh	Chilli	43	47.50	27.50	72.73	32308	34758	-7.05	148195	67843	118.44
		Maharashtra	Cotton	42	35.00	22.50	55.56	26448	31140	-15.07	46353	13860	234.44
		Maharashtra	Banana	20	645.00	612.50	5.31	37813	50575	-25.23	168588	136238	23.75
6	Kumar and Palanisami (2010)	Tamil Nadu	Banana	50	603.40	577.9	4.41	--	--	--	--	--	--
			Grapes	50	228.40	194.5	17.43	--	--	--	--	--	--
7	Kalyankar *et al.,* (2011)	Maharashtra	Ginger	32	111.00	55.00	101.82	156294	90024	73.61	59098	42921	37.69
8	Kumar (2012)	Tamil Nadu	Banana	100	605.60	591.5	2.38	--	--	--	--	--	--
9	Chandrakanth *et al.,* (2013)	Karnataka	Tomato	30	121.00	110.15	9.85	48855	51982	-6.02	65520	56990	14.97
			Mulberry	30	49.81	36.62	36.02	37912	42347	-10.47	19052	12445	53.09
			Grapes	30	115.77	79.75	45.17	57402	64215	-10.61	130210	53710	142.43
10	Narayanamoorthy *et al.,* (2016)	Tamil Nadu	Green Chili	60	118.00	77.40	52.45	196250	278000	-29.41	552565	228190	142.15
11	Dave *et al*., (2016)	Gujarat	Banana	120	701.69	616.01	13.91	150098	151735	-1.08	165185	108135	52.76

Source: Results gathered from the studies mentioned above.

Table 8: Impact of Bt cotton on Productivity and Profitability: Results of Selected Studies

Sl. No	Author (year)	Study Area	Sample Size	Productivity (Qtls/ha)			Cost of Cultivation (Rs/ha)			Profit (Rs/ha)		
				Bt	non-Bt	% over non-Bt	Bt	non-Bt	% over non-Bt	Bt	non-Bt	% over non-Bt
1	Narayanamoorthy and Kalamkar (2006)	Maharashtra	150	24.00	15.77	52.19	26067	19344	34.75	31883	17797	79.15
2	Loganathan *et al*., (2009)	Tamil Nadu	120	33.52	20.33	64.88	30895	33686	-8.29	45660	6828	568.72
3	Kiresur and Ichangi (2011)	Karnataka	60	24.00	18.40	30.43	27679	30385	-8.91	30618	12189	151.19
4	Gandhi and Namboodiri (2006)	Gujarat	180	31.76	23.45	35.44	29878	26287	13.66	32065	18244	75.76
		Maharashtra	154	26.05	17.80	46.35	31679	23207	36.51	22634	14317	58.09
		Andhra Pradesh	180	29.62	20.49	44.56	32139	30444	5.57	18831	5426	247.05
		Tamil Nadu	180	18.93	14.73	28.51	23040	20260	13.72	15242	5772	164.07
5	Peshin *et al*., (2007)	Punjab	210	28.75	17.50	64.29	22431	24259	-7.54	21558	18311	17.73
6	Dev and Rao (2007)	Andhra Pradesh	623	23.72	18.02	31.63	28665	25702	11.53	12915	5245	146.23
7	Ashok *et al.*, (2012)	Maharashtra	120	11.66	8.28	40.82	15482	13652	13.40	9146	3502	161.17
		Gujarat	120	25.59	16.85	51.87	27899	22088	26.31	37462	9516	293.67
		Andhra Pradesh	120	25.67	19.02	34.96	33106	29855	10.89	18273	7997	128.50
		Tamil Nadu	120	23.88	17.39	37.32	37435	28046	33.48	20762	4110	405.16
		All India	480	21.70	15.39	41.00	28481	23410	21.66	21411	6281	240.89
8	Visawadia *et al*., (2006)	Gujarat	128	18.71	14.46	29.39	28084	25647	9.50	16602	8853	87.53
9	Herring and Rao (2012)	Andhra Pradesh	623	23.72	18.02	31.63	24805	22717	9.19	16725	8127	105.80
10	Qaim *et al*., (2006)	Maharashtra	141	16.02	12.15	31.85	19382	16792	15.42	12495	8007	56.05
		Karnataka	117	19.50	11.27	73.03	19335	16312	18.53	20765	7627	172.26
		Tamil Nadu	41	19.52	13.65	43.00	26532	25171	5.41	17225	5240	228.72
		Andhra Pradesh	135	12.55	12.95	-3.09	21800	19275	13.10	5020	8382	-40.11

Source: Results gathered from the studies mentioned above.

Table 9: Impact of SRI Method on Productivity and Profitability in paddy: Results of Selected Studies.

Sl. No	Author (year)	Study Area	Sample Size	Productivity (Qtls/ha)			Cost of Cultivation (Rs./ha)			Profit (Rs/ha)		
				SRI	non-SRI	% over non-SRI	SRI	non-SRI	% over non-SRI	SRI	non-SRI	% over non-SRI
1	Reddy *et al.*, (2005)	Andhra Pradesh	74	73.57	57.12	28.80	23641	20589	14.82	19510	14787	31.94
2	Sinha and Talati (2007)	West Bengal	220	53.29	40.42	31.84	7622	9208	-17.22	16257	8664	87.64
3	Basavaraja *et al.*, (2008)	Andhra Pradesh	480	85.10	60.70	40.20	33102	31773	4.18	23593	9720	142.73
4	Devi and Ponnarasi (2009)	Tamil Nadu	100	54.00	35.00	54.29	21655	25914	-16.44	27009	14499	86.28
5	Barah (2009)	Coimabtore	116	65.20	60.70	7.41	16774	20283	-17.30	16555	14564	13.67
		Kanchipuram		65.40	54.10	20.89	16604	18938	-12.32	17629	13386	31.70
		Ramnathpuram		51.00	42.50	20.00	11589	15953	-27.36	16155	9263	74.40
		Tanjore		50.60	47.60	6.30	16699	19010	-12.16	14875	12643	17.65
6	Radha *et al.*, (2009)	Andhra Pradesh	214	68.50	55.00	24.55	45681	58645	-22.11	23052	26466	-12.90
7	Rao (2011)	Andhra Pradesh	90	64.00	49.00	30.61	26115	28525	-8.45	19885	7233	174.92
8	Adusumilli and Laxmi (2011)	Andhra Pradesh	110	53.90	45.50	18.46	19289	28476	-32.26	41389	27257	51.85
9	Palanisami *et al*., (2013)	13 States in India	2234	46.40	37.90	22.43	20555	23536	-12.67	24261	14309	69.55
10	Durga and Kumar (2013)	Kerala	84	54.68	42.97	27.25	38741	46462	-16.62	26957	7909	240.84
11	Islam *et al.*, (2014)	Meghalaya	134	57.40	18.50	210.27	26783	21025	27.39	47727	3008	1486.67

Source: Results gathered from the studies mentioned above.