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Possibilities and Constraints in Adoption of Alternative Crops to Paddy in Haryana

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PREFACE

The present study sponsored by the Ministry of Agriculture, Government of India aimed at analyzing issues related to crop diversification in Haryana. The primary as well as secondary sources of data were used to fulfill the specific objectives of the study. Primary data were collected through a field survey of 210 farmers growing paddy and alternative crops in the selected six districts of Haryana.

The results of this study reveal (i) growth in production of paddy and its alternative crops in kharif season (bajra, maize and cotton) in Haryana was 5.07, 2.17, -3.79 and 4.25 per cent per annum respectively between 1970-71 and 2011-12. Paddy and cotton gained due to area expansion and increase in yield. The productivity growth benefitted bajra despite shrinkage in area, while, maize lost irrespective of increase in yield. (ii) the similar pattern of gains and losses was noticed in the selected districts. (iii) the sampled farmers produced 101 qtls of paddy, 5.22 qtls of bajra, 8.67 qtls of maize and 22.33 qtls of cotton per farm during 2012-13. They retained a part of produce for self consumption and other purposes. They sold marketed surplus of paddy to government agencies, private companies and local traders, while the entire marketed surplus of other crops was sold to local traders. (iv) the net returns from cultivation of paddy and cotton were found much higher in comparison to bajra and maize. (v) farmers did not use analysed resources at the optimal level and hence, they need to make adjustments in their usage to attain resource use efficiency (vi) farmers faced problems in cultivation of alternative crops due to biotic and abiotic stresses.

The shift away from paddy in kharif season in Haryana is not easy due to higher profitability from its cultivation in comparison to alternative crops. Therefore, ensuring profitability of alternative crops on sustainable basis through suitable policy reforms appears to be a pre-requisite for successful crop diversification. These reforms include favourable price regime, technology for raising the existing level of productivity, financial support, rural infrastructure and above all, multi-pronged government support. Crop diversification will remain an elusive goal in Haryana without firm policy reforms in favour of alternative crops.

We are grateful to Prof. Pami Dua, Chairperson, GB, for her constant encouragement to complete this study. We express our thanks to the Ministry of Agriculture, Government of India for providing support during the course of this study. Thanks are due to the coordinator of the study, Prof. D.K. Grover, Director, Agro-economics Research Centre, Ludhiana for providing the study design, tabulation scheme and useful comments on the draft report. We are thankful to Dr. Sanjay Walia, PAU, Ludhiana for his involvement in this study. We are also thankful to Deputy Directors, Agriculture of Selected districts for the useful discussion on various aspects of the project. Thanks are due to study team for contribution during the course of this study. Author gratefully acknowledges the support of all the staff members of the AER Centre, Delhi University.

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1.1 Background:

India has made tremendous progress in agriculture over the past decades. Technological change with the introduction of short duration high yielding varieties of wheat and rice in the sixties increased productivity of these crops manifold. The effective price policy coupled with relatively better technology has resulted in the emergence of paddy in kharif and wheat in rabi as the most secured and profitable crops in several states. Consequently, production of wheat and rice in India has increased from 23.8 and 42.2 million tonnes in 1970-71 to 95.8 and 106.3 million tonnes in 2013-14. This translates into a growth rate of 2.82 and 1.86 per cent per annum for wheat and rice during this period.

The output of wheat and rice in the country has reached a saturation point. But, farmers in agriculturally advanced states like Punjab and Haryana still prefer to grow wheat and rice despite being aware of problems created by this crop rotation in terms of deteriorating soil health and depleting water table. The production, productivity and profitability which reached a plateau in leading green revolution states, started plummeting in early eighties. These developments made clear that the country would have a surplus of superior cereals and therefore, farmers should diversify towards other crops by increasing area under pulses, oilseeds, fruits, vegetables and commercial crops.

