

Getting Punjab Agriculture Back on High Growth Path: Sources, Drivers and Policy Lessons





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July 2017

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List of Abbreviations

ADF	Augmented Dickey Fuller
AIDIS	All India Debt and Investment Survey
BAHFS	Basic Animal Husbandry and Fisheries Statistics
CACP	Commission of Agricultural Cost and Prices
CGWB	Central Ground Water Board
CSO	Central Statistics Office
DBT	Direct Benefit Transfer
DES	Directorate of Economics and Statistics
e-NAM	Electronic National Agriculture Market
FCI	Food Corporation of India
FPO	Farmer Producer Organization
GADVASU	Guru Angad Dev Veterinary and Animal Sciences University
GCA	Gross Cropped Area
GSDP	Gross State Domestic Product
GST	Goods and Services Tax
GVOA	Gross Value of Output from Agriculture and Allied Activities
HCR	Head Count Ratio
HYV	High Yielding Varieties
ICRIER	Indian Council for Research on International Economic Relations
IWMI	International Water Management Institute
KMS	Kharif Marketing Season
MoFPI	Ministry of Food Processing Industry
MOSPI	Ministry of Statistics and Programme Implementation
MP	Madhya Pradesh
MT	Metric Ton
NDDB	National Dairy Development Board
NDP	National Dairy Plan
NSSO	National Sample Survey Organisation
OLS	Ordinary Least Squares
PAFC	Punjab Agro Foodgrains Corporations
RKVY	Rashtriya Krishi Vikas Yojana
RMS	Rabi Marketing Season
ToT	Terms of Trade
UP	Uttar Pradesh

Acknowledgement

This paper forms part of the study on Agricultural growth and its linkages to poverty alleviation in six selected states of India, namely Bihar, Uttar Pradesh (UP), Odisha, Punjab, Gujarat and Madhya Pradesh (MP). There has been low to moderate growth in agriculture in Bihar, UP and Odisha over the period 2000-01 to 2014-15. Punjab has been the seat of the green revolution and was a front-runner in agriculture during the late 1960s, but has slipped to low levels of agricultural growth in the recent past. Gujarat and Madhya Pradesh have shown some extra-ordinary growth in their agriculture sectors (almost three times the all-India agricultural growth rate) in the last decade or so. The key idea of this study was to look for policy lessons from each other within Indian context, and see how to propel growth in agriculture for faster alleviation of poverty.

We would like to express our sincere gratitude for the financial support provided by Bill and Melinda Gates foundation (BMGF) for this project. In particular, we would like to thank Mr. Hari Menon, Mr. Brantley Browning and Dr. Purvi Mehta from BMGF for their productive communication from the very beginning of the project and their suggestions as the work proceeded.

We would also like to express our gratitude to Mr. Ramesh Inder Singh (Former Chief Secretary, Government of Punjab) and Mr. Bharat Sharma (Senior Visiting Fellow ICRIER and Scientist Emeritus IWMI) for reviewing the paper and providing valuable insights and useful comments. We are grateful to Mr. Suresh Kumar (Principal Secretary to Chief Minister of Punjab), Mr. H Sandha (Director, Agriculture, Govt. of Punjab), Mr. Vivek Kumar Singh and Mr. Harinder Singh for their comments and interactions on several issues. We would also like to thank Pavitar Pal Singh Pangli (President, Borlaug farmers' Association for South Asia), Manjit Singh Brar (Managing Director, Verka), and Shweta Saini (Senior Consultant, ICRIER) for useful interaction on several issues. We express our gratitude to Dr. Pritpal Singh Lubana (University Librarian, PAU), and Inderjit Singh (Director, Dairy Development, Punjab) for furnishing data and information relating to agricultural development in Punjab. We are grateful to Mr. Malwinder Malhi (Project Manager, North India, Syngenta) for introducing us to different stakeholders during our field visit to Ludhiana. We are also thankful to the participants of the "Workshop on Studying Drivers of Agricultural Growth in selected Indian States with focus on Role of Agricultural Extension Systems", held in Delhi on June 17, 2016. Finally, we are grateful to Smriti Verma (Consultant, ICRIER) for giving a careful reading to do a consistency check and light editing of the final version. Needless to say, if there are still any errors, it is the authors who are fully responsible for that.

Abstract

Punjab has been a star performer in agriculture during heydays of the Green Revolution. Agriculture in Punjab grew at a high growth rate of 5.7 per cent during 1971-72 to 1985-86, which was more than double the all-India growth rate (2.31 per cent) during this period. It was this spectacular performance of Punjab, first witnessed in large wheat surpluses followed by steep rise in production of rice, which helped India free itself from the PL 480 food aid and its associated political strings. Punjab played a crucial role in achieving the much needed food security for India. However, the state slipped soon after and grew at a lower rate of about 3 per cent between 1986-87 and 2004-05, equivalent to the all-India agricultural growth rate. The situation has deteriorated further as Punjab's agriculture GDP grew at only 1.61 per cent per annum, which is less than half the all-India average growth rate of 3.5 per cent in the period between 2005-06 and 2014-15. It is intriguing what led to the sharp deceleration of agriculture growth in Punjab and what sort of policy intervention is required to put it back on a high growth path. The landslide victory of the Congress Party in the state assembly election offers hope to change the fate of Punjab's agriculture. In this paper, we study the composition, sources and drivers of agricultural growth that had contributed to the high growth of agriculture in Punjab until 1985-86. The study finds that among the many steps taken by the state, three interventions played the most important role in the state's impressive performance in agriculture. They are irrigation facilities, all-weather roads to provide rural connectivity and assured market for agricultural produce. But, the state has already achieved the best position in technology and infrastructure development and there is no real scope left to expand these areas. The future of Punjab's agricultural prosperity lies in the high-value sectors of agriculture. The study makes three sets of recommendations to stimulate agricultural growth in Punjab, viz., (1) encouraging diversification from common rice in the kharif season by moving on to maize for poultry feed, silage and starch industries, promoting fruits and vegetables to at least 10 percent of GCA including their protected cultivation through drips, etc. with an eye on export markets of the Gulf countries; (2) encouraging processing industries by liberalising land lease markets, developing contract farming, rationalising tax structure on raw commodities, especially wheat and rice and revisiting tax rates approved by GST council for processed food under new GST regime; (3) promoting sustainable agriculture by shifting to DBT with respect to power and fertiliser subsidy so that inefficiencies in the use of power and fertilisers can be minimised as also propagating micro irrigation techniques and encouraging the use of solar power for powering irrigation pumps, and generating solar power as the third crop.

Keywords: Agricultural Growth, Irrigation, Water Depletion, Power, Surfaced Roads, Marketing Infrastructure, Procurement, Punjab

JEL Classification: Q1, Q10, Q13, Q15, Q25

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Executive Summary

Punjab was the frontrunner of agriculture performance during the glorious days of Green Revolution. Despite the state's small geographical area (1.5 per cent of the total area of the country), the GSDP from agriculture increased at 5.7 per cent per annum in the period of 1971-72 to 1985-86, which is more than double of 2.31 per cent all-India growth in the same period. It was this stellar performance of Punjab, first witnessed in large wheat surpluses and then similar rise in rice production, which helped India free itself from the PL 480 food aid and its associated political strings. Punjab became a symbol of grain surpluses, giving India the much needed food security. Thanks to the earlier years of high agri-growth Punjab had one of the lowest poverty ratios (7.7 percent in rural Punjab) in the country in 2011-12, as per Tendulkar poverty line, which was almost one-third of the levels of poverty at all India level. These have been the most commendable achievements of Punjab. But lately Punjab's agriculture growth plummeted to just 1.6 per cent per annum during 2005-06 to 2014-15, which was less than half the all-India agri-GDP growth of 3.5 percent over the same period. The question arises is where did Punjab go wrong and what sort of policy revival is needed to get back to high growth path of more than 5 percent per annum in agriculture and overall GSDP of more than the national average of 7-8 percent per annum, say for the next 10 to 15 years?

With 77 seats in the 117-member assembly, Congress has set up a historic victory in the 2017 assembly election. This can bring a significant change in Punjab's agriculture if the promises made in the election manifesto are honoured in spirit. The most notable of them are agricultural sustainable programme (Free soil testing, 80 per cent subsidy on drip and sprinkler irrigation and solar energy, incentives on alternative crops), special incentives for the agro-processing sector (input tax waiver, establishment of food parks)

and DBT of subsidy to the farmers. In this paper, we have used secondary data published by the Govt. of India and state government to study the composition, sources and drivers of agriculture growth in Punjab.

Cereals constitute the major share of 42.7 per cent in the gross value of output from agriculture and allied activities followed by livestock (28.6 per cent) in TE 2013-14. In the 14-year period between 2000-01 and 2013-14, the value of output from agriculture and allied activities in Punjab increased at an average annual rate of 2.71 per cent in 2004-05 prices. Decomposing this growth into various sectors, cereals contributed 38.9 per cent to this growth; livestock contributed 31.7 per cent, while fruits and vegetables contributed 15.4 per cent to growth despite its small share in the GVOA.

Agriculture growth is impacted by a host of factors, which can be classified at least in three distinct sets: (i) Technology (Irrigation, Fertiliser consumption, seed replacement ratio, farm mechanisation), (ii) Price Incentive (Terms of Trade, Minimum Support Price), and (iii) Infrastructure (Electricity, Roads, Mandis etc). Besides these, there could also be factors that impact the institutional setting of agri-sector, such as land markets, land lease laws, marketing laws (Essential Commodities Act (ECA) and Agriculture Produce Marketing Act (APMC), contract farming laws, etc)

In a simple econometric regression model, taking log GSDP as the dependent variable and the above mentioned three sets of quantifiable variables as independent variables (in log form), with data from 1970-71 to 2014-15, we estimate the following equation:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \quad (1)$$

Here, X_1 is Irrigation Ratio; X_2 is terms of trade between agriculture and industry; and X_3 is surfaced road density.

The estimated equation gives the following results¹:

$$\text{GSDPA} = 7.7 + 3.47\text{IRR}^{***} + 0.35\text{ToT}^{***} + 0.37\text{SRD}^{**}$$

(7.97) (4.43) (4.32)

Adj R-square= 0.97

What this equation implies is that 97 percent of the growth in agriculture during this period (1970-71 to 2014-15) can be explained by expansion of irrigation ratio, road density, and price incentives (ToT), with irrigation having played the most important role.

The state has performed very well in terms of high input use and infrastructure development and it set an example for many other states. The state successfully brought 98.5 per cent of the gross cropped area under irrigation which is commendable. The road infrastructure in Punjab is among the most developed in India. Transport facilities enhance the interaction between different agents starting at the farm level to household consumption level. It becomes even more crucial when it comes to perishable agricultural commodities. Road density in Punjab has increased from 564 per thousand sq km in 1970-71 to around 2271 per thousand sq km in 2014-15. Further, surfaced road as a percentage of total roads is 87 percent in Punjab, one of the highest in the country. Unlike decreasing size of land holding at all India level, Punjab has experienced increase in operational land holding over the years. Average land holding size has increased from 2.89 ha in 1970-71 to 3.77 ha in 2010-11. The share of wheat and rice procurement in total production is highest in the country. There may be no real scope for further improvement in these factors. Therefore, in order to bring agricultural growth in Punjab back on track, we must look to other sectors that could lead to high agricultural growth in the future. This combination of highest irrigation cover, one of the best road densities in the

country, and increasing holding size, places Punjab in a very fortunate situation to get its agriculture back to growing at more than 5 percent per annum for another decade or more, provided it follows right mix of policies and incentives.

Diversification from Common Rice:

The most significant problem of Punjab has been free power leading to massive depletion of water table, as cropping patterns leaned towards paddy. As a result, water table is going down at an alarming rate (70cms per year during 2008-12) and currently 80 per cent of the blocks are overexploited. Encouraging diversification away from common rice in the kharif season by moving on to maize for poultry feed (as corn, along with soybean, is the most important ingredient of feed in the poultry industry), silage and starch industries, promoting fruits and vegetables to at least 10 percent of GCA including their protected cultivation through micro irrigation, etc. with an eye on export markets of the Gulf countries will boost the agriculture in the state.

Encouraging Food Processing Industries:

Agriculture is going to stay as the backbone of farmers for another 10-15 years in Punjab. It can build on this core competence by linking agriculture to food processing sector, adding value, creating jobs in rural areas, and increasing farmers' incomes. The state can emerge as a hub for units using wheat as raw material like flour mills, noodles and pasta manufacturing, biscuits and bakery, etc. But all these years, wheat based processing units always felt unenthusiastic to buy wheat from Punjab due to very high taxes and statutory levies which touched 14.5 per cent. Under new GST regime the VAT of 5 per cent will be abolished and there will be no GST on food grains.

¹ Numbers in the parentheses are t values.

With abolition of high taxes, Punjab can again become attractive to private trade to purchase grains instead of buying them from other States. There is also an opportunity now to attract food processing industry which can benefit farmers and create employment. However, under the new GST regime, taxation structure approved by GST council for processed food is too high. The Centre may reconsider these rates and bring them down to the 5 per cent slab.

Promote Sustainable Agriculture especially with respect to Water Use Efficiency:

The most critical problem of Punjab agriculture is its depleting water table primarily due to paddy cultivation during kharif season. Fertiliser

consumption is also skewed toward highly subsidised urea. We recommend promoting sustainable agriculture by shifting to DBT with respect to power and fertiliser subsidy so that inefficiencies in their use can be minimised as also propagating micro irrigation techniques and encouraging the use of solar power for powering irrigation pumps, and generating solar power as the third crop.

Overall, the strategy for Punjab agriculture needs to shift from food security concerns of the country to sustainable agriculture practices coupled with income augmentation of Punjab farmers. We are confident that with this shift in strategy, the state can turn around its agricultural growth back to more than 5 percent per annum, increase farmers' incomes, and use its precious water resources in a more sustainable manner.

1. Introduction

Punjab has been a star performer in agriculture during heydays of Green Revolution. Its agriculture GDP grew at 5.7 per cent per annum during 1971-72 to 1985-86, which was more than double the growth rate of 2.31 per cent, achieved at all-India level during the same period. It was this spectacular performance of Punjab, first observed in large wheat surpluses and then in rice, which helped India free itself from the PL 480 food aid and its associated political strings. Punjab became a symbol of India's grain surpluses, giving India a much needed food security. But after 1985-86, green revolution started greying and growth in Punjab agriculture slowed down to 3 percent per annum over the period 1985-86 to 2004-05, almost same as achieved at all India level. But the real challenges to Punjab agriculture emerged when its growth crashed down to just 1.6 per cent per annum during 2005-06 to 2014-15, which was less than half the all-India agri-GDP growth of 3.5 percent over the same period. Owing to the earlier years of high agri-growth that Punjab had one of the lowest poverty ratios (7.7 percent in rural Punjab) in the country in 2011-12, as per Tendulkar poverty line, which was almost one-third of the levels of poverty at all India level. Providing food security to the country and reducing its own poverty to lowest levels within all India context, have been the most laudable achievements of Punjab.

But lately, as a result of its decelerating agri-growth,

Punjab has lost its pre-eminent position of being the state with highest per capita income in India, a title it carried since its inception in 1966 till 2002-03. In 2014-15, e.g., Punjab stood at the 7th position in per capita income amongst 21 major states of India. And if current growth trends continue, it won't be a surprise that Punjab slips further down in this hierarchy of large Indian states in terms of its per capita income.

That raises some fundamental questions: where did Punjab go wrong? And how can it get back to high growth path of more than 5 percent per annum in agriculture and overall GSDP of more than the national average of 7-8 percent per annum, say for the next 10 to 15 years? It is precisely these questions that we try to address in this study on Punjab agriculture, identifying its sources and drivers of growth, and how best to accelerate its agri-growth.

The paper is organised in six sections as follows:

- Agriculture in Punjab
- Trends in agricultural growth
- Composition and Sources of agricultural growth
- Plausible Determinants of Agriculture Growth: Technology, Infrastructure Development, Incentives and Institutions
- Econometric Analysis for Drivers of Agriculture Growth
- Conclusion and Policy Recommendation

2. Methodology

The study has used time-series secondary data compiled from various published sources of Government of India and Government of Punjab, covering the period 1990-91 to 2014-15. We have analysed the composition of agriculture by calculating the share of value of output from different segments as a percentage of total value of output from agriculture and allied activities (at current prices). To calculate the sources of growth, the current series of value of output of each segment is deflated by the WPI of all commodities at 2004-05 prices. Then, year-on-year growth of each segment is calculated by taking the

absolute year-on-year difference in GVO from each segment as a proportion of previous year's GVO from agriculture and allied activities. Further, in the paper we have used a simple ordinary least square model to identify the drivers of growth. We have considered a longer time period of 1970-71 to 2014-15 for the regression analysis to identify the drivers of growth during the green revolution period. We also performed a unit root test on the residuals of the model to determine if it is stationary. The null hypothesis in the Engle-Granger procedure is no co-integration.

3. Agriculture in Punjab

3.1 Geography

The state of Punjab, “land of five rivers” was located at the confluence of five rivers Beas, Chenab, Jhelum, Ravi and Sutlej. After the partition of India in 1947, Punjab was divided between India and Pakistan along religious lines. Indian Punjab was again divided in 1966 on a linguistic basis, giving birth to a truncated Punjab after the formation of Haryana and Himachal Pradesh as separate states. Present day Punjab is situated in the northern part of India bordered by Jammu and Kashmir to the north, Himachal Pradesh to the east, Haryana to the south and Rajasthan to the southwest.

Punjab has an area of 50,362 square kilometres which is 1.5 per cent of the total geographical area of the country. It extends from the latitudes 29.30° north

to 32.32° north and longitudes 73.55° east to 76.50° east. The subtropical location leads to variation in temperature and Punjab experiences three main seasons: hot season, rainy season and cold season. The monsoon season provides most of the rainfall in Punjab.

Punjab has been divided into five agro-climatic zones on the basis of homogeneity, rainfall pattern, cropping pattern, etc. The zones are: sub-mountain undulating zone, undulating plain zone, central plain zone, western plain zone and western zone.

The state has hilly areas in the north covering 20 per cent of the total area, alluvial plains in the centre covering 55 per cent of the total area and sandy region in the south-western part of the state.

Figure 1: Agro-Climatic Zones in Punjab



Source: created by Krishi Vigyan Kendra, Faridkot, PAU, Ludhiana

3.2 Climate and Water Resources

The climate of Punjab is influenced by the Himalayas in the north and the Thar Desert in the south and south west. The state receives only 61.9 cm (normal) rainfall, of which 75 per cent is received during monsoon months. The maximum rainfall occurs in the districts situated north of Gurdaspur and the least occurs in the districts southwest of Ferozpur [Annexure: 1].

3.3 Disasters

Punjab is vulnerable to several types of natural hazards. A substantial part of the geographical area of the state is flood prone but most of it is protected through flood control measures. In the last three decades, Punjab experienced droughts in 1987, 2002, 2004, 2007, 2014 and 2015. The intensity of drought was the highest in 2002 – all districts were declared as drought affected. Occasionally, Punjab experiences hailstorms, which cause damages to standing crops. Apart from natural calamities, the state faces severe depletion of ground water. The agricultural sector accounts for 85 per cent of the water consumption in state. Due to increase in the demand for water and reduction in canal capacity, the area irrigated by tube wells has been increasing. As a result, ground water is being over exploited for irrigation purposes. The present ground water development² in the state is 172 per cent and ground water is over exploited in 80 per cent of blocks.³ (CGWB, 2016). While the northern and central districts of the state suffer from severe ground water depletion, the south western districts face the problem of water logging and soil salinity. The affected districts include Muktsar, Fazilka, Bathinda and Faridkot. According to the GoI Report of the High level Expert Group on Water Logging in Punjab,

“...An area is said to be waterlogged when the water table rises to such an extent that the soil pores in the root zone of a crop becomes saturated, resulting in restriction of normal air, decline in the level of oxygen and increase in the level of carbon dioxide” Many farmers have lost their livelihood in these areas as their agricultural land becomes unproductive.

Burning of paddy straw has been identified as a major threat to the environment in Punjab and neighbouring states, especially Delhi. The state produces about 20 million MT of paddy straw and 85 per cent of it is burnt in the fields.