With this realization, crop pattern in several states experienced significant change with diversification from traditional food crops to commercial crops, plantation crops and horticultural crops (Vyas, 1996; Nadkarni, 1996; Joshi et.al, 2004; Joshi 2014). However, cropping pattern in leading green revolution states of Punjab and Haryana has not witnessed significant change and remained skewed towards wheat paddy monoculture which has created ecological problems in the long run sustainability of agriculture.

Agriculture occupies a dominant place in the economy of Haryana and is favorably placed in terms of water resources and soil potential. The old and new alluviums are ideal for the production of wheat and rice under irrigated conditions. Of

the total cropped area, more than two-third is shared by foodgrains. In addition, cash crops such as oilseeds and cotton are also grown. The legumes are gradually loosing area. The introduction of these crops in crop rotation may increase production of fine foodgrains due to complementary relationship between grains and legumes. Since legumes are known for nitrogen fixing quality, this will reduce cost of production and improve incomes. The farmer must search for the combinations through diversification of crops that will provide higher farm business income from his limited land and economic resources. It is imperative to determine the most profitable and environmentally sustainable crop rotation, with low yield and price risk using value productivity and cost of production per hectare for each crop over a period of three to four agricultural years.

There has been a sharp shift in area under various crops in Haryana during the past three decades. It has shifted in favor of those crops which provide higher returns per unit of land due to increasing productivity or increasing prices or both i.e. rice, wheat, rapeseed-mustard and American cotton. For these crops, growth in area and yield has been impressive but growth in area was comparatively higher. In view of higher proportion of area under rice-wheat rotation and rice being major consumer of irrigation water, the state is experiencing sharp decline in groundwater table and deterioration in the agro-economic systems. It is therefore, important to reduce area under this crop rotation in order to sustain production and agro-eco-systems of the state in the long run.

So far, potential of the new seed-fertilizer technology has been fully exploited in Haryana. The limited scope for expansion of irrigation facilities via canals was circumvented by increasing number of tube wells and pumping sets from 28,000 to over five lakh. Haryana has been catapulted to the forefront of agricultural scene in the country. The higher growth in various sectors of economy could help in visualizing overall perspective. During the period from 1981 to 1991, GSDP of Haryana grew at 6-7 per cent per annum, sustained by a 7-8 per cent per annum growth in the industrial and service sectors and a 4 per cent growth in the agricultural sector. It has been contributing about 3 per cent to the gross domestic product (GDP). The share of industrial sector in the GSDP in 1980-81 was 19.46 per cent, which rose to 29.07 per cent in 2010-11. Conversely, though agriculture continues to have a dominant place in economy, its share in GSDP has come down from 53.78

per cent in 1980-81 to 20.92 per cent in 2010-11. The share of the service sector has appreciated from 26.76 per cent to 50.01 per cent during this period.

Thus, the monoculture of rice wheat crop rotation in several districts of Haryana particularly in areas with assured irrigation has led to over exploitation of natural resources, degradation in soil fertility and higher susceptibility of crops to the attack of various insects, pests and diseases. Moreover, profitability from these crops has almost stagnated due to stagnating yields and rising input costs including human labour. In such circumstances, crop diversification towards coarse cereals, pulses, oilseeds, fruits, vegetables and commercial crops is being advocated as a future strategy in order to improve income of the farmers and to save natural resources from further degradation. In this backdrop, diversification from paddy to alternative/competing crops in kharif season in Haryana assumes special significance and this study is planned to address these concerns.

1.2 Need for the Study:

Before analyzing need for the study, it would be useful to review recent literature on crop diversification to understand the issues related to the theme.

The available literature on crop diversification comprises two sets of studies. First, macro studies at the national, state and district levels based on secondary data, (Bhatia,1965; Pingali,1995; Joshi et al ,2004; Raga et al,2005; Bhattacharyya,2008; Jha et al,2009; Chakrabarti and Kundu 2009; Kalaiselvi,2012; Das and Mili,2012; Pal and Kar,2012; Sharma and Mohan,2013; Pinki et al,2013; Singh et al.,2013; Reddy, 2013 and Saha, 2013) and second, micro studies based on primary data collected by the researchers through field surveys. (Blank, 1990; Ashfaq et al, 2008 and Lin, 2011). Now, we present a brief review of these studies.