3.4 Land Use

The land use pattern has remained unchanged over the years with net sown area marginally declining from 83 to 82 per cent between TE 1986-87 to TE 2012-13. Forest area marginally increased from 4.4 per cent to 6 per cent in the same period. Net sown area and net irrigated area in TE 2012-13 stood at 4.15 million hectare and 4.09 million hectare respectively. In Punjab, gross cropped area and gross irrigated area per 100 persons are 28.4 ha and 27.9 ha respectively, which are much higher compared to the all-India figures (16.2 ha and 7.5ha respectively).

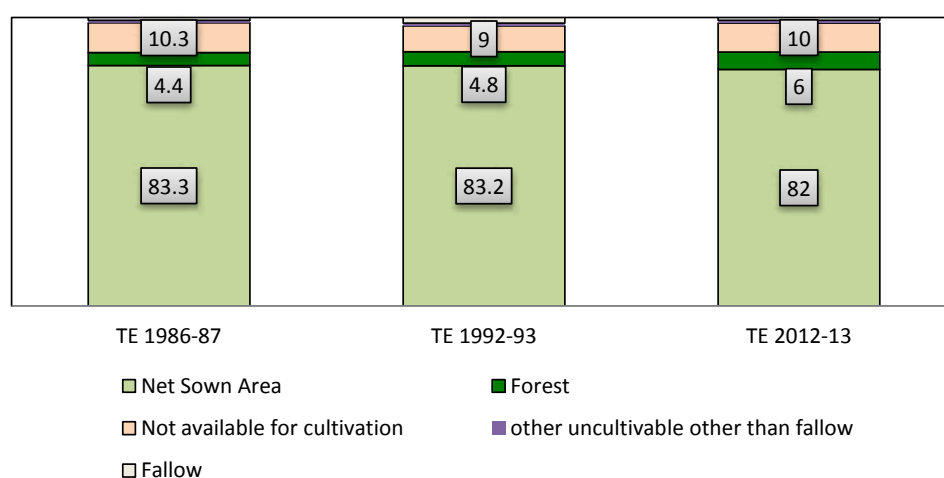
3.5 Cropping Pattern

The major crops grown in Punjab are wheat, rice, maize, cotton, sugarcane and horticulture crops. Over the years, Punjab has concentrated on food grain production with the area under food grains as a share of gross cropped area (GCA) increasing from 76.5 per cent in TE 1986-87 to 83.4 per cent in TE 2014-15, while the share of cotton, sugarcane and oilseeds declined significantly. In TE 2014-15, the area under

² The stage of development is defined as the ratio of Annual Ground Water Draft to Net Annual Ground Water Availability in percentage.

³ As per Central Ground Water Board (North Western Region, Chandigarh 2016), out of total 138 administrative blocks there are 110 over exploited, 4 critical, 2 semi-critical and 22 safe blocks.

Figure 2: Land use Statistics (Percentage Share in Total Geographical Area)

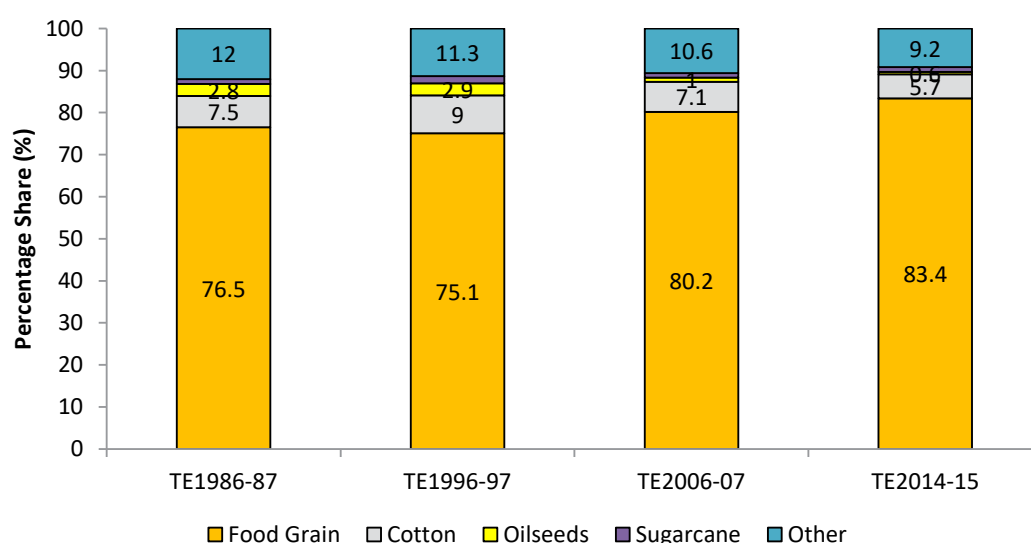


Source: Directorate of Economics and Statistics

cotton, oilseeds and sugarcane was 5.7 per cent, 0.6 per cent and 1.2 per cent respectively. Within the food grain sector, the state had focussed on rice and wheat production, while the share of maize declined from 3.9 per cent in TE 1986-87 to 1.6 per cent in TE 2014-15 [Annexure: 3]. The total gross cropped area

in the state is 7.9 million hectares and, with excellent irrigation infrastructure, 98.5 per cent of the gross area sown is irrigated. Cropping Intensity, which is measured by the ratio of gross cropped area to net sown area, was 190 in the TE 2013-14, which resulted in boost in productivity over the years [Annexure: 1].

Figure 3: Share of different crops in Gross Cropped Area)



Source: Directorate of Economics and Statistics

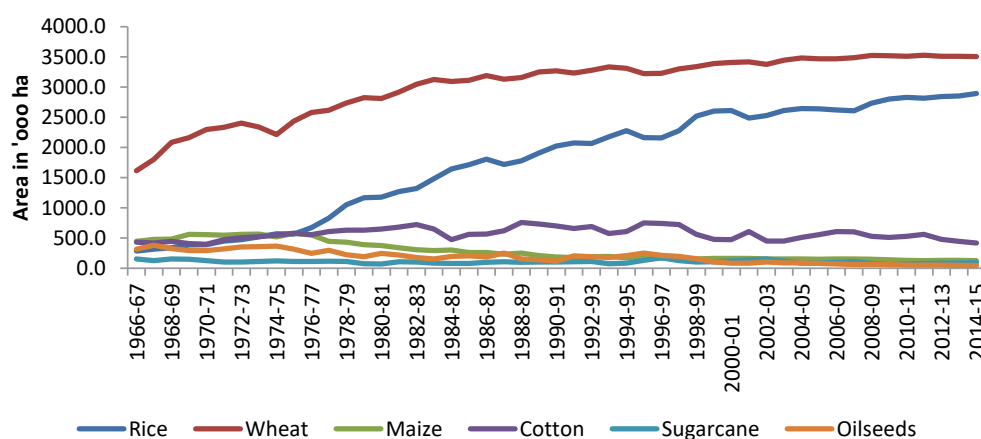
Punjab farmers, for various reasons, have specialised in food grain production and it serves as the food bowl of India. It devotes around 83 per cent (TE 2014-15) of gross cropped area to production of food grains. Within cereals, wheat has traditionally been the dominant crop, but the higher profitability of rice, ensured by free water and an assured market, prompted farmers to shift to rice cultivation. As a result, the area under rice kept increasing and stood at around 36 per cent of GCA in TE 2014-15. Area

under wheat remained stagnant at around 44 per cent of GCA in the same period.

The area under fruits and vegetables has remained more or less constant over the years. Fruits and vegetables constitute 0.99 per cent (77.75 thousand ha) and 2.6 per cent (2,08 thousand ha) of the total gross cropped area in 2014-15 respectively.

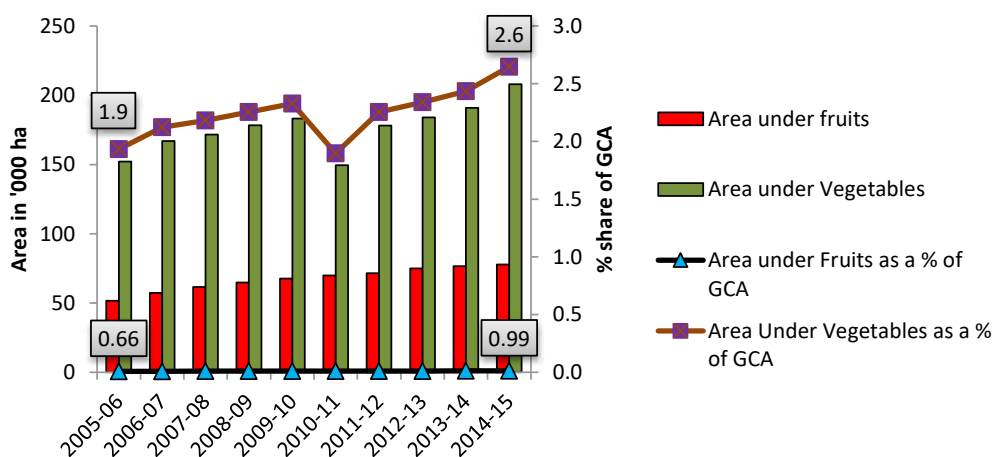
The area under fodder crop in Punjab has declined marginally from 5.7 lakh hectare in 2005-06 to 5.2

Figure 4: Change in Acreage under Important Crops (Area in '000 Ha)



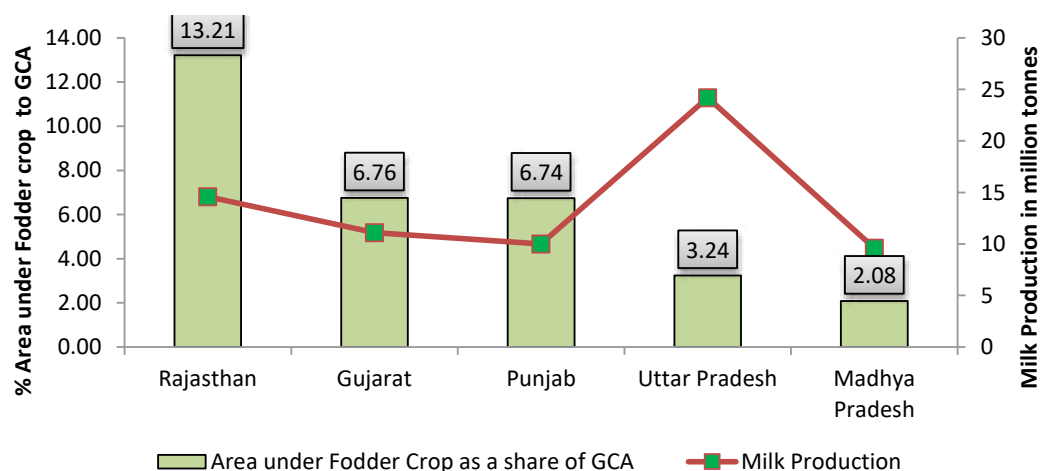
Source: Directorate of Economics and Statistics

Figure 5: Area under Fruits and Vegetables



Source: Various Reports of National Horticulture Board

Figure 6: Area under Fodder per ha of GCA (TE2011-12) and Production of Milk



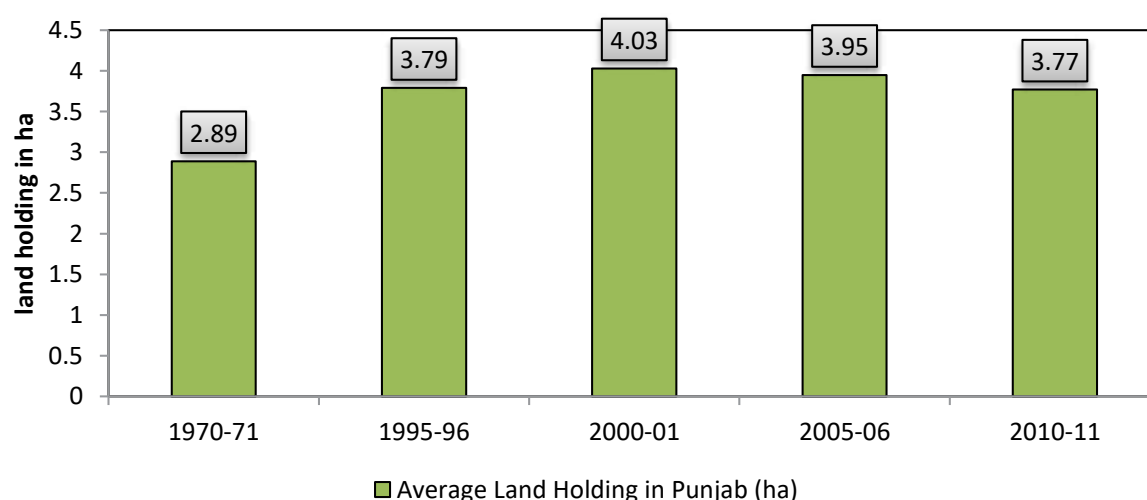
Source: Basic Animal Husbandry and Fisheries statistics

lakh hectare in 2011-12, which is 6.3 per cent of the gross cropped area. Area under permanent pasture and other grazing land is negligible (4000 ha in 2011-12). In figure 6, we present a comparative picture of the top producers of milk and area devoted to the production of fodder. It is observed that the area under fodder is highest in Rajasthan, followed by Gujarat and Punjab.

3.6 Operational Holding

The biggest challenge facing Indian agriculture is the decreasing size of land holding. But Punjab has experienced an increase in land holding over the years. Average land holding increased from 2.89 ha in 1970-71 to 3.77 ha in 2010-11. There has also been a reduction in the workforce engaged in agriculture in the state, which implies rural- urban migration. But

Figure 7: Average Landholding in Punjab (in ha)



Source: Agricultural Census

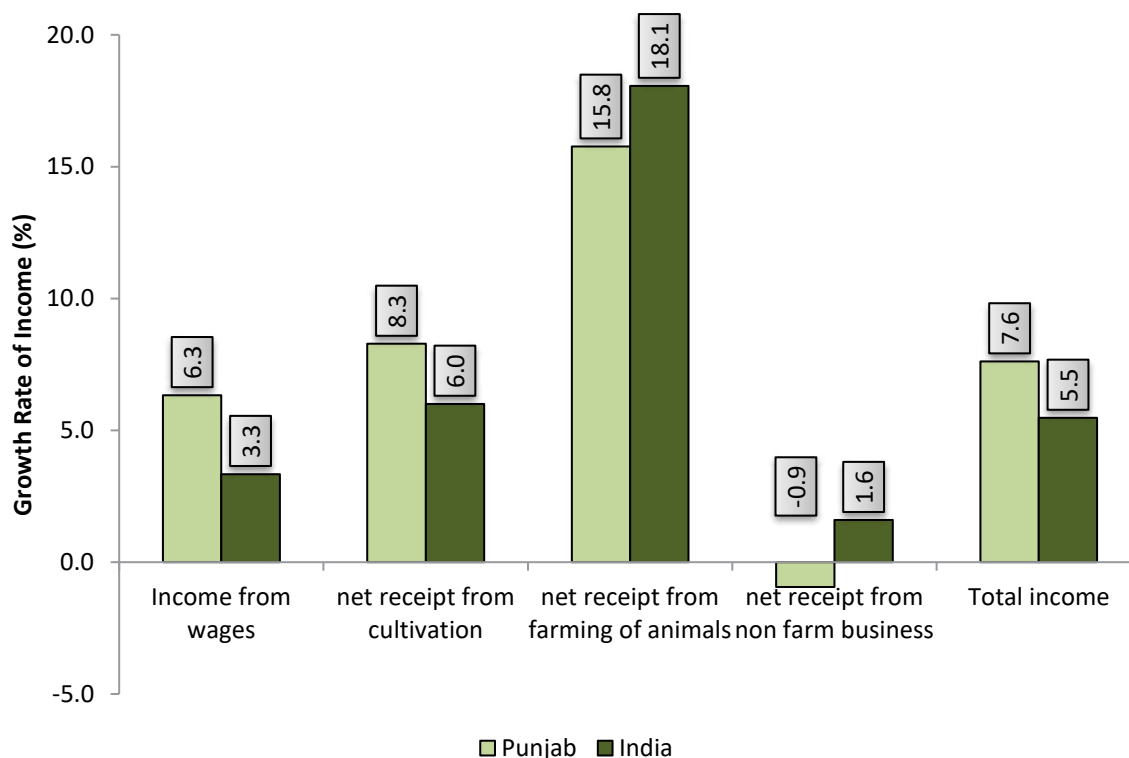
some other studies have held the rapidly declining water table as the reason for the rise in landholding. They point out that the rapid decline in water table requires deepening of existing wells, inflating the cost of production and this has forced small and marginal farmers to sell off their land (Sarkar and Das, 2014).

3.7 Agricultural Livelihood

The state's population in 2011 was 27.7 million and the estimated population for 2016 is 29.5 million, which is 2.3 per cent of India's population. In Punjab, 39 per cent of the workforce was engaged in agriculture according to Census 2001, which fell to 35.6 per cent in 2011 (34 per cent according to Labour Bureau 2015-16). The number of persons engaged in cultivation is 19.35 lakh (19.55 per cent of

the total work force) and 15.88 lakh (16.04 per cent of total work force) work as agricultural labourers. The contribution of the agricultural sector in the GDP of the state declined from 48 per cent in the triennium ending TE1982-83 to 27.7 per cent (at current prices) in the TE 2014-15 [Annexure 1 & 2]. Although Punjab became the richest state in the country by improving its agriculture, a structural change is taking place in the economy with the share of agriculture in workforce and its contribution in GDP declining over the years. But the sector is still quite important in the state's economy. The average monthly income per agricultural household stood at Rs. 18,059 in 2012-13, which is still the highest in India. Income from farm and nonfarm activities grew at 7.6 per cent per annum in the period of 2002-03 to 2012-13.