Bhatia (1965)[1] analyzed crop pattern of India on a regional basis with a view to bringing out real concentration and diversification of crops on the basis of secondary data. The regional character of crop distribution was determined by comparing proportion of sown area under different crops and ranking them. Second,

[1] Bhatia, S.S. (1965). Pattern of crop concentration and diversification in India, *Economic Geographer*, 41(1): 39-56p.

author compared crop density in each of the component at regional level with the corresponding density for the country as a whole.

Pinagli and Rosegrant (1995)[2] studied agricultural commercialization and diversification through gradual replacement of integrated farming systems by specialized enterprises for crops, livestock, and aquaculture products. Changes in product mix and input use are determined largely by the market forces during this transition. Commercialization of agricultural production is an endogenous process and is accompanied by economic growth, urbanization and withdrawal of labor from the agricultural sector. This paper provides a selective overview and synthesis of the issues involved in the commercialization and diversification process of agriculture. Based on an assessment of the process observed in selected countries, findings show that the commercialization process should not be expected to be a frictionless process as significant equity and environmental consequences may occur at least in the short to medium term, particularly when inappropriate policies are followed. Findings highlight that appropriate government policies including investment in rural infrastructure and crop improvement, research and extension, establishment of secure rights to land and water development and liberalization of capital markets can help alleviate many of the possible adverse transitional consequences.

Joshi et al. (2004)[3] analyzed the emerging concerns about the viability of small farm agriculture, particularly in the context of on-going process of globalization. It is contended that viability of small farms can be improved through diversification of agriculture towards higher-value crops like fruits and vegetables. The study has assessed the impact of diversification of agriculture towards vegetables on farm income and employment using household level information from the state of Uttar Pradesh. The results clearly reveal that vegetable production is more profitable and labor-intensive therefore, it fits well in the small farm production systems. The smallholders are relatively more efficient in production and own more family labor in contrast to large farmers. Vegetable production is the emerging sector in agricultural

[2] Pinagli, P.L. and Rosegrant, M.W. (1995). Agricultural commercialization and diversification: Process and policies. *Food Policy,* 20 (3):171-185p

[3]Joshi, P.K; Joshi, Laxmi and Birthal, Pratap S. (2004). Agriculture diversification in South Asia: Patterns, determinants and policy implications. *Economic and Political Weekly*, 39 (24): 2457-2467.

diversification that would augment income of smallholders and generate employment opportunities in rural areas. Women are also benefited as the vegetable production engages relatively higher women labor in various operations. However, prevailing constraints do not allow smallholders to explore the emerging opportunities in vegetable production. Major constraints in vegetable production are lack of assured markets and a well-developed seed sector. Since, vegetables are perishable in nature, lack of efficient marketing system and appropriate infrastructure is extremely important.

Elzaki et al. (2005-06)[4] in their study "Comparative Advantage Analysis of the Crops Production in the Agricultural Farming Systems in Sudan" state that most of the rural people in developing countries are highly dependent on resource-based subsistence economies using products obtained from plants and animals. The study proposed to assess the efficiency and sustainability of the domestic resources and tradable inputs for crop production in the dominating farming systems, to analyze the comparative advantage and protection of major agricultural crops. The study was conducted in irrigated, traditional and mechanized rain fed farming systems and applied linear programming (Policy Analysis Matrix) to determine competitiveness and policy effects of crop production in the farming systems in Sudan. The primary data were collected through the field survey using questionnaire. Findings suggest that agriculture remains as the main source of livelihood of the rural people in the surveyed farms as more than half of the population derives their livelihood from land. Majority of the rural households in traditional farms (78.4%) were fully occupied with their tenancies (had no off-farm occupation).The results further indicate that farmers owned agricultural land but lack appropriate technology and removal of subsides from the production inputs (e.g. from fertilizer) would escalate cost. Most of land is not occupied efficiently to satisfy the needs of rural households. Sorghum crop did not appear in the optimal farm plan despite the fact that it is the main food staple in the farms, particularly in the irrigated farms. The groundnut crop also disappeared from the irrigated and traditional farms, while in the mechanized farms, it was the