Figure 8: Growth of Income from Farm and non Farm activities in Punjab and All-India from 2002-03 to 2012-13 (2004-05 prices)



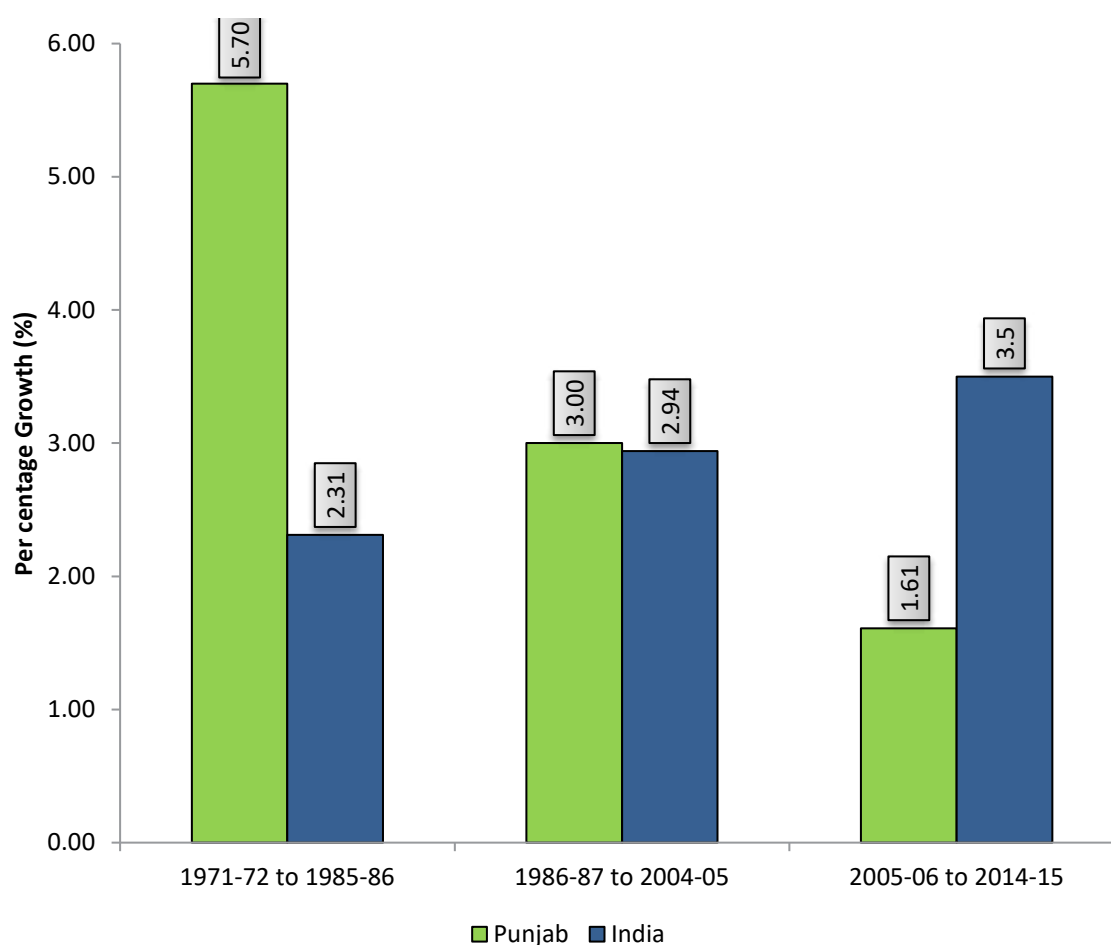
Source: Situation Assessment Survey, NSSO: 2002-03 & 2012-13

4. Trends in agricultural growth:

After Punjab was reorganised in 1966, a set of policies was undertaken which paved the way to the state becoming a dominant agro-based economy. As India was a food scarce economy after independence, the main goal was to achieve self-sufficiency in food grain production. In order to do that, the green revolution strategy was adopted initially focusing on Punjab, Haryana and Western UP. The adoption of new agricultural technologies consisting of

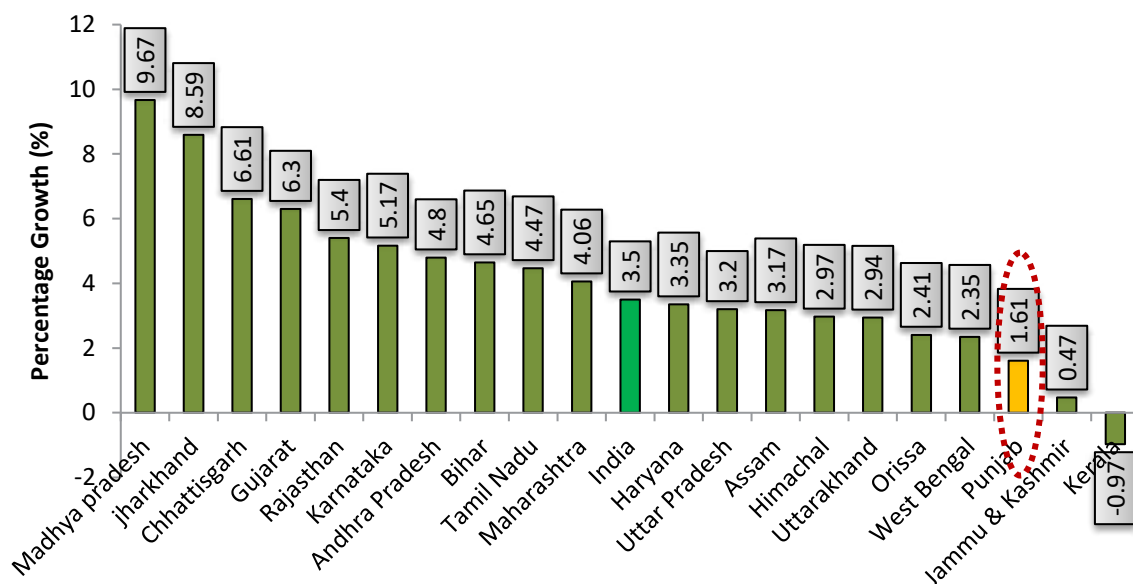
high yielding varieties of seeds (wheat), chemical fertilisers and irrigation facilities helped the Punjab economy achieve a high growth trajectory. The sector grew at 5.7 per cent per annum in the period 1971-72 to 1985-86. The growth rate dropped to 3 per cent in the period of 1986-87 to 2004-05 and further to a level as low as 1.61 per cent in the more recent period of 2005-06 to 2014-15, which is almost half the all-India average of 3.5 per cent.

Figure 9: Agriculture Growth in Punjab and India (2004-05 prices)



Source: Government of India, Central Statistical Organization and Government of Punjab (www.pbplanning.gov.in)

**Figure 10: State wise Agriculture Growth in the period 2005-06 to 2014-15
(at 2004-05 prices)**



Source: Government of India, Central Statistical Organisation. GSDP at Factor cost in 2004-05 prices

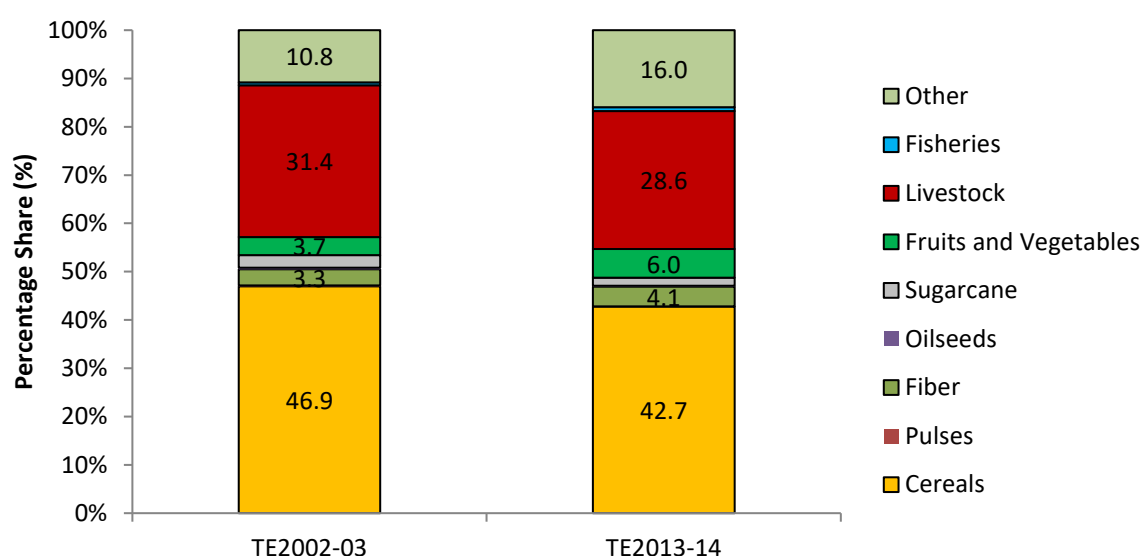
5. Composition and Sources of Agricultural Growth

In this section, we discuss the composition and sources of agriculture growth. The share of value of output from different segments as a share of the total value of output from agriculture and allied activities (at current prices) has been calculated. To determine the sources of growth, we have deflated the current series of each segment by the WPI at 2004-05 prices and then decomposed the year-on-year growth in the GVO from agriculture and allied activities by taking the absolute year-on-year difference in GVO from each segment as a proportion of the previous year's GVO from agriculture and allied activities.

The primary goal of the green revolution was to achieve self-sufficiency in food grain production. As a result, there was remarkable increase in production of rice and wheat in Punjab. Being predominantly a

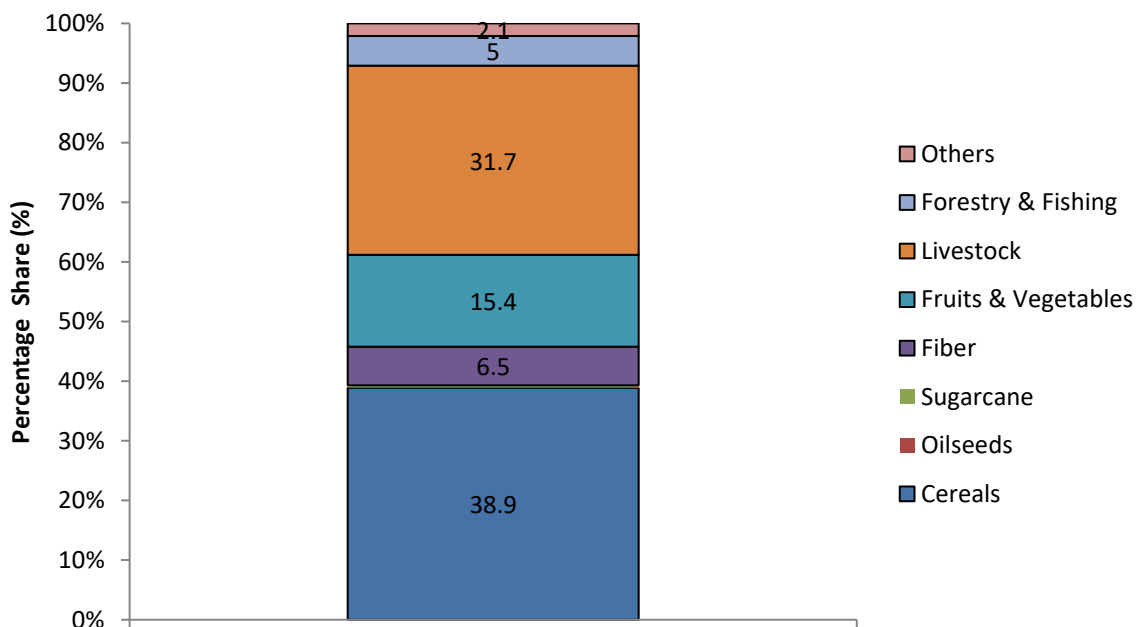
food grain economy, rice and wheat constitutes the highest share in the gross value of output even now (TE 2013-14). Agriculture and allied activities are divided into eight sub-sectors 1) cereals, 2) pulses, 3) oilseeds 4) sugar 5) fibre 6) fruits and vegetables 7) livestock and 8) other crops. Figure 11 highlights the composition of the agrarian economy. Rice and wheat continue to be the dominant crops in Punjab. The fruits and vegetables and livestock sectors have marginally increased their share in the gross value of output. Cereals (42.7 per cent) constitute the highest share in the GVOA, followed by livestock (28.6 per cent) and fruits and vegetables (6 per cent). Data on the value of output for the recent years shows that 3.7 per cent of the total value of output came from fodder crop in Punjab in TE2013-14.

Figure 11: Sector-wise shares in Total value of Output from Agriculture and Allied sector (at current prices)



Source: CSO, Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

Figure 12: Sources of Growth 2001-02 to 2013-14 (Share in growth contributed by each segment)



Source: Calculated by authors

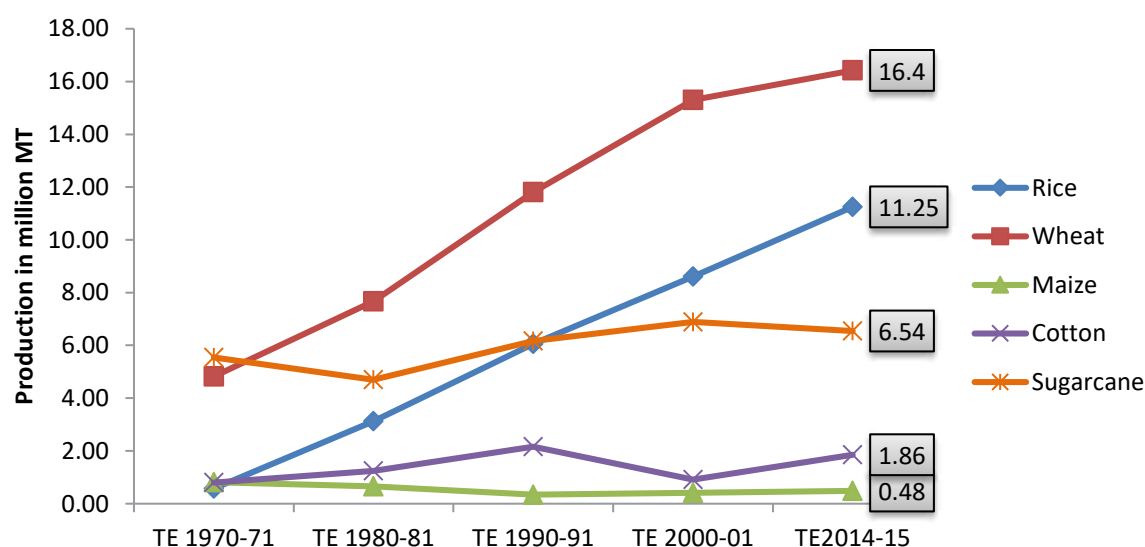
Agriculture and allied activities grew at 2.71 per cent in the period 2001-02 to 2013-14. The contribution of different sectors in the total growth of agriculture and allied activities shows that the highest contribution came from the cereal segment (38.9 per cent) followed by livestock (31.7 per cent) and fruits and vegetables (15.4 per cent).

5.1 Food grains and Non-food Crops

The important crops produced in Punjab include rice, wheat, maize, bajra, sugarcane, oilseeds and cotton. However, rice and wheat alone constitute 80 per cent of the total gross cropped area. In tandem with the increase in acreage under wheat and rice

cultivation, the production of these crops also increased rapidly. Production of wheat increased from 4.8 million MT in TE1970-71 to 16.4 million MT in TE 2014-15. Similarly, production of rice increased from 0.57 million MT to 11.25 million MT in the same period. The share of rice produced in the state in total rice production in the country increased from 1.40 per cent in TE 1970-71 to 10.6 per cent in TE 2014-15 while the share of wheat declined from 23.2 per cent to 17.9 per cent in the same time period. The share of cotton also declined from 16.05 per cent to 5.31 per cent. The cropping pattern has shifted to rice with 36 per cent of total gross cropped area under rice production.

Figure 13: Production of important crops in million MT



Source: Directorate of Economics and Statistics

Even though the predominant rice-wheat system provided good returns to farmers, in recent years, the situation has completely changed. India emerged as the largest exporter of rice in three years in a row (2012-14), and on July 1, 2012, India had unprecedented stocks of grains with public agencies that crossed 80 MMT. Punjab has been the largest contributor of grains to the Central pool. Mounting buffer stocks of grain often meant that MSP increases would be

minimal and that affects the profitability of large mass of Punjabi peasants. It has created a number of serious problems. The intensive cultivation of rice has resulted in severe depletion of ground water resources. It has also increased the cost of production as shallow tube wells are replaced with deep tube wells fitted with submersible pumps (Sarkar & Das 2014). The requirement of electricity for pumping water has also increased with the decline in water level.

Table 1: Productivity of Important Crops in Punjab and India (kg/ha)

yield (kg/ha)	Rice		Wheat		Maize		Cotton		Sugarcane	
	Punjab	India	Punjab	India	Punjab	India	Punjab	India	Punjab	India
TE 1970-71	1539	1091	2208	1228	1527	1071	327	326	38645	48408
TE 1980-81	2760	1245	2747	1545	1645	1081	331	160	54326	52105
TE 1990-91	3170	1725	3658	2216	1621	1515	503	227	61456	64000
TE 2000-01	3335	1936	4530	2708	2552	1804	317	213	62138	70238
TE2014-15	3929	2423	4678	3004	3929	2423	702	486	73732	70096

Source: Directorate of Economics and Statistics

Punjab already has achieved very high productivity for all its important crops and the state does not have much scope to improve yield. Clearly, diversification from wheat-rice cropping pattern to other crops is important to both increase farm income and conserve soil and water resources.

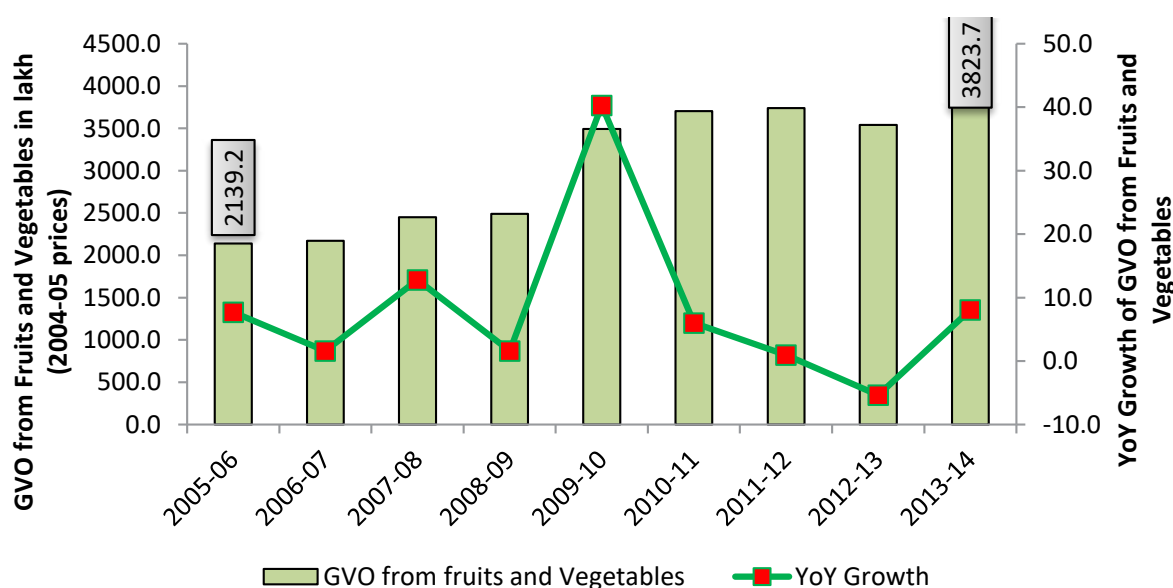
5.2 Horticulture

Fruits and vegetables together constitute only 3.64 per cent of the gross cropped area. However, the sector contributed to 15.4 per cent of the total growth in agriculture and allied activities between 2001-02 and 2013-14. The gross value of output from fruits and vegetables has increased but year-on-year growth has been erratic.

Punjab makes a very small contribution to the total production of fruits and vegetable in the country (1.9 per cent of fruits and 2.5 per cent of vegetables). The production of fruits increased from 0.75 million MT in 2005-06 to 1.64 million MT in 2014-15. Similarly, the production of vegetables increased from 2.43

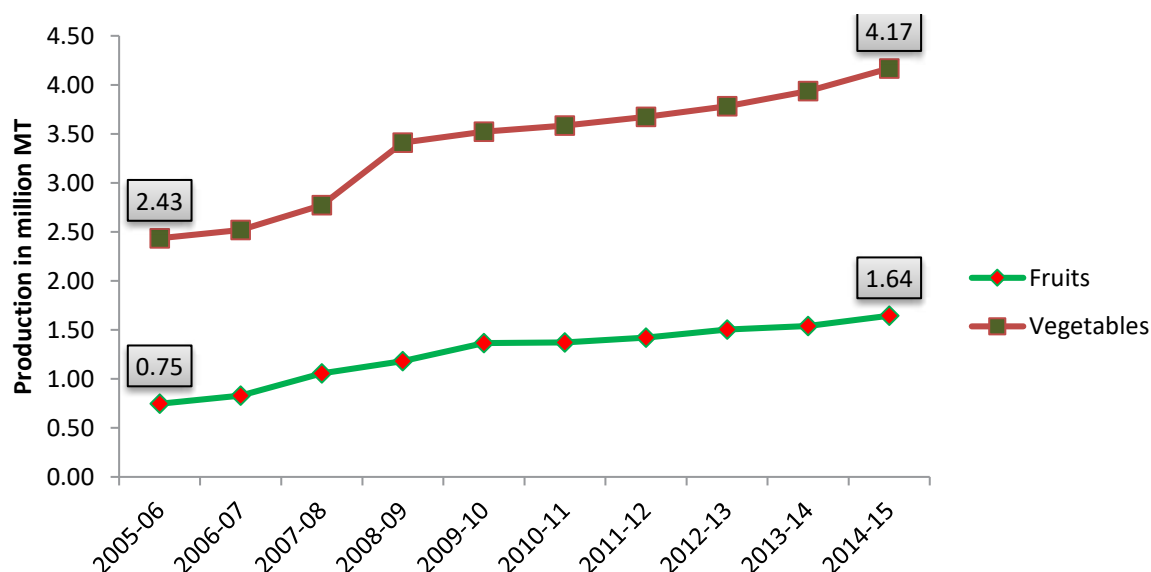
million MT to 4.17 million MT in the same period. The increase in production can be attributed to a rise in the yield per hectare for both vegetables and fruits as the area under these crops did not change much over the years. In terms of production, the important vegetable crops produced in Punjab are potato and peas. Punjab is the sixth largest producer of potato in the country and accounts for 5 per cent of the total production of potato in the country. In 2013-14, the production of potato was 41.6 million MT grown in an area of 0.09 million hectare. The productivity of the crop is 25 MT/ha. Moreover, the state is the fifth largest producer of peas producing 5.5 per cent (0.2 million MT) of the country's production. Kinnow, orange, malta, lemon, guava, pear, mango and grapes are important fruits grown in Punjab. The state is currently the fourth largest producer of citrus fruits, accounting for 9 per cent of the country's production. However, the state is the second highest in terms of productivity. Likewise, the state is the sixth largest producer of guava in the country with 5 per cent of the country's production.