[4] Elzaki, Raga Mohamed et al. (2005-06). Comparative advantage analysis of the crops production in the agricultural farming systems in Sudan, 1-12p.

only crop that appeared at optimal solution and its area has increased in the optimal solution. The optimal crop plan in the mechanized, irrigated and traditional farms are groundnut, vegetables and watermelon crops, respectively. There are significant differences in the degree of policy transfer for crops across farms. The government policies on main crops and self-sufficiency lead to allocation inefficiency.

Bhattacharyya (2008)[5] examines crop diversification as a search for an alternative source of income for farmers in the state of West Bengal in India to meet the challenges of a globalizing market in agriculture as well as growing and changing needs of the population. Many countries in South East Asia have undertaken crop diversification to enhance productivity and cultivate high value crops with positive outcomes. These countries are gradually diversifying their crop sector in favor of high value commodities, especially fruits, vegetables and spices. Diversification is taking place either through area augmentation or by crop substitution. If carried out appropriately, diversification can be used as a tool to augment farm income. The study covers a period of eight years from 1997-98 to 2004-05. There are two obvious reasons for choosing this period. First, whatever diversification has taken place, it has occurred during the late nineties and second, availability of meaningful data from reliable sources regarding the high value crops. It was hypothesized that gradual slowing down of the green revolution in terms of yield levels of cereals and opening up of the economy are paving way for diversification, employment generation, alleviate poverty, water resources and conserve precious soil. Studies by Pingali and Rosegrant (1995), and Ramesh Chand (1996) support this positive impact of diversification. The nature of crop diversification is first examined through changes in allocation of land for cultivation of different crops grown over the years. Different diversity indices have been used to measure the degree of diversification taking place in the state. Inter-crop variation in output is also considered for the period under consideration. Compound growth rates of area under high value crops are also calculated to show the trends in diversification. Diversification index is calculated for the state as well as for the districts. Diversification may be broadly

[5] Bhattacharyya, R. (2008). Crop diversification: A search for an alternative income of the farmers in the state of West Bengal in India. *International Conference on Applied Economics,* p.83-93.

defined as a shift of resources from the low value agriculture to high value agriculture as indicated by Hayami and Otsuka (1992), Vyas (1996). It can also be considered as a shift of resources from farm and non-farm activities or simply a larger mix of diverse and complementary activities within agriculture. There are different methods of measuring diversification. The study reveals that fruits and vegetables have shown good performance during the period under consideration. Though, share of area under fruits is relatively low in the state as compared to the major crops, an increasing trend is observed in area allocation under most of the fruit crops. Of the fruit crops grown in West Bengal, mango accounted for bulk of the total area (36.57 per cent) under fruit crops followed by banana (17.46 per cent), other fruits (11.3 per cent) and Jackfruit (8.4 per cent). The maximum area under mango is in Malda district followed by Murshidabad district. Nadia followed by Hooghly is the largest producer of banana. The share of area has gone up considerably in case of most of the fruits like other fruit groups (455 per cent), orange and citrus fruits (196 per cent), banana (86 per cent), guava (78 per cent) and jackfruit (68 per cent). Production of fruits also has shown a remarkable increase during this period. In case of sapota, litchi and jackfruit, increase in production has been tremendous amounting to 393, 266 and 216 per cent respectively. The results of the study show that agricultural sector in West Bengal is gradually diversifying towards high value commodities such as fruits, vegetables and flowers. Detail investigations reveal that most of the diversification has come through individual efforts of the small farmers with little support from the government. It is because food security issues are still critical in the state as well as in the country and government policy is still obsessed with self sufficiency in cereals. However, speed of diversification in West Bengal is rather slow and is much less than that of the country as a whole. Moreover, diversification is not evenly distributed over the districts. While some of the districts are picking up diversification quite rapidly, others are lagging behind. Vegetable cultivation is eco-friendly and uses less water than cereals, especially paddy, necessitating withdrawal of less amount of ground water from wells and tube-wells and thus, helps in conservation of ground water. It may be noted that widespread cultivation of summer *paddy (boro)* has now resulted in reduction of water table and consequent non-availability of ground water for irrigation and even for drinking in many areas. If diversification can be efficiently managed to reduce risk and augment income of the small farmers, environmental degradation may be checked to a certain extent

Jha et al. (2009)[6] in their study discuss factors responsible for agricultural diversification at different levels: country (India), state (Haryana) and farms of Kurukshetra district in Haryana. The study used alternate measures of diversification namely, the Simpson index and concentration of non-food crops on several possible factors such as income, land distribution, irrigation intensity, institutional credit, road density, urbanization and market penetration. The determinants of resource diversification have been studied at the macro and micro-levels. At macro-level, resource diversification has been studied for the country and the states. Subsequently, one of the progressive states, Haryana has been chosen purposively to study diversification at the regional level, which is referred as diversification at mesa level. The state of Haryana as compared to many other states is relatively uniform and it would be easy to understand the role of various factors in agricultural diversification. Average farms have subsequently been chosen to study diversification at the micro- level. The authors use different type of regression models to analyze the factors responsible for diversification. The regression results suggest that increased road density, urbanization, encouraged commercialization of agriculture in a region boost specialization of some crops and crop-groups as per the resource, infrastructure and institutions of the region. The country-level analysis of regression with the Simpson Index often goes against the established findings on determinants of agricultural diversification in the country. The regression results with diversification indices are clear at the state-level. A negative relationship of alternate measures of diversification with irrigation intensity reveals that an increase in irrigation is leading to specialization under paddy and wheat crops. This process is strengthened with the penetration of the regulated markets. During the last decade, urbanization has emerged as an important factor which has a positive effect on agricultural diversification. Farm level diversification suggests that small farms are less diversified in Kurukshetra district of Haryana. Interestingly, diversification with crops is increasing risk in the farm portfolio whereas; diversification with livestock reduces risk in farm income.

[6] Jha, B; Tripathi, A and Mohant, B. (2009). Drivers of agricultural diversification in India, Haryana and the greenbelt farms of India, *Working Paper Series,* No. E/303/2009, Institute of Economic Growth, University of Delhi Enclave.

Chakrabarti and Kundu (2009)[7] attempted to examine the rural non-farm economy and impact of crop diversification in India. Results show that crop diversification under the integral institutional set up of contract farming, processing, packaging and retailing may display the petty manufacturing and services that mattered over the years in different parts of rural India as constituent of an endogenous process driven by agricultural growth and changing land relations. The authors show that sectoral policies such as crop diversification in agricultural land, conversion of land for industrialization should not be formulated in isolation. Such policies should particularly take into account the corresponding impact in the case of rural labor and intensive non-farm sector which is accepted as a dynamic segment of the economy having employment generation potential. They further argue that policies of crop diversification to raise farm income and land conversion for rapid industrial progress should form part of a more comprehensive broader project encompassing all major sectors of the economy. It can socially benefit when it is complimented with intensive infrastructural facilities, financial and technological support, etc, especially for the localized micro (labor-intensive) enterprises engaged in processing, storing and packaging.