Figure 14: GVO from Fruits and vegetables



Source: MOSPI

Figure 15: Production of Fruits and Vegetables in Punjab (million MT)



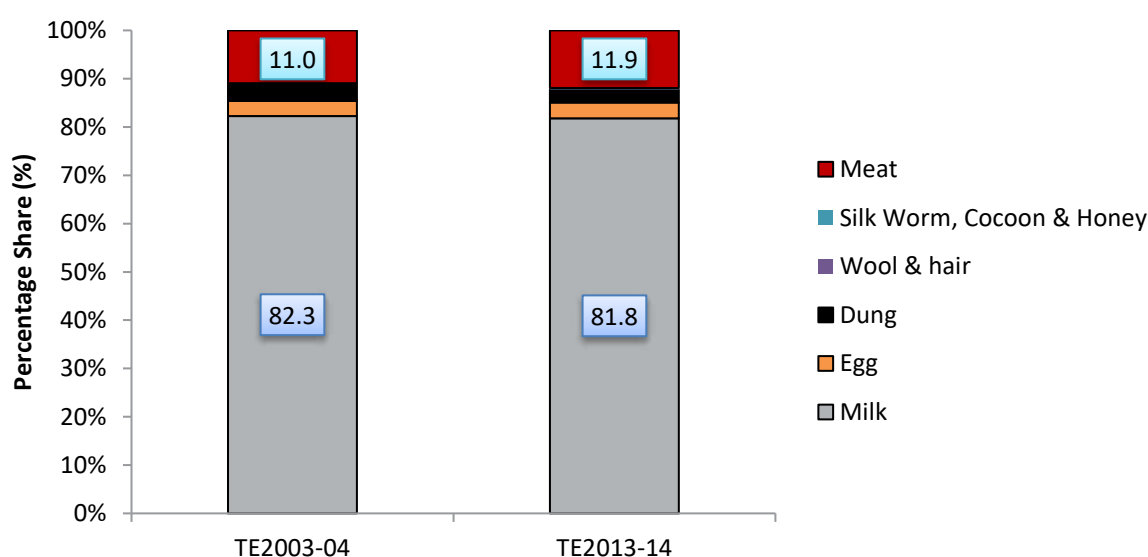
Source: Indian Horticulture Database 2008 & 2014

Although the area, production and yield for fruits and vegetables have increased, there is untapped potential which can be exploited.

The government has taken some steps to enhance diversification of agriculture in the state. These include

the target of bringing an area of 20,000 hectares under fruits during the 12th five year plan (Economic Survey of Punjab, 2015-16) Other steps include the strengthening of citrus estates, establishing lichi and pear estates, technology dissemination and training of farmers, etc. (Punjab Economic Survey 2013-14).

Figure 16: Composition of Livestock Products (Current Prices)



Source: CSO, Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

There is a huge demand for fruits in the processing sector (juice/jam/jelly) but it takes 3-5 years for citrus trees to bear fruits. Hence, it becomes difficult for farmers to engage in fruit cultivation without an alternate source of income.

5.3 Livestock

The livestock sector is an important sub-sector in the state as it accounted for 28.2 per cent of the total value of output in TE 2013-14. The composition of livestock products in the total value of output from the sector is as follows:

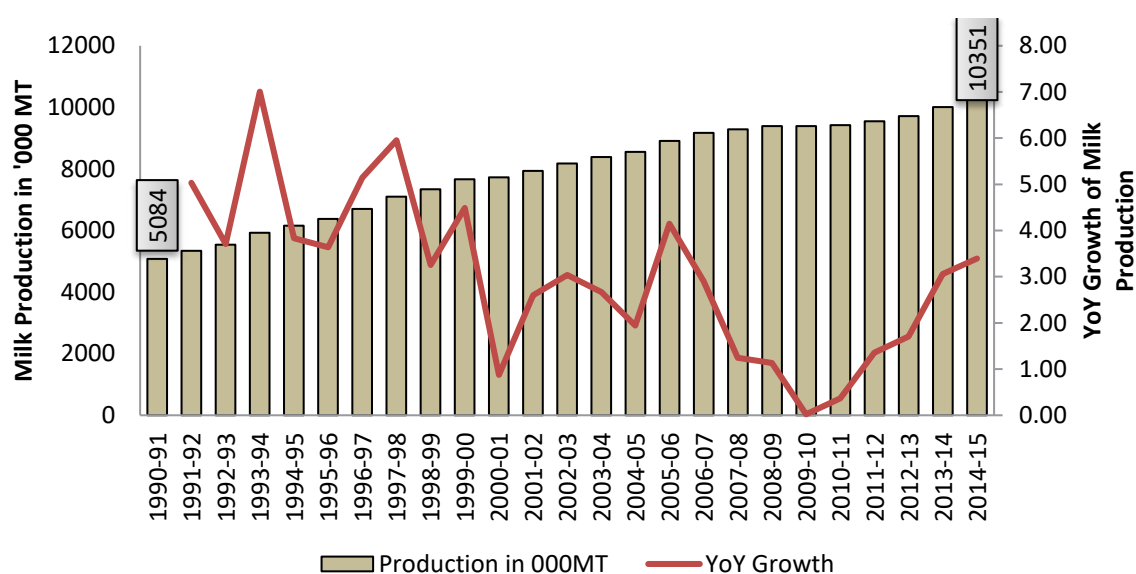
(a) Milk

Dairy contributes 82 per cent of the total value of output from the livestock segment. Milk production has increased impressively in the past, making the state India's fifth largest producer only after Uttar Pradesh, Rajasthan, Andhra Pradesh and Gujarat despite its small geographical area and population. Milk production grew at 4.3 per cent per annum in the

period 1991-92 to 2010-11, but the growth rate fell in recent years to 1.98 per cent during 2010-11 to 2014-15. The state has the highest per capita milk availability with 980 grams/day (2013-14) compared to the all-India availability of 307 grams per day in the same period. Per capita per day liquid milk consumption increased from 11.45 grams in 1993-94 to 12.71 grams in 2011-12 in India. However, consumption of milk is as high as 31.78 grams per day in Punjab. Given the preference for vegetarianism in the state, milk and dairy products hold a significant share in the food basket of households.

The Punjab State Co-operative Milk Producers' Federation Limited (Milkfed) was established in 1973 with twin objectives of providing a remunerative milk market and to disseminate technical inputs to milk producers. Milkfed is a three-tier system with the Federation at the top as the apex body at state level, milk unions at the district level and co-operative societies at the village level. Currently, 4 lakh farmers from 7000 village level societies are members of

Figure 17: Production and Average growth of Milk in Punjab for 1990-91 to 2014-15



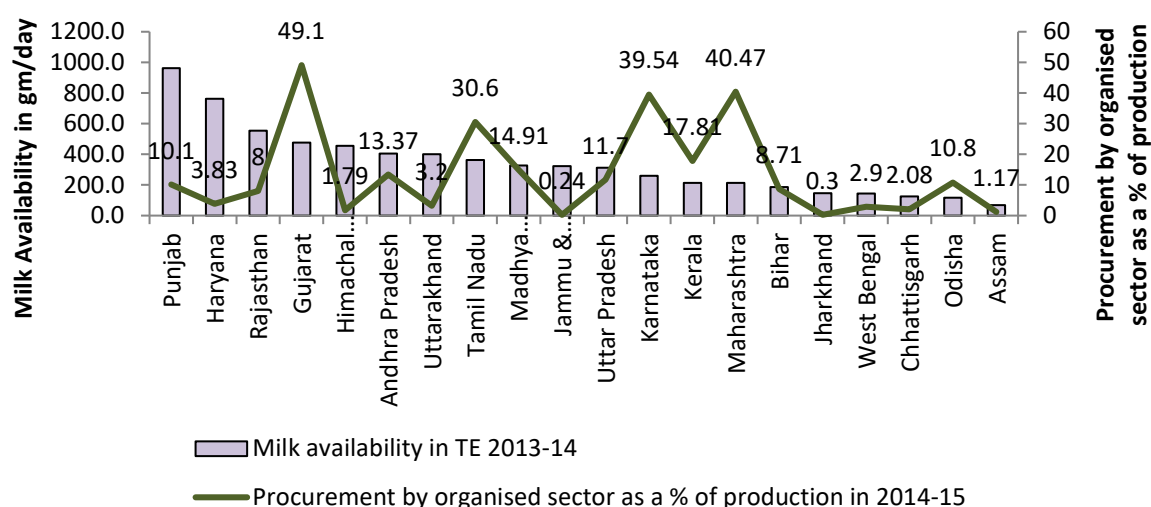
Source: National Dairy Development Board

Milkfed. Verka is the brand under which milk and milk products are marketed by the Punjab State Co-operative Milk Producers' Federation. Non-members are only allowed to sell milk to Milkfed in the lean season. There is no upper limit on quantity sold by member. The Verka brand is available in Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir and also in North-Eastern India. Ghee is exported to countries in the Middle East, Australia, Japan, New Zealand and Malaysia. NESTLE India set up its first manufacturing facility at Moga. Nestle is engaged with around 110,000 milk famers and procures over 300 million kg of milk every year across Punjab, Haryana and Rajasthan. (<https://www.nestle.in> accessed on June 07, 2017). Dairy co-operatives and major private players together procure just about 10 per cent of the total production in Punjab, which is much lower than the 49 per cent procured in Gujarat. This shows the enormous potential that exists in the state to increase the procurement and processing of milk.

The recent crash in the global prices (2015) of skimmed

milk powder led to a steep drop in the export of SMP. Low export demand has put downward pressure on domestic prices as well. This has had an impact on the profitability of private dairies. The average milk procurement was 11.60 lakh litres during 2013-14. During the year 2014-15, the procurement increased to 12.87 lakh litres per day and in 2016-17, up to January 2016, it was 12.66 lakh litres per day. As global prices are expected to remain low in the near future, liquid milk sales will be the mainstay of the dairy sector. There has been a positive change in the food consumption pattern of the Indian population with a higher share of expenditure and an increase in the physical quantity of protein rich products consumed. Since 77 per cent of the people are vegetarian in Punjab, (Gulati & Verma, 2016), milk and milk products are a major source of protein in the state. There has been an increase in milk consumption according to the NSSO data (2011-12). Hence, the sale of processed liquid milk can be promoted via co-operatives as well as private players to promote the sector.

Figure 18: Per Capita Milk Availability (grams/day) and Processing by Organised Sector (percentage of production) in Major Producing States, 2014-15



Source: Calculated from NDDB data

Dairy farming can emerge as an alternative employment opportunity in Punjab. In the year 2015-16, 56 per cent of the total milk production was offered by farmers for marketing after accounting for own consumption. In Punjab, the organised sector handles only 18 per cent of the total marketed surplus (10 per cent of production). The rest is marketed through the unorganised sector comprising local vendors. The main problem with the unorganised sector is the presence of many middlemen between producers and consumers that prevents producers from receiving a remunerative price for their produce (Rajendran, K et al, 2004, Journal of Food Distribution Research). Punjab should follow the example of Gujarat and increase the participation of the organised sector, especially the private sector, in the marketing of milk and milk products.

Effective breed improvement programmes are already in place in the state with the import of high genetic Sexed Semen and embryos from France, Canada and the USA. Besides it, under NDP-1, there is an emphasis on genetic upgradation of the indigenous bovine population in the state through the rearing of the high genetic merit bulls of Murrah (Nili Ravi and Sahiwal). Along with this, the semen station at Nabha, which is an A grade semen station, has been

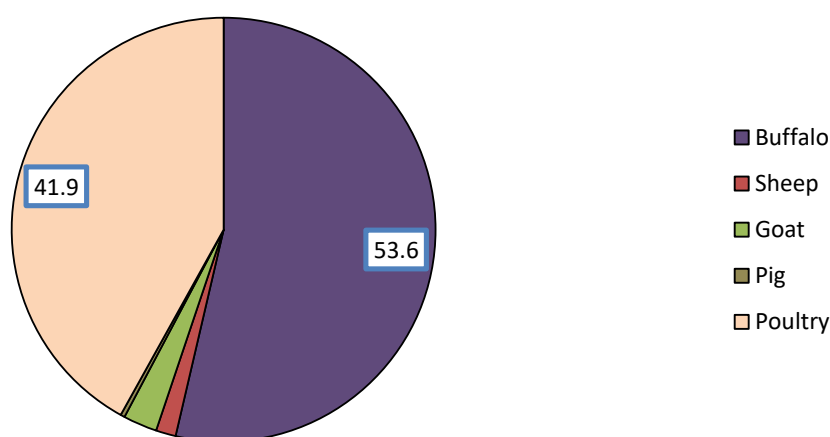
further upgraded for the production of 50 lakh high genetic merit semen doses annually. However, feed and fodder are critical inputs in the livestock sector. Research should be undertaken on priority to develop high-yielding fodder varieties.

(b) Meat & Eggs

Meat production has been increasing at the rate of 5.22 per cent annually for the last six years but the share of meat in the gross value of output (GVOA) has been more or less stagnant in the past two decades. According to the latest livestock census (2012), the total livestock and poultry population in Punjab is 81.2 lakh and 167.9 lakh respectively. The estimated meat production in 2013-14 stood at 235 thousand MT. The production of eggs in Punjab was 43,375 lakh in 2013-14 with per capita availability of eggs is 155 per annum.

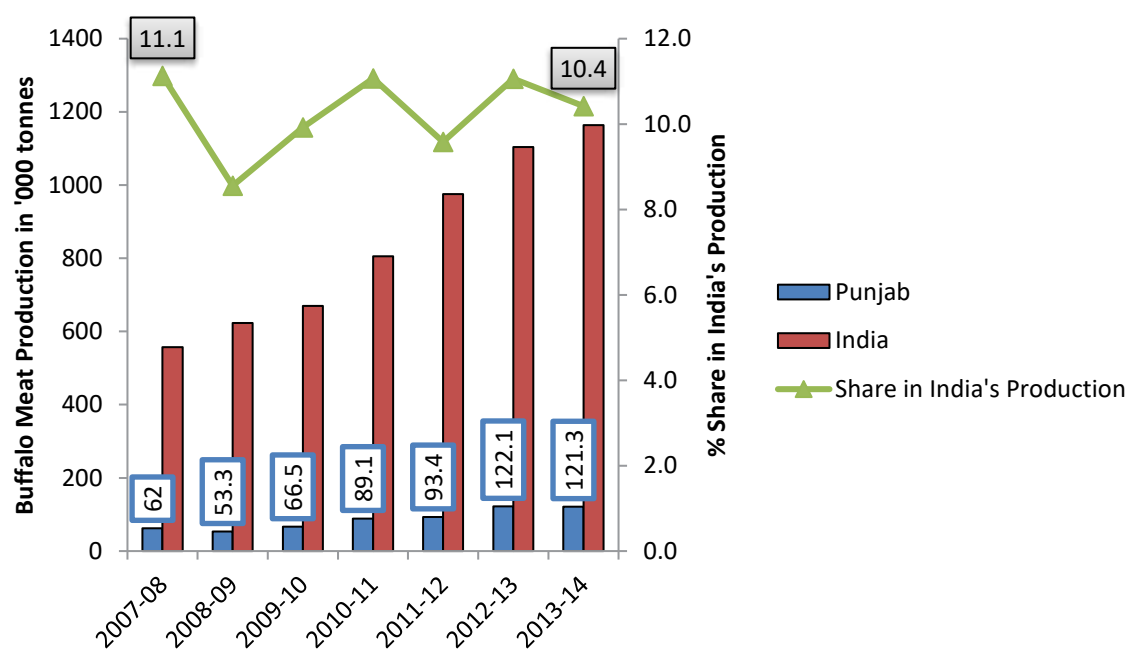
Although Punjab accounts for only 4 per cent of total meat production in the country, the state's share in buffalo meat production is higher (10.4 per cent) and it is the third largest producer of buffalo meat in the country, the top two producers being Uttar Pradesh and Andhra Pradesh. The meat sector of the state can be understood from the disaggregated picture, which is dominated by buffalo meat followed by poultry.

Figure 19: Share of different meat items in the total meat production in TE 2013-14



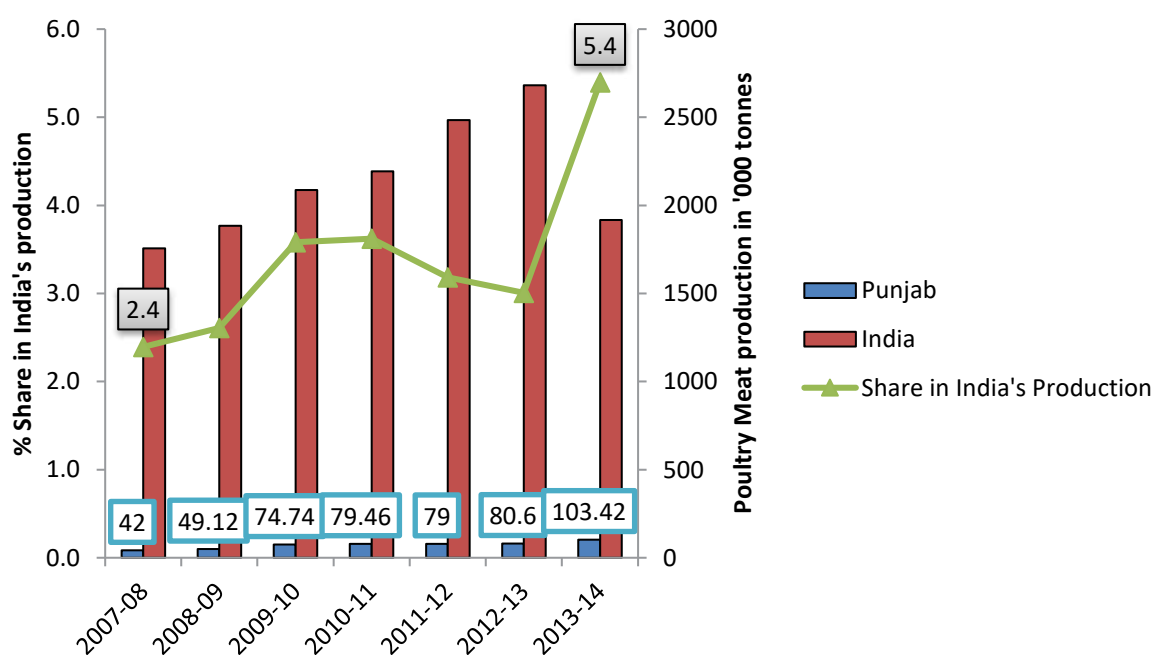
Source: Basic Animal Husbandry and Fisheries Statistics

Figure 20: Production of buffalo meat in Punjab and its share in all-India production



Source: Basic Animal Husbandry and Fisheries Statistics

Figure 21: Production of Poultry Meat in Punjab and its share in all India production



Source: Basic Animal Husbandry and Fisheries Statistics

The buffalo meat sector in India is export oriented as there is good demand for Indian buffalo meat due to its quality and price competitiveness. The country exported 1.3 million MT of buffalo meat in 2015-16 for US\$4069.2 million (APEDA). State needs to take initiative to make it free from foot and mouth disease in order to fetch better price for non-milching but healthy buffaloes kept by farmers which can be sold for slaughtering.