Kalaiselvi (2012)[8] in his paper has evaluated crop diversification in India. The paper based on secondary sources of data has tried to assess crop diversification in the Indian perspective. The author concludes that India with wide variations in agro-climatic conditions being a vast country of continental dimension presents excellent opportunities for crop diversification. Such variations lead to the evolution of regional niches for various crops. Historically, regions were associated with dominant crops in which they specialized due to agronomic, climatic, hydro-geological and historical reasons. But, with technological change encompassing bio-chemical and irrigation technologies in the sixties, agronomic niches have undergone significant changes. Results show that there is a mixed scenario regarding the typology of diversification within the states. Some states exhibit more diversification, while others lack it. The pattern is completely diverse across India.

[7] Chakrabarti, S. and Kundu, A. (2009). Rural Non-farm Economy: A note on the impact of crop diversification and hand conversing in India. *Economic and Political Weekly*, 44(12):.69-75.

[8] Kalaiselvi, V. (2012). Patterns of crop diversification in Indian scenario. *Annals of Biological Research,* 3 (4): 1914-1918p.

Recently, Das and Mili (2012)[9] conducted a study of Dibrugarh district in Assam to analyze the pattern of crop diversification and nature of changes in cropping pattern for the period 1999-2000 to 2009-10 by using secondary data. Gibb's and Martin Index of crop diversification were computed to fulfill the objectives. They observed that crop diversification is slow in Dibrugarh district. Findings suggest that crop diversification was above 62.9 per cent for large farmers with higher cropped area while this ratio was only 37.04 per cent in the medium category and there was no diversification in the lower category of farmers. But, crop diversification has declined in case of large category and reached to 16.43 percent in the year 2009-10 while it has increased in the case of medium category and reached to 70.84 per cent during the same year. It is worth noting that index for the lower category of farmers has increased in 2009-10 which was zero in 1999-2000. The authors conclude that diversification index for the year 2009-10 in comparison to 1999-2000 exhibits a declining trend which is indicative of poor crop diversification.

In order to analyze different measures of crop diversification, Pal and Kar (2012)[10] conducted a study of Malda district in West Bengal and compared district and state level diversification for the period 2001 to 2008. The authors used different methods to measure extent of crop diversification. Results show that there is hardly any change in the number of crops cultivated by the farmers except tea in a few northern districts of West Bengal. Moreover, under aman and boro paddy, potato and mustard together increased from 64% of GCA in 1970-73 to 77 % in 2002-2005 despite some inter-district variations, owing to important factors such as use of chemical fertilizer and irrigation. Findings show that blocks with urban or rural urban tendencies registered higher level of crop diversification. Most of the poor farmers are still addicted to mono cropping.

[9] Das, Beejata and Mili, Nitashree. (2012). Pattern of crop diversification and disparities in agriculture: A case study of Dibrugarh district, Assam (India). *Journal of humanities and Social Science,* 6(2): 37-40p

[10] Pal, S. and Kar, S. (2012). Implication of the methods of agricultural diversification in reference with Malda district: Drawback and rationale. *International Journal of Food, Agriculture and Veterinary Sciences*, l2 (2): 97-105.

Sharma and Mohan (2013)[11] conducted a study to find out growth and challenges of diversification of agricultural sector in the state of Punjab. The study based on secondary data has covered a time period of 1970-71 to 2010-11. The study has evaluated major indicators of diversification and provided alternative diversification strategy for the economy. Findings show that Green Revolution was limited in its impact in terms of crops, regions and farmers. At present, agricultural sector of the state is passing through severe economic crisis. Currently, slowing down of agricultural growth, paddy-wheat monoculture, over exploitation of natural resources, increasing debt burden of the farmers, rapidly rising labor force, declining land man ratio, higher use of fertilizers and pesticides, steep rise in land prices, inadequate financial facilities, poor human capital formation, increasing income inequalities, etc. are the major issues creeping in the agricultural economy of the state. Looking at the crisis, authors suggest immediate need to diversify economy of the state instead of advocating only crop diversification.