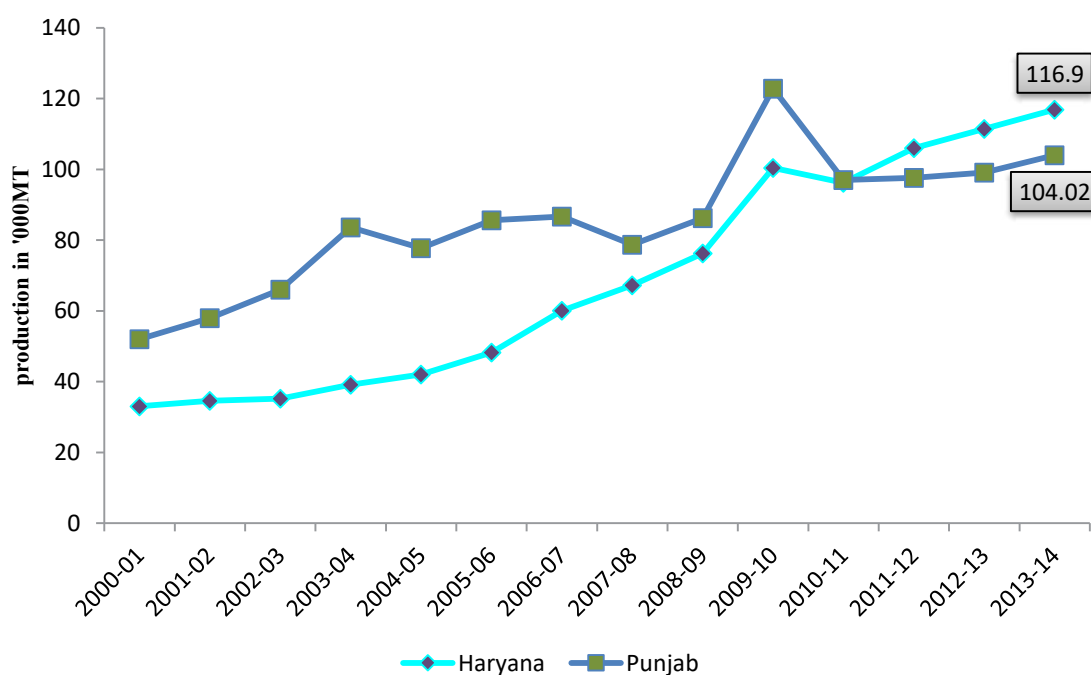
The state can also target the domestic market of meat through the promotion of the poultry and goat meat sector. Punjab has done well in the poultry sector despite rising cost of poultry feed. It has been catering to the demand for eggs within the state and in J&K. The Barwala-Derabassi-Lalru cluster in Punjab/Haryana is already the largest poultry cluster in north India but due to cheaper land in UP, a number

of Punjab poultry farmers are setting up units in UP. The Government of Punjab needs to formulate an attractive policy to get investment in the sector as it has the raw material for feed and a large market for eggs and poultry meat within the state, NCR and in J&K.

(c) Fisheries

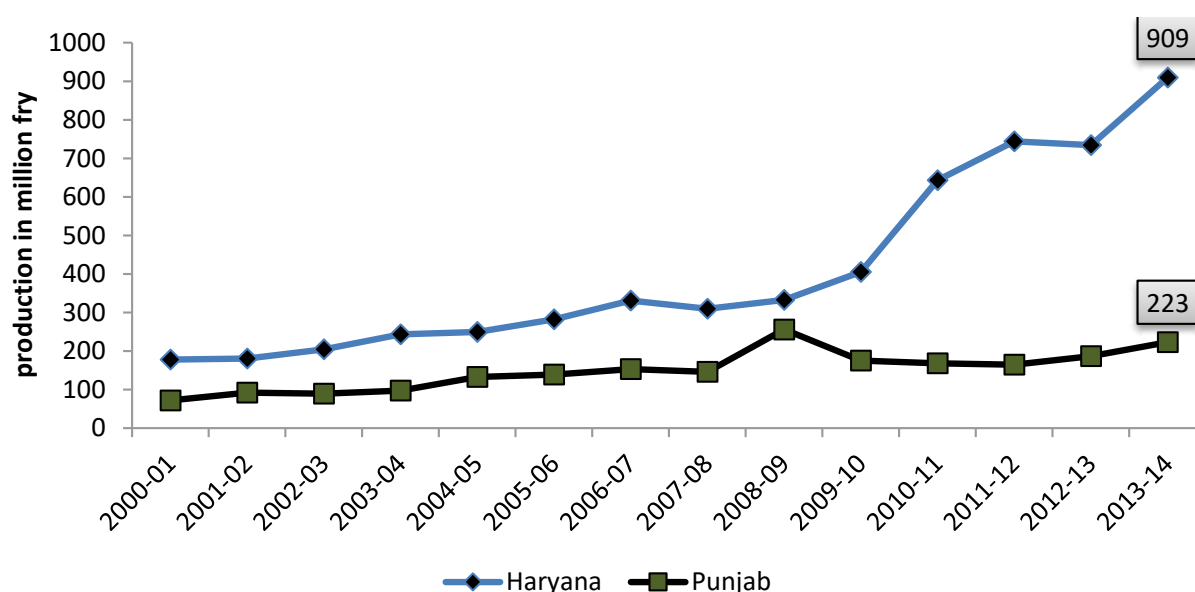
Only inland fish can be produced in Punjab as it does not possess any coastline. There are 868 km. of river, 13 notified reservoirs, 11200 km. of canals and 14510 acres of small reservoirs in the state as water areas. In addition, there are 9318 constructed village ponds covering an area of 32,597 acres. But, the state is not doing well in the sector. Punjab's fish production was higher than Haryana's until 2009-10 but it declined thereafter, while Haryana experienced a steady increase in production.

Figure 22: Fish Production in Punjab and Haryana



Source: Handbook of Fisheries Statistics, 2014-15

Figure 23: Fish Seed Production in Punjab and Haryana



Source: Handbook of Fisheries Statistics, 2014-15

Quality seed production should be promoted through the private sector so that fish seed is available at affordable prices. Fish seed production has remained almost stagnant in Punjab while it increased steadily in the neighbouring state of Haryana.

Tube wells installed at fish farms require electricity. Fish farming can be encouraged in water logged and salinity affected areas by providing assistance for fish ponds. But, cold storage and other marketing infrastructure should be improved to increase the marketable surplus and reduce wastage.

6. Plausible Determinants of Agriculture Growth

Studies (FAO, 1996, Gulati et al, 2017) have shown that investment in technology and physical infrastructure enhances farmers' access to the input and output market and flourishes farm economy. In this section, we discuss the temporal development of technology, physical infrastructure and institutions in Punjab to understand the reasons for rapid agriculture growth in the state in its glorious days.

6.1 Technology

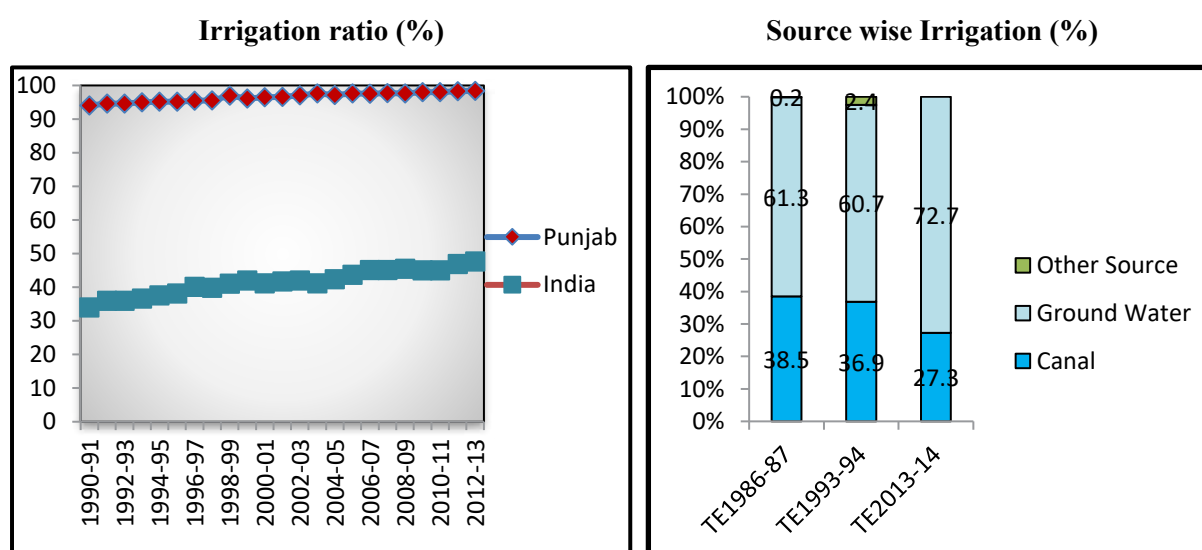
6.1.1 Irrigation Infrastructure

As discussed in the first part, normal rainfall is only 62 cm, with the south-west monsoon contributing about 79 per cent of the total rainfall. Thus quantum of rainfall is quite low and is concentrated in the period of July-September. Hence, providing irrigation facilities was essential for unconstrained supply of water for cultivation. With the use of HYV seeds, irrigation became a necessary technology to increase production during the early years of green revolution. The state has the highest net irrigated area in India

and agriculture accounts for almost 85 per cent of water consumption in the state.

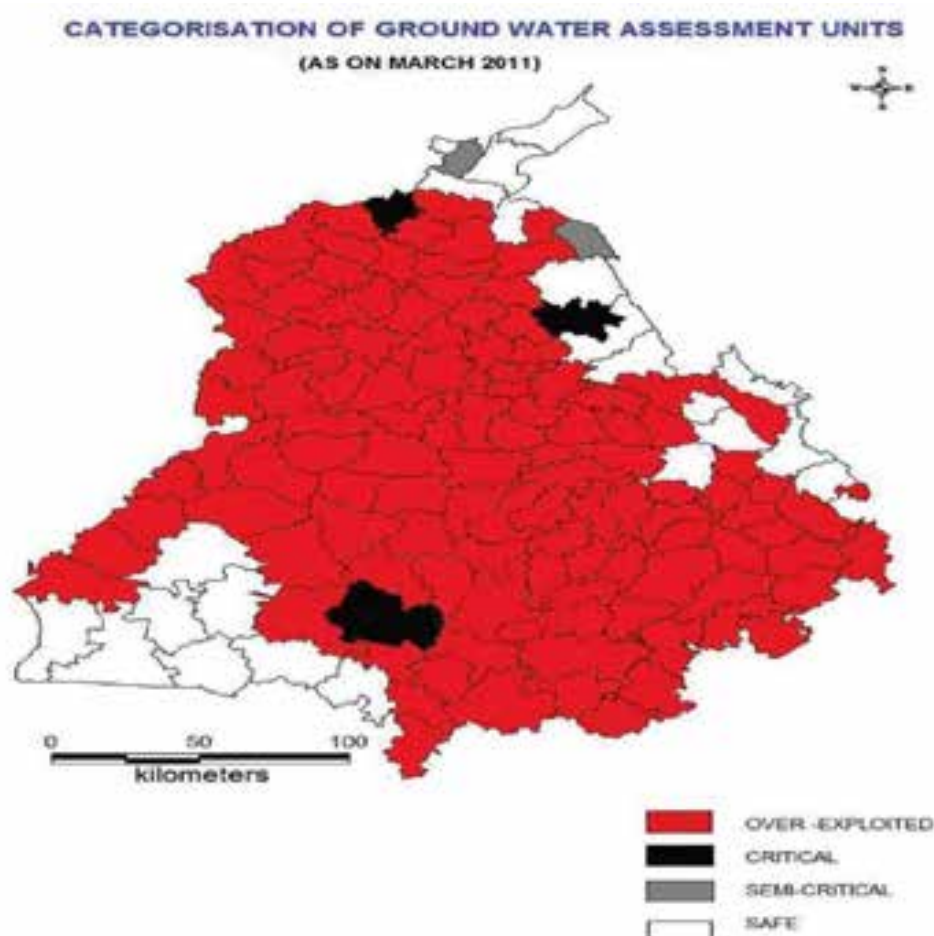
In TE1986-87, 61 per cent of the net irrigated area was under tube wells and other wells. Over the years, Punjab went through a major shift from canal irrigation to tube well irrigation as demand for water increased. Tube well irrigation ensures steady flow of water, and easy credit facilities and free electricity made it possible to enhance the use of centrifugal tube wells as the major source of irrigation. In TE2013-14, around 73 per cent of the net irrigated area was under ground water irrigation. But non-judicious use of water is leading to over exploitation of ground water. The present ground water development in the state is 172 per cent and ground water in 80 per cent of the total geographical area is over utilised. The water table declined by 70 centimetres per year from 2008 to 2012 (<http://punenvis.nic.in/> accessed on 28.4.2017). With one kilogram of rice consuming 3000-5000 liters of ground water, large-scale production and export of rice from Punjab is an unsustainable idea.

Figure 24: The Irrigation Situation in Punjab



Source: Directorate of Economics and Statistics

Map: Dark Blocks in Punjab



Source: Central Ground Water Board, 20165

With its semi-arid nature, Punjab was more appropriate for the production of wheat and maize. But irrigation policies made water easily accessible to the farmer and free electricity reduced the economic cost of water. At the same time, the food procurement policy of the Government of India for the Central Pool ensured good return on wheat and rice production. As a result, Punjab shifted from traditionally a wheat-maize cropping pattern to water intensive wheat-rice cropping pattern. This cropping pattern is not only ecologically unsustainable but is also making cultivation economically unviable. Because of ground water depletion, centrifugal pumps are becoming redundant and they are being replaced with submersible pumps, which are increasing the cost of production. The consumption of energy for pumping

water from deeper underground layers is also increasing, adding to the cost. This alarming situation needs to be addressed with utter seriousness.

The Government of Punjab enacted the Punjab Preservation of Subsoil Water Act in 2009 to check ground water depletion. Under this act, “no farmers shall sow nursery of paddy before 10th day of May of the agricultural year or such other date notified by the state”. This legislation has been quite successful in saving up to 7-8 per cent of water as compared to May transplanting but as per the Central Ground Water Board’s 2016 data, out of 138 blocks in Punjab, 110 continue to be over exploited (80 per cent), thus posing an enormous challenge to sustainable agriculture.

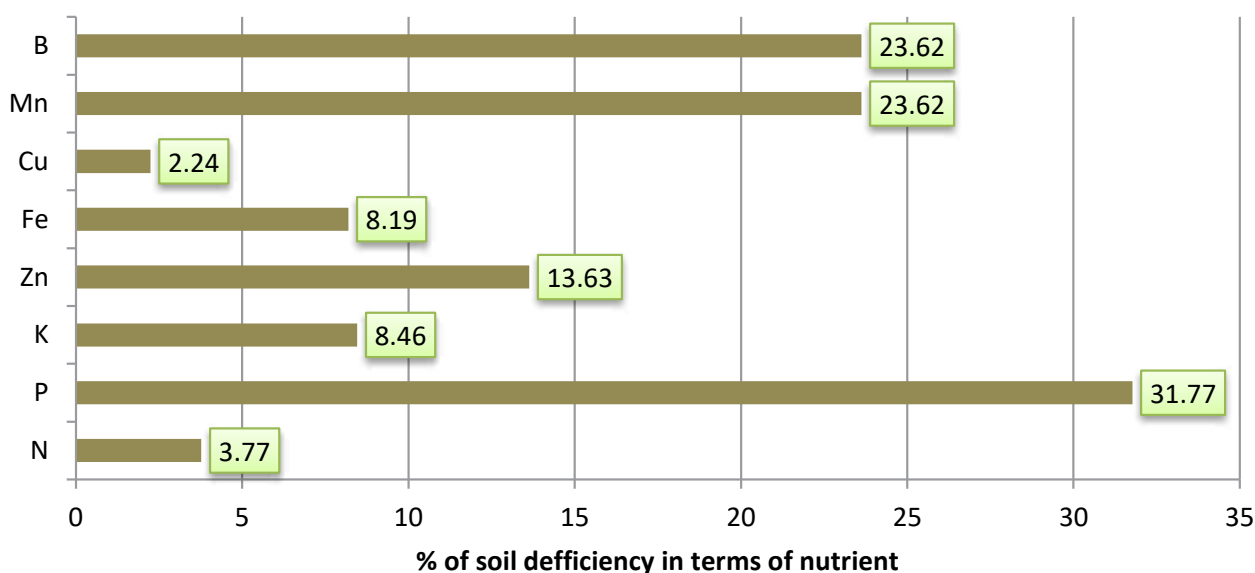
6.1.2 Fertiliser Consumption

Crop yields can be augmented significantly through optimal utilisation of fertilisers. Wheat and rice are the most nutrient exhaustive crops in Punjab and the mono-cropping of paddy and wheat in the past four decades has led to steady decline of macro (NPK) as well as micro (zinc, iron, manganese) nutrients in the soil. The Government of India has encouraged the use of chemical fertilisers by heavily subsidising it. Initially it contributed to increase in productivity in Punjab but now, it has become a vicious circle of high use of urea and decreasing soil fertility. There is no doubt that the fertiliser subsidy has helped achieve self sufficiency in food grain production but it has also led to inefficient use of fertilisers. The low price of urea has resulted in the imbalanced use of fertilisers, which has affected the fertility of land. The NPK

ratio in Punjab is 36:8.74:1, which has affected crop productivity. In order to improve yield, farmers are pumping more nitrogen into the soil, thus degrading the soil. According to an ongoing ICRIER study (Gulati and Terway, ICRIER) burden of economic cost for fertiliser is estimated to be Rs.7022 crore in 2012-13.

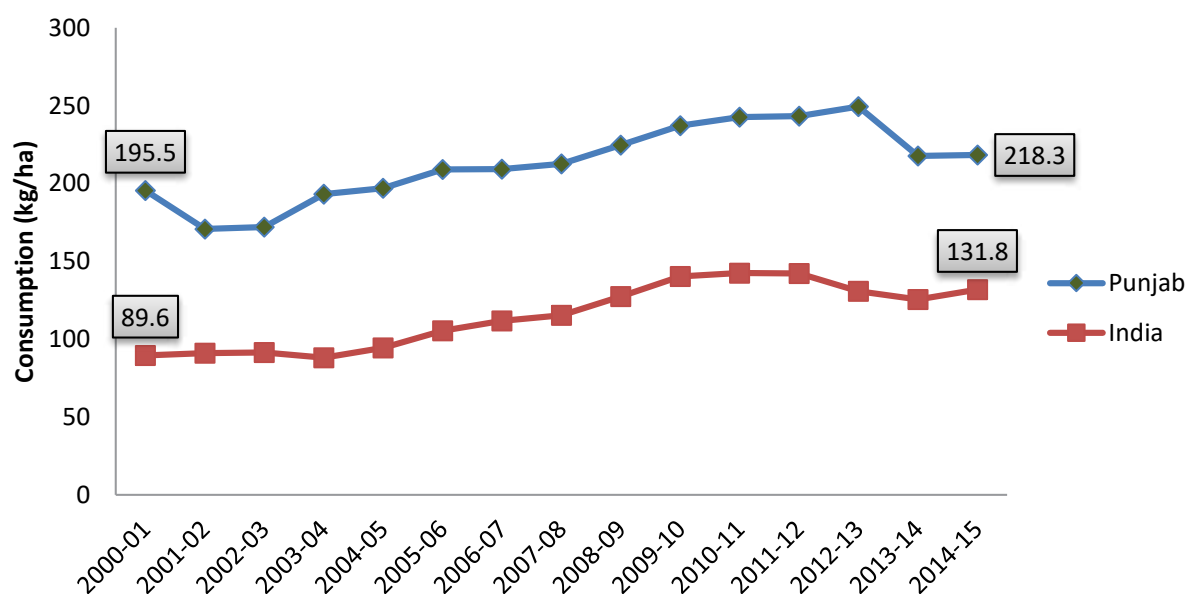
Studies have shown that (Gulati et al, 2015) this imbalance in the use of fertilisers can be addressed by switching to direct cash transfers to farmers on a per hectare basis. Farmers should be incentivised to get soil testing done and to procure soil health cards by linking these to cash transfers. Moreover, the import duty on urea should be reduced to zero and prices should be determined by the interplay of demand and supply.

Figure 25: Soil Deficiency in terms of Nutrients in Punjab



Source: <http://www.soilhealth.dac.gov.in>

Figure 26: Fertiliser Consumption (kg/ha)



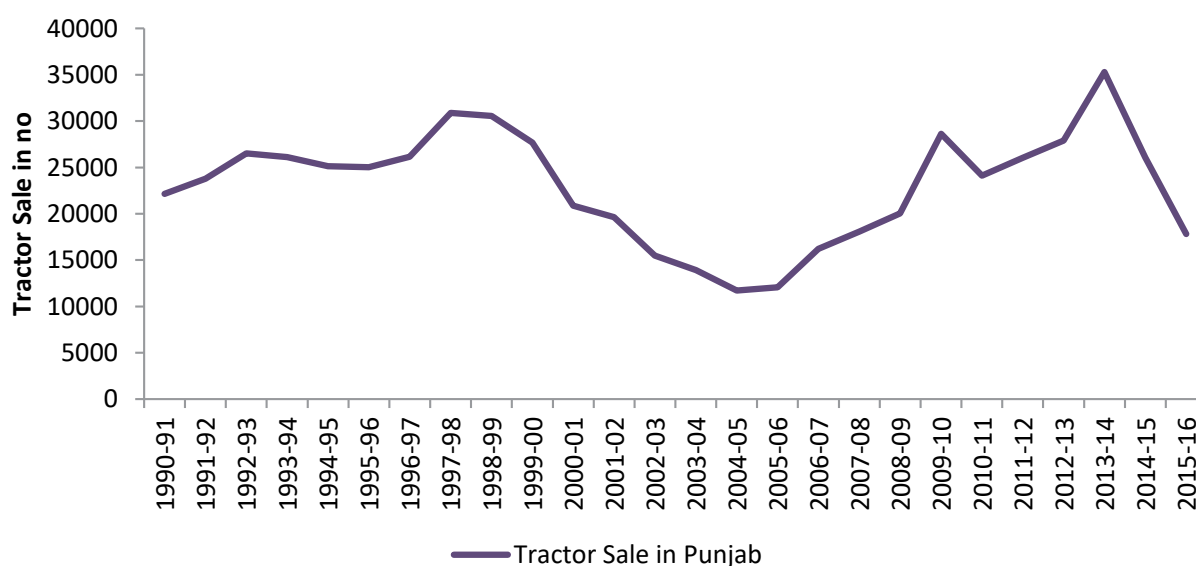
Source: Fertiliser Association of India

6.1.3 Agricultural Mechanisation:

Along with seed-water-irrigation, farm mechanisation has played a pivotal role in augmenting agricultural productivity. Farm mechanisation helps in increasing production, productivity and profitability by reducing time taken in various farm operation,

bringing precision, reducing input loss and increasing efficiency in input use. Punjab is a highly mechanised state with 2.6kw/ha farm power availability. Punjab's average of one tractor per 8.71 ha of net cultivable area is much higher compared to the national average of one tractor per 62 ha.

Figure 27: Tractor Sale in Punjab



Source: Tractor Manufacturers Association, New Delhi

However, tractor sales dropped in 2004-05 but again picked up from 2007-08 onwards. Farm mechanisation in Punjab has reached a saturation point and over capitalisation is now leading to an increase in the cost of production. Over mechanisation also has a major impact on environment because of the use of fossil fuels. Common service centres and the private sector's innovative programmes of sharing equipment should be promoted by the state government so that farmers having small holdings are not over burdened by excessive credit.

6.2 Infrastructure Development

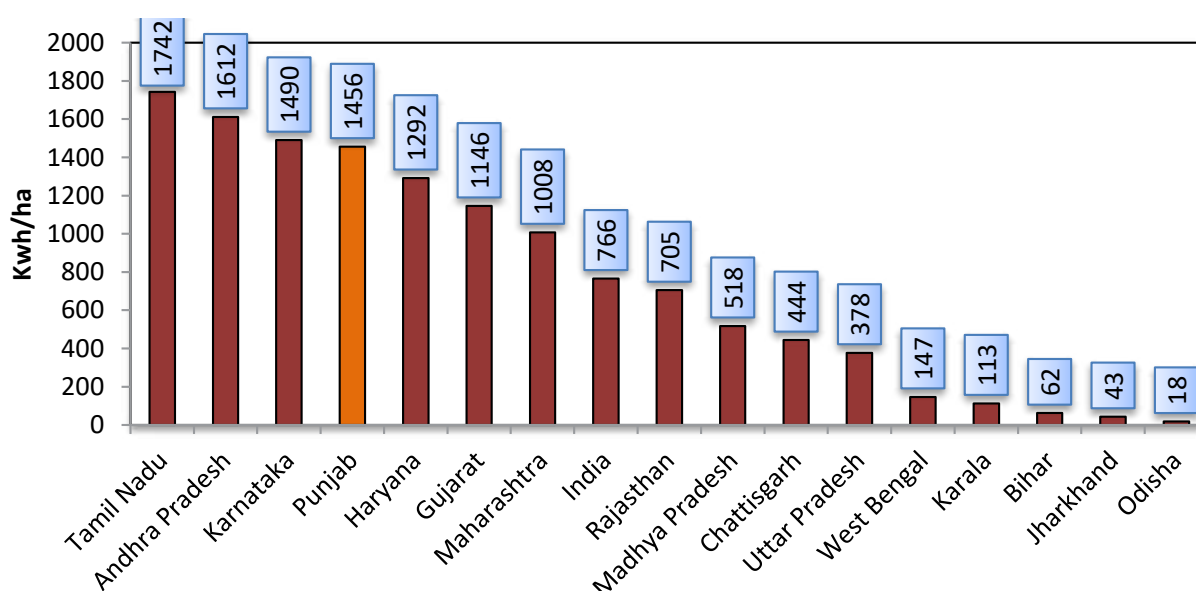
6.2.1 Electricity for Agriculture

Power pricing policies played an important role in augmenting production during the green revolution. The sale of electricity for agriculture as a share of total sale is very high in Punjab [Annexure: 8]. The number of pump sets energised per hectare of GCA

was already high in 2000-01 at 98; it increased to 146 in 2011-12. Power intensity in the state measured by power sale per hectare of GCA is 1456kwh/ha in TE2013-14, which is pretty higher than the national average of 766kwh/ha.

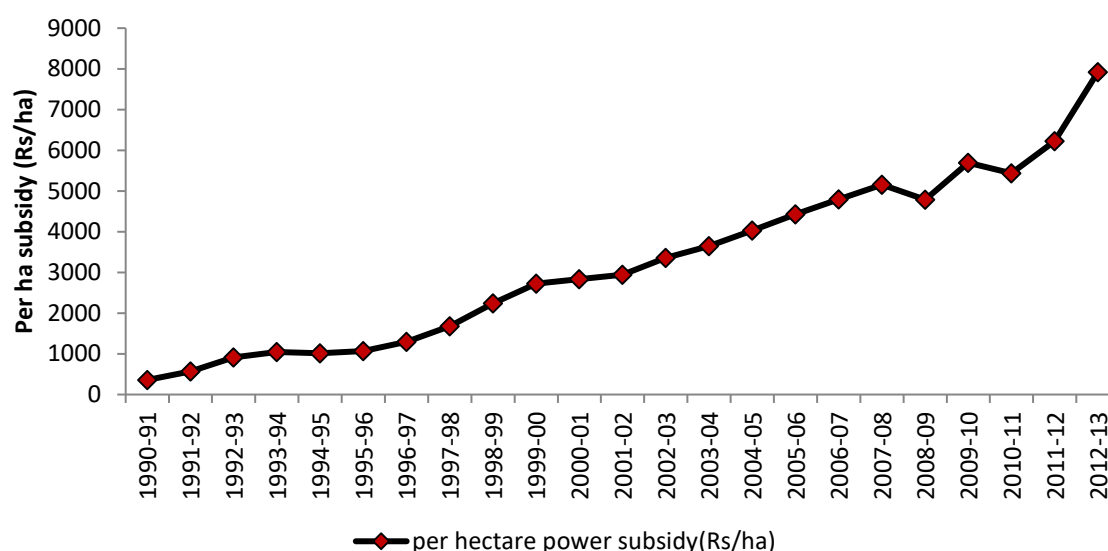
Free supply of power [annexure: 7] has increased the subsidy burden of state Govt. and has also led to inefficient use of power, resulting in an alarming depletion of ground water. In the initial years of the green revolution, a part of the electricity cost used to be recovered from the farmers on a per unit consumption basis. In the second half of 1970s, the net return from wheat cultivation fell sharply and there emerged a strong movement to reduce input cost. In the late 1970s, the basis of electricity pricing was changed to a flat tariff. From 1984 onwards, there was a reduction in the charges on electricity connections as well. Electricity for the agricultural was made free in 1997 and continues to be so till date.

Figure 28: Power Intensity (Power Sales/GCA (KWh/ha)) TE 2012-13



Source: Planning Commission

Figure 29: Trends in Power Subsidy per hectare of GCA in Punjab



Source: Gulati and Terway Upcoming Working Paper

The figure above shows that per hectare of electricity subsidy is steadily increasing and there has been a 16 per cent growth in the subsidy given to this sector. Power policy was an important element in the successful implementation of the green revolution. But inefficient and wasteful use of power and water is making farming itself an unsustainable means of livelihood and there is urgent need to restructure the power policy. Punjab has already achieved feeder separation for agricultural use in 10,911 villages out of a total of 12,272 villages. But the inefficiency in the consumption of electricity in Punjab's agriculture still persists and urgent steps need to be taken to curtail this.

6.2.2 Roads

Roads are a basic infrastructure requirement for economic development. Road connectivity is an important indicator of market accessibility for farmers. Transport facilities enhance the interaction between different players starting at the farm level to the household consumption level. It becomes even more crucial when it comes to perishable agricultural commodities. Often, farmers are forced

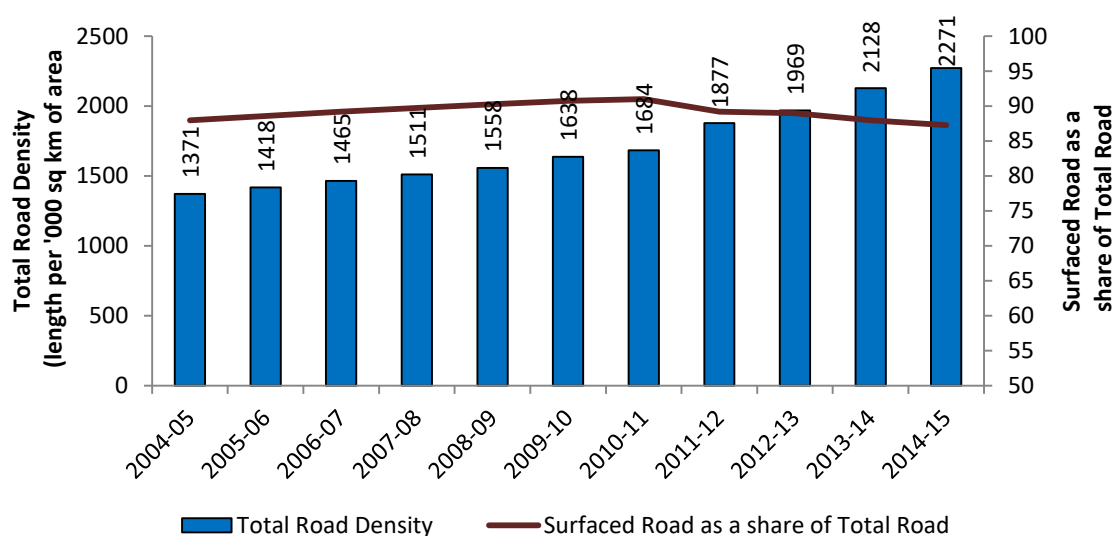
to sell their product at prices even lower than the cost of cultivation just to avoid the full damage of crops. Advanced road and transport facilities ensure that agricultural commodities reach mandis on time and their quality is not compromised. The road infrastructure in Punjab is among the most developed in India. Road density in Punjab has increased from 564 per thousand sq km in 1970-71 to around 2271 per thousand sq km in 2014-15. Further, surfaced road as a percentage of total roads is 87 per cent in Punjab, one of the highest in the country. All the villages in the state are linked to roads.

6.3 Incentives and Institutions:

6.3.1 Procurement Policy

The goal of growth with equity involves the dual objectives of ensuring a minimum price to the farmers and assured supply of food grains at affordable prices to vulnerable sections of society. The Food Corporation of India (FCI) was set up in 1965 which, along with other state agencies, undertakes procurement of wheat and paddy. Coarse grains are procured by state agencies as per government's direction but not

Figure 30: Road Density in Punjab



Source: Ministry of Road Transport and Highways

on a regular basis. The MSP is supposed to make sure that price does not fall below a certain level. Procurement at MSP was adopted primarily for wheat and paddy to ensure remunerative prices to farmers for their produce, which works as an incentive to increase production. The minimum support prices are recommended by the Commission of Agricultural Cost and Prices (CACP) which, among other items, considers the cost of cultivation and a profit margin for farmers. To facilitate procurement, a large number of purchase centres for wheat and paddy have been set up at various mandis and key points.

Punjab contributes considerably to the procurement of rice and wheat and this has played an important role in the progress of its agriculture. Around 74 per cent of rice and 67 per cent of the wheat produced in the state was procured by government agencies in Punjab in TE2013-14 (Agricultural Statistics at a Glance, 2014). Thus, there is an assured market for most of the farmers' produce, which works as an incentive for production of just wheat and paddy. Punjab contributed 27 per cent of the rice in KMS 2015-16 and 46 per cent of wheat in RMS in 2016-17 in the central pool.

Table 2: Procurement of Rice and Wheat in some Selected States

Rice						
States	TE 2005-06			TE 2013-14		
	Procurement (Million Tonnes)	Production (Million Tonnes)	% of Production	Procurement (Million Tonnes)	Production (Million Tonnes)	% of Production
Punjab	8.9	10.1	87.9	8.1	11.1	73.5
Uttar Pradesh	2.9	11.2	25.7	2.3	14.4	15.7
Madhya Pradesh	0.1	1.5	6.3	0.9	2.6	32.8
Odisha	1.6	6.7	23.7	3.1	6.9	44.9
India	25.1	87.8	28.5	33.4	105.7	31.6

Wheat						
States	TE 2005-06			TE 2013-14		
	Procurement (Million Tonnes)	Production (Million Tonnes)	% of Production	Procurement (Million Tonnes)	Production (Million Tonnes)	% of Production
Punjab	9.1	14.6	62.2	11.6	17.2	67.4
Uttar Pradesh	1.2	24.1	4.9	3.1	30.2	10.2
Madhya Pradesh	0.3	6.8	5.0	6.6	12.5	52.7
Odisha	0.0	0.0	0.0	0.0	0.0	0.0
India	15.8	70.0	22.5	30.5	94.7	32.2

Source: *Agricultural Statistics at a Glance 2014*, DES

Punjab, Haryana and Uttar Pradesh produce a large quantity of rice although Punjab is not geographically suitable for paddy cultivation. It was made possible by the provision of extensive irrigation facilities and procurement of paddy at MSP. Because of an assured market, rice production increased over the years. However, rice is not the staple food in Punjab and rice procured in Punjab is transported to states in the East, North East and South India. This imposes an additional cost of storage and transportation. As rice is the most remunerative kharif crop owing to the assured MSP, farmers prefer to grow rice over other crops (like maize or pulses). Thus food procurement policy in Punjab is also responsible for the change in cropping pattern which is having an impact on the environment. The policy which worked as a catalyst of growth in Punjab's agriculture has become detrimental to the sustainability of its agriculture. Specializing in cereals was great when India was suffering from food shortages; however the situation today is different. Central pool stock of cereals crossed 80 million MT in July, 2012, way above the buffer stock norm. Some of the state specific policies in Punjab have also been distorting the market mechanism. The Punjab government charges heavy commission/levies/cess on the purchase of wheat and rice, amounting to 14.5 per cent, which is much higher than the 2 per cent in Gujarat and West Bengal. This makes the food processing industry extremely reluctant to buy their raw material from Punjab. In

fact, there have been instances of flour millers from Punjab buying wheat from UP. Revenue from these taxes/levies accrues to the mandi board or the state government.

In the new GST regime, the tax structure has been rationalised by GST council as most agri-commodities like rice, wheat, F&V and milk fall in the zero tax slab. In Punjab, if we assume that only the arhatiya commission of 2.5 per cent will stay, all other taxes and cesses will disappear and purchase cost may decline by 12 per cent. Subsequently, private sector may find Punjab an attractive source which will boost grain milling. However it is still not clear if market fee, rural development fund and infrastructure development cess will be subsumed in GST.

6.3.2 Agricultural Marketing

The Punjab State Agricultural Marketing Board (now Punjab Mandi Board) was established in 1961 to control and oversee the marketing network for the sale, procurement, storage and processing of agricultural produce. Punjab emerged as a success story in developing an efficient market infrastructure. The major thrust of the state government has been on providing well organised market infrastructure, linking all the villages to the market with surfaced road and grading of agricultural produce in mandis. Major investment has been made to improve the connectivity of villages. Currently, there are 98 mandis in Punjab and farmers do not have to travel

Table 3: Statutory Levies and taxes in Major Wheat & Rice Producing States

Wheat				Rice			
State	Rate in 2012-13	Earlier rate	Year	State	Rate in 2012-13	Earlier rate	Year
Punjab	14.5	12.5	2010-11	Punjab	14.5	12.5	2011-12
Haryana	11.5	10.5	2010-11	Andhra Pradesh	13.5	12.50	2011-12
MP	9.20	3.20	2009-10	Odisha	12.00	8.50	2011-12
UP	8.50	7.50	2009-10	Haryana	11.50	10.50	2010-11
Uttarakhand	7.50	6.50	2011-12	Chhattisgarh	9.70	8.70	2010-11
Rajasthan	3.60	4.10	2008-09	UP	9.00	8.00	2008-09

Source: *cacp.dacnet.nic.in* , Price Policy for Rabi Crops 2014-15.

long distances to market their produce. (Punjab Mandi Board)

But after the implementation of Agricultural Produce Market Regulation Act during the green revolution, no significant reforms have been undertaken (Chand, 2017) and agricultural markets are characterised by inefficiency, the presence of middlemen, price manipulation and so on. Agricultural marketing is a state subject and it requires initiative from the state government to undertake serious reforms. As part of agriculture marketing reform, the Prime Minister launched the electronic trading platform for National Agricultural Market (e-NAM) on April 14, 2016. However, the Punjab government has not opted to join the e-NAM platform even though its neighbour has. e-NAM will bring transparency to operations in mandis and the details of arhatiyas and farmers as well as participants in auctions in mandis will be captured online. It will also enable direct payment of MSP and sale price to farmers' bank accounts while the commission of arhatiyas can be directly credited to their account. Therefore, Punjab should join e-NAM and ensure transparency in operations of mandis and arhatiyas. Although Punjab was the first state to build a good marketing infrastructure for wheat and paddy, it has not been successful in providing similar facilities for perishable products like fruits and vegetables. In most Mandis, maize dryers are not available due to which farmers bring

maize with high moisture content that deprives them of a remunerative price for maize. Volatility in prices increases the risk of farmers and they feel discouraged to shift to high value horticulture.

6.3.3 Agricultural Credit

Credit plays an important role in agricultural growth, especially when farming becomes highly capital intensive. Of the total loans of rural households, 64 per cent and 36 per cent have been advanced by institutional and non-institutional sources respectively (NSSO AIDIS 2012-13). Loans advanced by commercial banks are the major source of credit in India as well as in Punjab. In Punjab, commercial banks account for 80 per cent of the total institutional loan outstanding, with the rest being accounted for by co-operative banks (14 per cent) and regional rural banks (6 per cent). In 2014-15, the amount of agricultural loan disbursed per hectare of gross cropped area is the highest in Punjab (Rs92,970/ha) as against Rs 42,046/ha for India.

According to the debt investment survey of NSSO (2012-13), while the debt burden has increased in all states, 33 per cent of the rural households (40 per cent of cultivators and 32 per cent of non-cultivators) in Punjab are estimated to be indebted. The average amount of debt per rural household reached Rs 64,548 in 2012-13. Credit can be a driver of agricultural growth if it is used for the creation of assets. In Punjab,

the share of term loans (long term loan) in total loans disbursed is only 12 per cent, (Agricultural Statistics at a Glance, 2015), which is a cause for concern as long term investment is crucial for agricultural growth.