A study based on secondary data from 2007 to 2010 by Pinki et al. (2013)[12] examined spatial pattern of crop diversification by dividing Haryana state into three parts which consist of districts with high diversification, districts with medium diversification and districts with low diversification. They point out that higher crop diversification was found in western part of Haryana, medium crop diversification in northern and southern parts of the state while eastern part of the state showed low crop diversification. The districts with wheat paddy rotation in cropping systems are facing the problems of soil degradation and declining crop yield per unit of land. These districts require immediate attention for achieving a high degree of crop diversification.

Singh et al. (2013)[13] also made an attempt to analyze crop diversification in the state of Punjab. The study was based on time series data for the period 1980-81

[11] Sharma, N and Mohan, H. (2013). Diversification of agriculture sector in Punjab: Growth and challenges. *Agricultural Situation in India,* 69(11):21-31.

[12] Pinki; Lekha, Harsh and Rana, Sandeep. (2013). Pattern of crop diversification in Haryana. *Research Journal of Humanities and Social Sciences,* 4(3): 405-409p.

[13] Singh, Jaspal; Yadav, H.S. and Singh, Nirmal. (2013). Crop diversification in Punjab agriculture: A temporal analysis. *Journal of Environmental Science, Computer Science and Engineering & Technology*, 2(2): 200-205p.

to 2008-09. The authors used various concentration indices i.e., Herfindahl and Entropy to work out agricultural diversification. Findings reveal that cultivation of crops is determined by a set of indices like technology, market forces, government policies, climate and global factors. These factors directly and indirectly impact cropping pattern in a region. Although, growth rate of agricultural production and yield have decelerated, there is hardly any major diversification in cropping pattern since 1981-82. The authors conclude that Punjab agriculture is moving towards specialization of crops primarily, paddy and wheat in most of the districts except American cotton in Malwa region, sugarcane and moong in Gurdashpur, Jalandhar, Kapurthala and Hoshiarpur districts. Findings suggest that there is a need to shift production profile. A farmer needs to diversify crop pattern in favor of crops such as soybean, maize, fruits and vegetables. Developing dairy sector to produce milk and milk products for urban centers of north India is additional method of diversification in the crop base of Punjab. Also, establishing processing plants for vegetables, fruits, dairy and poultry products are efficient methods of diversifying the agricultural base. For achieving the objectives of crop diversification and agro –industrialization, building a golden triangle with farmers, agro-industry and banker as the corner of the triangle appear to be a pragmatic policy.

Reddy (2013)[14] conducted an important study to examine agricultural growth and crop diversification towards pulses, oilseeds and other high value crops in the state of Orissa. The study used secondary data and covered a time period from 1971 to 2008 which is divided into two sub-periods i.e. pre-liberalization and post liberalization period. The author used the Battese and Coelli (1995) stochastic production function model. In particular, production of pulses seems to have stagnated in the state during this period. Results show dominance and increased importance of paddy in the state. However, productivity of paddy is still low and increased at a slow rate, while productivity of pulses and oilseeds declined during the same period. The author concludes that cost of production of pulses, oilseeds and other crops are low as compared to paddy, hence net returns per hectare to the economy and to the farmers are higher compared to paddy. He suggests that it is

[14] Reddy, A.Amarender. (2013) Agricultural productivity growth in Orissa, India crop diversification to pulses, oilseeds and other high value crops. *African Journal of Agricultural Research*, 8 (19): 2272-2284p.

necessary to improve infrastructure, services and human capital for crop diversification.

Saha (2013)[15] examined crop diversification in Indian agriculture with special reference to emerging crops. The author used secondary data to explore the levels and trends of crop diversification and identify major emerging crops. The study has covered a time period of 1990-91 to 2008-2009. Results show that crop diversification is taking place gradually and most of states are associated with this process. Although, dependence on food crops persists, commercial and horticultural crops are emerging as a fast alternative. The study has found that leading states like Rajasthan, Gujarat, Maharashtra and Karnataka are setting examples for other states and defining strategy through which diversification and self sufficiency could be achieved in crop sector.