6.3.4 Contract Farming

Contract farming has not been very successful in Punjab. Punjab Agro Foodgrains Corporation (PAFC) was established in 2002 as the nodal agency for dealing with contract farming in the state. The corporation has a tie up with a set of companies providing inputs, credits, extension services and buy back arrangements. PAFC in its first phase identified crops like maize, sunflower, hybrid rapeseed, basmati, durum wheat, barley and moong for contract farming. Area under contract farming increased from 9 thousand ha in 2002 to 102 thousand ha in 2006-07. But since 2011-12, PAFC has only undertaken contract farming of Barley. (<http://www.punjabagro.gov.in/pafc-c-farming.html> accessed on 3/06/2017) There are some instances of firms having direct arrangement with the farmers as well. The firms provided inputs/extension services and also bought the end products. The success of contract farming lies in long term commitment and mutual trust between firms and farmers. Refusal to purchase, low market price put the farmers in a difficult situation. Nestle was successful in sustaining its partnership with the farmers for purchase of milk. But similar kind of success was not achieved for horticulture. In April, 2013, the Punjab Assembly passed the Punjab Contract Farming Act. The idea was to facilitate direct purchase of farm produce so that farmers can realise better price. The salient features of the act were as under (The Punjab Contract Farming Act, 2013; Punjab Govt Gaz. (Extra) (CHTR 26, 1935 Saka)):

- a) Under the new Act, state government will assert control over purchase, sale, storage and processing of agri- produce.
- b) Buyers have to register themselves with an authority constructed for this purpose.

- c) Buyers are to provide support for inputs, technical advice etc.
- d) Loans and advances could be recovered from sale of agri-produce but farmers' land could not be sold or mortgaged.
- e) Punjab Contract Farming Commission was to be set up.
- f) The duration of contract is allowed up to 3 years and 108 crops are notified under the Act.
- g) Farmers will receive the payment on the spot at the time of delivery or a delayed payment with interest is allowed up to 30 days.
- h) District collector will deal with the dispute between farmers and firms. Both party's interest has been protected in the new act.

But rules under the act were not notified and the act has not been operationalised. Contract farming undertaken by PAFC is also not registered under the act. The state Govt. needs to formulate the rules under this Act without any further delay so that high value agriculture can be promoted through contract farming coupled with assured protection to the farmers.

6.3.5 Incentives for Food Processing Industries

The previous Govt announced a number of fiscal incentives in its 2013 policy on Fiscal incentives for Industrial Promotion. The detailed incentives are presented in the annexure:4. There is need to ensure that the incentives listed in the policy are actually available to food processing units being set up in the state.

However, under the new GST regime, taxation structure for processed food finalised by the GST council is not very encouraging. Fruits and vegetable juices are to be taxed at 12 per cent while jams, jellies, purees etc will be taxed at even higher rate of 18 per cent. This will weaken the linkages between farmers and the food processing industry and the expected growth of high value agriculture will not be realised. The Centre may reconsider these rates.

7. Econometric Analysis for Drivers of Agricultural Growth

The performance of the agricultural sector is influenced by several supply side factors as discussed above, the broad ones being the technological development, infrastructure facilities and price incentives through institutions. It is difficult to analyse the effect of all the variables in a simple framework because these variables would affect agricultural performance through various mechanisms. In this section, we make an attempt to find out the drivers of agricultural growth in Punjab through a simple econometric model. For the model, we have taken one representative factor from the three broad areas to assess its impact on agricultural growth. For example, fertiliser consumption and irrigation infrastructure are both crucial for agriculture but are highly correlated and hence, cannot be taken in the same equation due to multicollinearity. Annexure table 9 gives the correlation matrix of the variables. Keeping aside this limitation, it is observed that GSDPA shows a significant and positive correlation with irrigation, terms of trade between agriculture and industry and surfaced road density.

The function is defined:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \quad (1)$$

Here, X_1 is Irrigation Ratio; X_2 is terms of trade between agriculture and industry; and X_3 is surfaced road density.

In our model Logarithmic value of GSDPA is the dependent variable and the above mentioned variables in logarithm are the independent variables. The equation has been estimated using data from 1970-71 to 2014-15. We have run the model with different variables and have presented only those variables that have a significant effect on agriculture GDP.

The estimated equation is as follows⁴:

$$\text{GSDPA} = 7.7 + 3.47\text{IRR}^{***} + 0.35\text{ToT}^{***} + 0.37\text{SRD}^{**}$$

(7.97) (4.43) (4.32)

Adj R-square = 0.97

Table 4: Variables and Definition Used for the Model

Variable	Definition
GSDPA	GSDPA is the log of gross domestic product from agriculture and allied activities (2004-05 prices)
IRR	Log of ratio of gross irrigated area (GIA) to gross cropped area (GCA)
TOT	Log of GDP deflator between agriculture sector and industry sector for Punjab
SRD	Log of surfaced road length per thousand sq. km of area

⁴ Numbers in the parentheses are t values.

The effect of irrigation, road and ToT are found to be significant in the model. Irrigation turned out to be the most significant factor affecting agri-GDP. Since we have used a double-log model, the result indicates that a one per cent growth in the irrigation ratio increases agricultural GSDP by 3.5 per cent. It implies unconstrained supply of water is very important for cultivation and ensuring irrigation has helped the sector flourish. Similarly, one per cent increase in terms of trade in favour of agriculture increased agriculture GSDP by 0.35 per cent. Price policy plays a significant role in driving the sector and remunerative prices persuade the farmers to take on higher investment. A strong marketing infrastructure and procurement facilities ensured that farmers can avail accurate prices for their produce. Roads as well play a major role in agricultural development as through roads farmers are connected to input and output markets. One per cent increase in surfaced density leads to 0.37 per cent increase in GSDP from agriculture. What this equation implies is that 97 percent of the growth in agriculture during this period can be explained by expansion of irrigation ratio, road density, and price incentives (ToT). The detailed correlation matrix is given in the annexure [Annexure: 9].

Stationarity and Causality:

It is crucial to note that time series data have a common tendency of growing over time. Many times two time series processes turn out to be correlated because they are both trending over time caused by other unobserved factors. This may lead to spurious correlation between the dependent and independent variables. We have used an augmented Dickey-Fuller test (ADF) to check for stationarity. It tests the null hypothesis of a unit root is present in a time series sample. The unit roots were performed on levels and first differences of all variables. GSDPA and IRR are stationary as level and SRD (surfaced road density) and ToT (terms of trade between agriculture and industry) are stationary as a first difference.

To test for co-integration, we run the OLS regression in equation 1 and then run the ADF test on the residuals to determine stationarity. The series are co-integrated if the residual is stationary. The following table represents the Augmented Dickey Fuller Test for residuals. The null hypothesis of non-stationarity is rejected at 1 per cent level of significance. Hence, there is a long-term relationship between GSDPA, irrigation ratio, road density and terms of trade between agriculture and industry.

Table 5: ADF unit root test results

Variable	Level	1st Difference
Log(GDPA)	-3.63**	-13.09***
Log (Irrigation Ratio)	-3.52**	-10.47***
Log (ToT)	-0.307	-12.18***
Log (SRD)	3.07	-4.08***

*** , *** denote significance at 5% and 1% level.*

	Augmented Dickey Fuller Test
Variable	Level (Coefficient)
Residuals	-5.737***

**** denote significance at 1% level.*

8. Conclusion and Policy Recommendations:

The econometric analysis in the previous section highlights the three factors that have been the drivers of agricultural growth in Punjab in the past - i) expanded irrigation through tube wells ii) assured remunerative prices for wheat and rice and iii) expansion of all weather roads. However, the growth that could be achieved by developing roads, irrigation and markets has already been realized and exhausted. The state has successfully brought 98.5 per cent of the gross cropped area under irrigation, which is commendable. The road infrastructure in Punjab is among the most developed in India. Transport facilities enhance the interaction between different agents starting at the farm level to household consumption level. This is particularly critical to facilitate the movement of perishable agricultural commodities. Road density in Punjab has increased from 564 per thousand sq km in 1970-71 to around 2271 per thousand sq km in 2014-15. Further, surfaced road as a percentage of total roads is 87 per cent in Punjab, one of the highest in the country. The share of wheat and rice procurement in total production is also the highest in the country. There is no real scope for further improvement in these areas. Therefore, in order to bring agricultural growth in Punjab back on track and get it growing at more than 5 per cent per annum for another decade or more, we must look to other sectors that could lead to high agricultural growth in the future. The future of Punjab's agricultural prosperity lies in the high-value sectors of agriculture. The combination of highest irrigation cover, one of the best road infrastructures in the country and increasing holding size places Punjab in a privileged position. What is required now is a correct mix of demand driven policies and incentives. The most significant problem of Punjab has been free power leading to huge depletion of water table, as cropping pattern inclined towards more paddy. The Johl committee report, 1986, had recommended a shift away from wheat-rice cropping pattern to

wheat-maize one which still remains valid. Punjab farmers have not diversified from rice to other kharif crops in the absence of equivalent incentives. We make the following three sets of policy suggestions as the way forward for the agricultural sector in Punjab.

Diversification from Common Rice:

a) Diversification to Maize: Currently, 0.13 million hectare area is under maize cultivation in Punjab which is 1.65 per cent of the GCA. The area under maize cultivation can be expanded by linking it to the processing industry for food and feed (especially poultry). Maize is used in many ways and these different uses should be explored to generate a market for different maize products.

i) Fodder Conservation: Maize constitutes a primary ingredient for poultry feed in India. It can also be used as feed for dairy animals. Silage preparation is a scientific way of storing green fodder for dairy animals. It helps in supplying fodder for dairy animals on a large scale during periods of scarcity seasons without any loss of nutrients. The criteria for forage to be used as silage include high level of fermentable sugar, low level of protein and low buffering capacity. On the basis of these criteria, maize, oat, bajra, sorghum, lemon grass, etc., are considered suitable for silage making. In anaerobic conditions (without air), sugar contained in green fodder is converted into lactic acid with the help of micro organism, which helps preserve the green fodder for a longer period of time. It is a time and labour saving technology compared to the traditional way as fodder cutting, transport and chaffing is done only once, making it economically viable.

Although India is ranked first in milk production in the world, the productivity of animals is not satisfactory. Good quality forages make a huge difference in milk productivity (50 per cent increase in productivity). An adult milch animal needs 35 kg of

fodder and according to Indian grassland and Fodder Research Institute (2010) the country faces a net deficit of 35.6 per cent in green fodder. As livestock contributes almost 30 per cent of the total value of output in Punjab and the state is the fifth largest producer of milk in the country, the demand for fodder is very high in the state as it is in neighbouring Haryana and Uttar Pradesh.

Silage making is a technology that can allow farmers to provide quality roughage throughout the year. In India, hay making was the traditional method of forage preservation. But silage making is a technologically advanced method that is not dependent on weather conditions and a variety of crops can be used.

In some pockets of Punjab, silage making has successfully been adopted. While 1 acre of land ensures Rs. 22,000-Rs. 25,000 income, production of maize provides an income of Rs. 45,000, when farmers are linked to silage making. The cost of making one kg of green fodder is only Rs 3.12/kg, and it is usually sold at Rs 5/kg. Adult cattle require 35kg of fodder per day. A mini dairy with 10 cattle and 5 calves will require 150 tonnes of green fodder per year (Dairy Knowledge Portal, NDDB). There are 50 community based silage pits established in Hoshiarpur and Gurdaspur with 100 per cent subsidy from Milkfed. But it needs to be scaled up. Currently, 540 thousand hectares of area is under fodder cultivation in Punjab (BAHFS, 2010). Area under common rice can be replaced with maize and farmers can directly be involved in silage making. The state can emerge as the feed-hub of northern India.

ii) Other Uses of Corn:

Cornmeal: It is prepared by grinding whole corn. It is used as a replacement for wheat flour and is used in baked food products like pizza, tortilla, corn bread and so on.

Corn syrup: It is used as a substitute of sugar in many products like soda, candy, cookies etc.

Corn Oil: It is produced by squeezing the germs of the corn and is used as a food ingredient.

Ethanol: Ethanol fuel or bio-fuel is made by distilling corn. It is a renewable resource and regular gasoline powered cars are run on gas blended with ethanol.

Pharmaceuticals: Preferred carbohydrate sources in antibiotics are corn syrup and corn starch. Over 85 different types of antibiotics are produced using corn.

Industrial products: Industrial products made from corn include absorbents for oil and hazardous waste, insecticides, fertiliser, industrial glue etc.

Alcoholic Drinks: Corn is the major source of carbohydrate in whiskey production.

Toothpaste: Sorbitol, produced from corn, is used in toothpaste.

Thus, corn and its by-products have many uses. The fast growing middle and high income classes and changes in taste and preferences have led to an expansion in the market for processed foods, which offers new opportunities for the state to explore. In order to tap these opportunities, the state needs to strengthen the value chain infrastructure. Value chain is a vehicle by which new forms of production, technologies and logistics are introduced. The government should facilitate diversification away from rice towards maize and horticulture by creating the infrastructure for value chain development. Maize production can be incentivised by developing maize value chains, connecting farmers to feed producers, processed food industries making cornflakes, popcorn or food marts selling horticulture products like baby corn and sweet corn, and producer of corn oil and ethanol. The maize crop faces marketing problem because it contains more moisture (20-28 per cent) than the optimal level (14 per cent) required for processing. So, farmers are sometimes forced to accept a lower price. Government needs to provide proper infrastructure facilities including maize dryers in mandis. Some mandis have been provided maize dryers out of RKVY funds but not all mandis in maize growing areas are equipped with dryers. These problems need to be addressed on priority.

b) Promotion of Livestock Sector: Similarly, milk processing needs to be promoted aggressively by the state government. Although Punjab has the highest per capita per day availability of milk (980 grams/day) in the country, currently only 10 per cent of the total milk production of the state is processed by the organised sector (co-operatives and private players), which is very low compared to Gujarat (49 per cent). Government should provide incentives to the private sector to improve milk processing in the state and set up several plants to process at least 30-35 per cent of the total production in the coming 5 years. Moreover, only 30 per cent of the total milk procured by Verka is converted into milk products. This share should be increased as sale of milk products generates more profit than liquid milk. Linking maize farmers with the dairy sector will help increase milk production through the supply of quality feed. But the abundance of liquid milk will put a downward pressure on its price. The government should incentivise the setting up of milk processing units. Following the example of Amul, the dairy sector in Punjab should target the market in the Middle East. Currently, marginal and small farmers are the major players in the dairy sector; hence, the formation of FPOs should be encouraged by the state government.

Punjab can also make rearing of cattle more profitable to farmers through its vibrant dairy sector, but also developing meat processing, especially buffaloes, as an export oriented industry. Farmers who want to sell their buffaloes for slaughter can fetch a better price for their non-milching buffaloes healthy buffaloes, if the state is declared free from foot and mouth disease.

c) Promotion of Horticulture: The state government needs to realise that growth in income through cereals has reached saturation and there is urgent need for value addition from high value dairy, fruits and vegetables. Only, 3.6 per cent of Punjab's GCA is under fruit and vegetable production, compared to 8.3 per cent at the all-India level. In order to promote the fruit and vegetable sector, protected cultivation should be

promoted using drip and sprinkler irrigation. But it has to be backed by proper processing, grading and packaging infrastructure. Government should aim to bring at least 10 per cent of cropped area under F&V in the next five years.

d) Fisheries: Large parts of Muktsar, Fazilka, Bathinda and Faridkot are waterlogged. A study by GADVASU has found that fresh water carps can successfully be reared in the saline water. Hence, it provides a good opportunity to develop fisheries in these districts as it can offer alternative employment opportunities. But quality fish seed production has remained stagnant in Punjab, while it has increased steadily in neighbouring Haryana. The government should take steps to overcome these shortcomings through capital assistance to construct fish seed mills and carp fish seed farms.

Encouraging Food Processing Industries:

Food processing sector should be the focus area in Punjab and farmers should be linked to the processing units. The abundance of wheat and milk suggests development of bakeries, flour mills, pasta manufacturing and other processing units which use wheat as raw material. Punjab's role in feeding Central pool for PDS should gradually come down. It will be taken up by other upcoming states like Madhya Pradesh and Uttar Pradesh.

Due to high taxes (14.5 per cent) on wheat, the processing industry has been reluctant to buy wheat from Punjab. In the past, private sector units located in Punjab itself have preferred to buy wheat from neighbouring Uttar Pradesh which seems more attractive due to lower taxes and is also cheaper at times due to non-payment of MSP. Under GST reform, it is hoped that these taxes and levies will get rationalised as most raw agri-commodities fall in the zero tax slab. Reduction in taxes and cesses by 12 per cent will reduce price of these basic staples in the open market. The state should take it up as an opportunity to build a vibrant wheat processing industry (and

basmati), creating employment and linking farmers directly to processors.

Special focus should be given to improve the value chain infrastructure, from farm to fork, in the state otherwise, perishable nature of the products makes farming risky and farmers are reluctant to shift from cereals to fruits and vegetables. Expressway linking Khanna to Kandla can minimise the transportation time and the state can totally exploit the opportunities offered by gulf market through speedy transportation of F&V to Middle East using cargo planes. But, high taxes on processed food items under the new GST regime will hamper the high value agriculture (F&V, Dairy) and there is an urgent need to reconsider these rates and bring down to the 5 per cent slab.

Contract farming is still not taken up in large scale in the state. The state needs to operationalise Contract Farming Act 2013, to incentivise contract farming by corporate agencies and to promote the food processing industry in the state.

Promote Sustainable Agriculture especially with respect to Water Use Efficiency:

a) Shift to DBT with respect to power subsidy: Electricity subsidy is an important component of subsidies that were introduced to increase agricultural growth and farm incomes. Although it has led to assured incomes, the combination of free water, power and procurement has led to rapid ground water depletion. Electricity consumption per hectare of agricultural land has increased over time, whereas agricultural production per unit of electricity consumption has not increased with free power supply; rather, it has been falling over time. This indicates serious inefficiency in the consumption of electricity in Punjab's agricultural sector, and steps need to be taken to curtail this. For improving power and water use efficiency, power supply should be metered and charged beyond a fixed level of free supply and the subsidy (currently, Rs 6236 crore in 2012-13) should be transferred to farmer's

bank account. Transferring a fixed amount of cash (calculated using the average land holding) to farmers will provide an incentive to reduce the consumption both of electricity and underground water.

b) Shift to DBT with respect to Fertiliser Subsidy:

Another problem faced by agriculture in Punjab arises from the imbalance in the use of fertilisers. Wheat and rice are the most nutrient exhaustive crops and the mono-cropping of paddy and wheat in the past four decades has led to steady decline of macro (NPK) as well as micro (zinc, iron, manganese) nutrients. The state has encouraged the use of chemical fertilisers through subsidies and the economic cost is estimated at Rs 7022 crore in 2012-13. Hence, it has become a vicious circle of higher use of fertilisers and low soil fertility. The fertiliser subsidy has helped achieve self sufficiency in food grain production but it has led to inefficient use of fertilisers. The extremely low price of urea has resulted in imbalanced use of fertilizers biased towards urea which has an impact on the fertility of land. The NPK ratio in Punjab is 36:8.74:1 which indicated highly skewed use of urea. Studies have shown that (Gulati et al, 2015) this imbalance in the use of fertilisers can be corrected by switching to direct cash transfer to farmers on a per hectare basis. Farmers should be incentivised to get soil tested and get soil health card by linking these to direct cash transfers. Moreover, import duty on urea should be reduced to zero and prices should be determined by market forces.

c) Propagating Micro Irrigation Technique:

Realising the gravity of the ground water situation, the state govt must consider making it mandatory for sugarcane farmers to use drip irrigation facilities. Karnataka has already done it and Maharashtra is also considering a similar system. Out of 10 lakh ha under sugarcane in Maharashtra, about 2.5 lakh ha is already under drip irrigation. Modern drip irrigation systems use computerised sensors that regulate the flow of water depending on temperature, humidity and nutrient levels in the soil. Moreover, water reaches the root of plant leading to better plant growth. The

automated systems ensure optimum use of water. If the Government of Punjab takes sugar mills on board, it should not be difficult to persuade farmers to install drip irrigation systems over a period of two or three years. There are pilots being conducted in Punjab for drip irrigation in paddy. These need to be closely monitored and encouraged. The manufacturers of drip equipment claim that using drip irrigation leads to savings of 65 per cent in the case of water and 45 per cent in the case of electricity, while improving crop productivity by 40 per cent, as compared to flow irrigation. Micro irrigation means more crop per drop.

d) Sustainable Futuristic Agricultural Development:

Another important way to deal with power shortage is to promote solar power for powering irrigation pumps, and generating solar power as the 'third crop' by enabling farmers to sell surplus power to the state grid. This will help check depleting water tables too.

Cold storages based on solar power can be more cost effective. Beginning should be made in case of potato cold storages in Jalandhar.

Overall, strategy for Punjab agriculture needs to shift from food security concerns of the country to income augmentation of Punjab farmers. This can be done by gradually shifting towards high value F&V, protected cultivation, focusing on food processing industry to add value to wheat, rice and milk production in the state. The strategy also needs to be demand driven (plate to plough), exploring new and remunerative markets, as in Gulf countries or even beyond to Europe and CIS countries. We are confident that with this shift in strategy, the state can turn around its agriculture growth back to more than 5 percent per annum, augment farmers' incomes, and use its precious water resources in a more sustainable manner.

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Annexure

Annexure1: Geography and Demographics of Punjab

State Profile	Punjab	India
Geographical Area(m ha)	5.0 (1.5%)	328 (100%)
No of Districts	22	676
GCA per 100 persons (TE 2012-13) (ha)	28.1	15.9
Gross Irrigated Area (m ha)) in TE 2012-13	7.7	91.1
Irrigation Ratio	98.5%	46.50%
Cropping Intensity in TE 2012-13	190.1	139.1
Projected Population 2016 based on Census 2011 (Million)	29.5	1,305.60
Share in India's Population	2.30%	100%
Population Density (population per sq km)	590	398
Agriculture's share in Total GSDP TE 2014-15 (%) (current prices)	27.7	17.9
Agricultural Workforce in Total Workforce (%)	34	47
Normal Rainfall (in CM) in 2015	62	116.1
Rural Poverty (%) (2004-05) [2011-12]	(22.1)[7.7]	(41.8)[25.7]

Source: DES, Census, Labour Bureau

Annexure 2: Agricultural Work force :(per cent of total workforce)

	Punjab	India
2001	39	58.2
2011	35.6	55
2015-16	34	47
Rural Work Participation Rate (2011)		
Male	54.9	53
Female	14.3	30

Source: CSO, Census, Planning Commission, Economic & Statistical Organization, Govt. of Punjab, Labour Bureau

Annexure 3: Share of different crops in gross cropped area

	Rice	Wheat	Maize	Food Grain	Cotton	Oilseeds	Sugarcane
TE1986-87	24.2	43.9	3.9	76.5	7.5	2.8	1.2
TE1996-97	28.4	42.0	2.2	75.1	9.0	2.9	1.7
TE3006-07	33.4	44.0	1.9	80.2	7.1	1.0	1.1
TE2014-15	36.4	44.6	1.6	83.4	5.7	0.6	1.1

Source: Directorate of Economics and Statistics

Annexure 4: Incentives Provided to Food Processing Industries

- Retention of VAT/CST for a period of 10 years (80 per cent VAT + 75 per cent CST) for Fixed Cost of Industry from 1 crore to below Rs.25 crore and 85 per cent VAT + 80 per cent CST for Fixed Cost of Industry Rs.25 crore to below Rs.100 crore
- Exemption from payment of electricity duty on power for a period of 10-12 years depending on the amount of investment.
- 100 per cent exemption from the payment of stamp duty for three years after the date of submission of application.
- Exemption from the payment of property tax for the period of 10-12 years, depending on amount of investment.
- Units in agro industries and food processing sector coming up in mega food parks set up under mega food park scheme of the Ministry of Food Processing Industries, Government of India, will be eligible for incentives under this package.
- Units in agro-industries and food processing sector set up in border districts will be allowed incentives up to 125 per cent of FCI as against 100 per cent for other areas.

Notification No. 17/7/2014-AS I/1372, Department of Industries and Commerce, Govt. Of Punjab

Annexure 5: Allocation of expenditure under various heads as a share of total expenditure on Agriculture and Forestry

	Crop Husbandry	Soil & Water Conservation	Forestry & Wildlife	Agricultural Research and Education	Capital Outlay on Crop Husbandry	Capital Outlay on Soil & Water Conservation	Capital Outlay on Forestry & Wildlife	Loans for Crops Husbandry
2010-11	76.3	2.3	1.7	17.2	0	0.78	0	1.08
2011-12	76.4	4.2	8.2	10.3	0	0	0	1.03
2012-13	44.6	13.5	17.5	23	0	0	0	0
2013-14	46.5	8.8	3.1	41.6	0	0	0	0
2014-15	61.4	8.3	1	29.3	0	0	0	0

Source: Detailed estimates of expenditure on Plan schemes, Government of Punjab, various years

Annexure 6: Allocation of expenditure among sub-sectors as a share of total expenditure on animal husbandry and fisheries

	Animal Husbandry	Dairy Development	Fisheries	Capital Outlays on Animal Husbandry	Capital Outlay on Dairy Development	Capital Outlay on Fisheries
2010-11	54.9	14.1	8.1	22.8	0.0	0.0
2011-12	89.1	13.0	0.0	2.1	(-)4.1	0.0
2012-13	48.4	23.9	1.9	25.8	0.0	0.0
2013-14	7.1	0.1	0.5	92.3	0.0	0.0
2014-15	34.5	6.5	0.0	59.0	0.0	0.0

Source: Detailed estimates of expenditure on Plan schemes, Government of Punjab, various years

Annexure 7: agriculture power tariff in selected states

(Paise Kwh)							
	1991-92	2001-02	2009-10	2010-11	2011-12	2012-13	2013-14
Bihar	10.50	13.40	64.00	223.60	169.10	357.00	410.55
Gujarat	11.00	39.00	176.9	167	207.2	214.88	217.56
Madhya Pradesh	24.50	7.20	261.20	299.00	317.70	340.49	350.70
Odisha	30.9	107.7	185.4	112.4	110.4	-	-
Punjab	10.8	0.00	0.00	51.33	0.20	0.35	0.00
Uttar Pradesh	31.58	107.8	159.6	195.9	191.9	236.82	224.18
India	16.1	35.4	101.6	138.2	143.7	165.39	183.06

Source: Planning Commission

Annexure 8: Sale of electricity for agriculture as a share of total electricity consumption (%)

	Punjab	India
1970-71	38.0	NA
1980-81	44.0	19.0
1990-91	43.0	26.0
2000-01	29.0	25.0
2007-08	31.2	21.0
2008-09	28.6	20.0
2009-10	32.5	21.0
2010-11	30.3	20.0
2011-12	29.3	21.0
2012-13	30.3	18.0
2013-14	30.1	22.0

Source: Agricultural Statistics at a Glance, 2014, Planning Commission, Punjab Statistical Abstract

Annexure: 9 Correlation Matrix for the period 1970-71 to 2014-15

	Matrix				1970-71 to 2014-15			
	GSDP	Fertiliser Consumption	Irrigation Ratio	ToT	ToT_1	Real MSP	Total Road Density	Surface Road Density
GSDP	1							
Fertilizer Consumption	0.93***	1						
Irrigation Ratio	0.94***	0.94***	1					
ToT	0.29**	0.06	0.07	1				
ToT_1	-0.27*	-0.39***	-0.44***	0.77***	1			
Real MSP	-0.53***	-0.63***	-0.64***	0.31**	0.52***	1		
Total Road Density	0.94***	0.87***	0.87***	0.37**	-0.19	-0.44***	1	
Surface Road Density	0.95***	0.91***	0.91***	0.25*	-0.31**	-0.48***	0.99***	1

Annexure 10:

Policies and Programmes:

The major commitment of the state government following the budget speech (state budget 2016-

17) is to put the economy on the path of sustained growth, which should be in a way that the benefits will trickle down to all sections of people. In order to do so, the Government of Punjab has provided a greater thrust to the development of agriculture.

In this section, we discuss the state and centrally sponsored schemes implemented in each segment in recent times – food grains, livestock and poultry and fruits and vegetables. Actual allocation figures are available up to 2014-15 (state budget). The share of allocation for agriculture and allied activities is 4.9 per cent of the total budgetary outlay (allocations to Agriculture & Forestry and Animal Husbandry Rs. 64,87,779 thousand and Rs.16,97,79 thousand

respectively for 2014-15). The broad allocation under agriculture and allied sectors for 2014-15 is shown below. The major changes in allocation over the years are shown above [annexure: 5 & 6]. Crop husbandry has the highest share but over the years, its share declined and allocation to research and education increased. Animal husbandry constituted the highest share under the major head of animal husbandry and fisheries.

Figure 31: Sector wise expenditure in Punjab as a share of total budgetary outlay in 2014-15

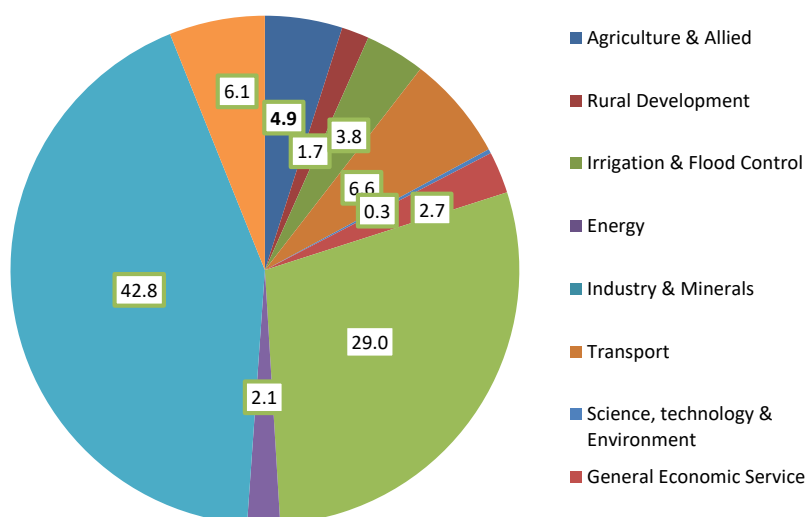
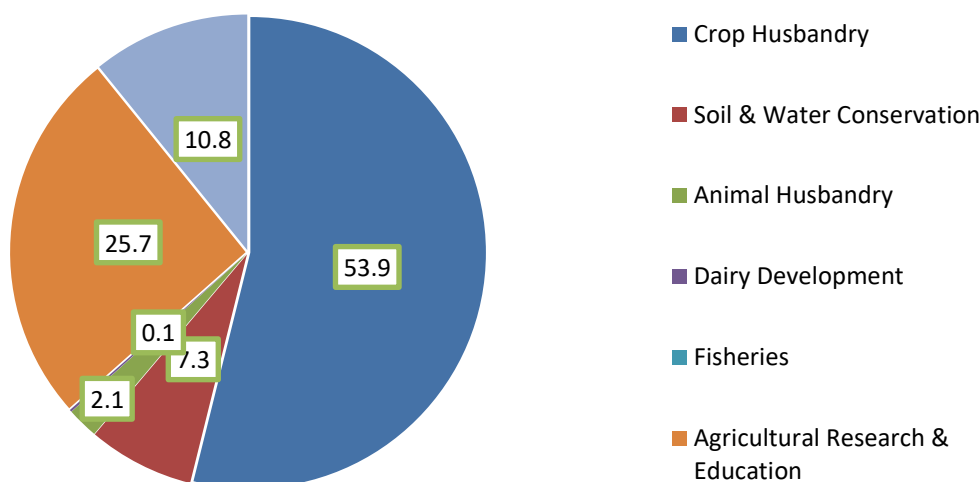


Figure 32: Allocation to broad heads as a share of total allocation to Agriculture and Allied Activities in 2014-15



Food Grain Sector:

There are several state and central programmes aimed at improving productivity of crops. In the following section, we discuss the National Food Security Mission and other state specific policies under Punjab's state agricultural policy. The major programmes are summarised below.

National Food Security Mission (Centre-state contribution in the ratio of 60:40):

The National Food Security Mission was launched to increase the annual production of rice, wheat and pulses by 10 million tonnes, 8 million tonnes and 2 million tonnes respectively by the end of the 11th five-year plan. The mission was impressively successful and is being continued during 12th plan with a new set of goals (additional 10 million tonnes of rice, 8 million tonnes of wheat, 4 million tonnes of pulses and 3 million tonnes of coarse cereals). In Punjab, NFSM-wheat is being implemented in 10 districts, NFSM-pulses is being implemented in 20 districts and NFSM-coarse cereals in 3 districts. The total expenditure incurred on this programme for the year 2014-15 was Rs.29 crore and the revised outlay for the year 2015-16 was Rs.35.4 crore (Detailed expenditure on estimates on plan schemes, Govt. of Punjab, 2016-17).

Krishi Karman awards were introduced in the year 2010-11 to reward the best performing states in food grains and for the best performing states in the production of rice, wheat, pulses and coarse cereals. There are three identified categories for food grain production. Punjab won Krishi Karman award in category I (states where production of food grain is more than 10 million tonnes) for the year 2013-14.

Support to State Extension Programmes (90:10 Centre State Partnership):

The main objective of the scheme is to identify research/extension priorities for districts taking into consideration ecological needs. The actual expenditure for the year 2014-15 was Rs.11.2 crore. The revised and approved outlays for 2015-16 and 2016-17 are Rs.22.4 crore and Rs.25 crore respectively.

Rashtriya Krishi Vikas Yojana (60:40 Centre State Partnership):

To incentivise the growth of agriculture, the National Development Council launched the Rashtriya Krishi Vikas Yojana. Until November 2015, RKVY was fully funded by the GOI. Now, the centre provides 60 per cent of the funding with the states providing the rest. This programme undertakes agricultural development plan taking into account agro-climatic

The actual expenditure under RKVY in the past few years are shown below.

Rashtriya Krishi Vikas Yojana						
Crop Husbandry (in crore)	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16(RE)
Direction & Administration	170.2	66.0	107.5	239.9	297.3	0.0
Commercial Crops	0.0	0.0	0.0	0.0	0.0	293.9
Extension & Farmers' Training	0.0	0.0	0.0	0.0	0.0	293.9
Special component Plan for SC, ST	9.0	3.5	0.0	12.6	14.1	15.5
Total	179.1	69.4	107.5	252.5	311.3	603.2

Source: Budget Document, Finance Department, Punjab

conditions. The main objectives include the following: i) increase public investment in agriculture and allied sectors ii) reduce the yield gap iii) maximise farm incomes iv) ensure addressing local needs. The central government provides funds to states in four streams: production growth, infrastructure & asset development, special schemes and flexi fund. An expenditure of Rs.311.35 crore was incurred during 2014-15. Under RKVY, the state has full flexibility to decide specific schemes. The SAP proposed to allocate 50.2 per cent, 23.4 per cent, 15.8 per cent, 4 per cent, 3 per cent and 2 per cent of the total proposed budget to agriculture, animal husbandry, soil & water conservation, dairy development and milkfed, horticulture and the fisheries sector respectively.

(http://rkvy.nic.in/static/Evaluation_of_SAPs/Evaluation_SAP_Punjab.PDF)

In the past few years, all spending has been directed towards crop husbandry only.

Paramparagat Krishi Vikas Yojana (60:40 Centre-State Partnership)

Under this programme, organic farming is promoted through the adoption of organic villages through a cluster approach. An outlay of Rs.8 crore is provided in the 2015-16 annual plan.

National Oilseed and Oil Palm Mission (75:25 Centre-State Partnership)

This programme aims at diversification of agriculture through an increase in the productivity of oilseeds and maize. The strategy includes increasing the seed replacement ratio, increasing irrigation coverage under oilseeds from 26 per cent to 36 per cent, diversification of area from low yielding cereals crops to oilseeds crops, and intercropping of oilseeds with cereals, pulses and sugarcane. An outlay of Rs.28 crore (75:25 centre state partnership) has been approved for the 12th five-year plan.

National Mission on Sustainable Agriculture (80:20 Centre-State Partnership):

Soil health management through residue management, organic farming, judicious application of fertilizers and minimising soil erosion, is the most important intervention in this programme. Soil characteristics will be derived through GIS. An expenditure of Rs.1.51 crore was incurred in 2014-15.

Programmes for the Horticulture Sector:

The horticulture sector plays a significant role in promoting crop diversification and increasing farm incomes. The ongoing programmes to promote horticulture are the following:

Mission for Integrated Development of Horticulture (85:15 Centre-State Partnership)

MIDH is a centrally sponsored scheme where the share of central and state funding is in the ratio of 85:15. The scheme aims to promote growth in the sector covering fruits, vegetables, root and tuber crops, mushrooms, spices, flowers and aromatic plants. The components of this scheme include research and development, new nurseries, additional area under different crops, rejuvenation, INM/IPM, formation of FPOs. The performance of NHM (Now MIDH) in the state since its inception is tabulated below.

The Government of India has announced the setting up of the Post Graduate Institute of Horticulture Research and Education in Amritsar. This is a big step towards crop diversification. An actual expenditure of Rs.44.32crore was incurred in 2014-15. The revised and approved outlays for 2015-16 and 2017-18 are Rs.86.6crore and Rs.80crore respectively.

Animal Husbandry:

Livestock is the second largest sector in terms of gross value of output and this sector can play a very

Physical Achievement of MIDH:

	Area Coverage (ha)		Rejuvenation (ha)		Nurseries (No)		Training of Farmers (No)	
	Target	Achievement	Target	Achievement	Target	Achievement	Target	Achievement
2005-06	...	1142	...	...	...	...	...	245
2006-07	...	5357	...	5720	...	...	...	1315
2007-08	...	5783.7	...	904.6	...	...	...	3092
2008-09	...	4521.05	...	380.7	...	1	...	6238
2009-10	...	9080.35	...	1246.67	...	1	...	6238
2010-11	5177	3215.74	2000	26.7	1	...	...	...
2011-12	2605	1951.28	1200	1991	2	...	...	...
2012-13	2150	3435	200		...	2	...	...
2013-14	2814	1409.3	200	50			150	
2014-15	3852	584.27	600	200	7	...	1500	3206
2015-16	1800	1642.31	1000	120.4		1	3125	112
2016-17	1420	1806	400	125	6	1	640	115

Source: <http://www.nhm.nic.in/> accessed on 29.9.16

important role in diversifying from cereals and in increasing farm incomes. State funded schemes to enhance the contribution of this sector are the following:

Up gradation of Veterinary Institutions in the state under RIDF:

Under this three-year project approved by NABARD during 2011-12, the state will up-grade 800 veterinary dispensaries by providing them with the latest equipment and construct 48 veterinary hospitals. Total spending for 2014-15 was Rs.3.12 crore and a revised outlay of Rs.3.65crore was provided in the 2015-16 annual plan.

Construction of buildings of tehsil and block level veterinary hospitals and other veterinary hospitals in the state under RIDF

NABARD approved a project under RIDF to construct 9 tehsil level, 28 block level and 110 veterinary hospitals in the state. An expenditure of Rs.6.86crore was incurred during 2014-15.

National Livestock Mission:

This is a centrally sponsored scheme with states sharing a part of the total outlay. The programme aims to ensure sustainable growth of the livestock sector, increase the availability of fodder, promote training and technology dissemination; prevent animal diseases and so on. An annual outlay of Rs.2 crore was provided in the annual plan for 2015-16.

Promotion of the Dairy Sector:

An outlay of Rs.30 crore has been provided in 12th plan to promote dairy training and education. The share of small dairy farmers with few dairy animals

accounts for a major share of the dairy industry. They lack proper training and scientific knowledge. Keeping this in view, six-day training programmes along with allowance to compensate for lost wages has been proposed. An outlay of Rs.1crore has been allocated in the current plan.

Promotion of Fisheries:

To develop pisciculture, the government has initiated the following steps:

1. Fish seeds are provided from government fish farms in states.
2. The state is providing extension services and training programme for fish farmers.
3. Subsidy is provided for excavation and renovation of ponds.

A total outlay of Rs. 41.26 crore has been released in 12th five-year plan.

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