Blank (1990)[16] analyzed returns from limited crop diversification in terms of absolute risk levels and the number of crops included in a portfolio. These are expected to be similar to those for stock market portfolios. Risk is reduced significantly at first as additional securities are added to a one-product portfolio, but the rate of decline in risk levels declines as the portfolio grows. In other words, possible risk reduction is achieved by including a few products in a portfolio. Data used in the study are annual observations reported by country extension staff for every product grown in the region. The study suggests that a new SIM application approach which enables growers or extension personnel to more accurately assess the returns/risk tradeoff among crop portfolios should be adopted. A new performance measure is derived from the SIM in ranking crop portfolios based on that tradeoff. It is shown that the new performance measure and its application can be a useful addition to, or substitute for, more complicated methods. This method also adds in avoiding data sensitivity problems of both Quadratic Programming (QP)

[15] Saha, Joydeep. (2013). Crop diversification in Indian agriculture with special reference to emerging crops. *Transaction,* 35(1): 139-147p

[16] Blank, Steven C. (1990). Returns to limited crop diversification. *Western Journal of Agricultural Economics,* 15(02):204-212p.

and standard SIM procedures. In particular, using betas for portfolios, rather than for crops, may give more accurate results while establishing rankings. Crop betas vary through time, but betas become increasingly stable for more diversified portfolios. The betas became stationary for portfolios with at least four crops. It is further shown that the new index derived in this study is superior to the standard Treynor-Black appraisal ratio in ranking crop portfolios. Performance measures from the finance literature, such as the Treynor-Black ratio, are likely to fail when evaluating agricultural markets because they are based on the assumption that portfolios will be composed of a small percentage of the assets in a market. To apply the SIM in agriculture, small regions must be used as the market proxy to produce results relevant to individual decision makers. This means that actual crop rotations may include a high percentage of enterprises in the market proxy.

Ashfaq et al. (2008)[17] tried to understand factors impacting farm diversification in rice-wheat in Pakistan. The study is based on the primary data collected from two districts of Punjab comprising 200 farm households and used multiple regression analysis to examine the factors which directly affect crop diversification in wheat paddy. Results show that holding size is positively related to diversification. The referred diversification is more common among the large farmers. The coefficient of age of the farmers was negative and insignificant. Findings further show that education and experience are positively and significantly related to diversification while off-farm income does not show any impact on diversification. However, distance from main road is negatively and significantly related to crop diversification. The authors suggest that cooperative groups based on the self help principle, infrastructure like roads and access to market should be enhanced for farm diversification.

Lin (2011) [18] in her study "Resilience in agriculture through Crop Diversification: Adaptive Management for Environmental Change" has recognized

[17] Ashfaq, M. et al. (2008). Factor affecting farm diversification in rice-wheat Pakistan. *Journal of Agricultural Science*, 45 (3):91-94.

[18] Lin, Brenda B. (2011). Resilience in agriculture through crop diver resilience in agriculture. *BioSciences,* 61(3):183-193.

that climate change may have negative consequences for agricultural production unless resilience is built into agricultural systems. One rational and cost-effective solution could be implementation of increased agricultural crop diversification. Although, idea of building resilience has been studied in a broad range of ecosystems from coral reefs to forests, it is not studied well for the agro- ecosystems which are important for the survival of human society. The development of resilient agricultural systems is essential because societies greatly depend on the provisioning through agriculture (food, fodder, and fuel) for their livelihoods. Several agriculture based economies have a few other livelihood strategies and small family farms have little capital to invest in expensive adaptation strategies, which increase vulnerability of rural agricultural communities to a changing environment. Recent evidences suggest that climate change will affect both biotic (pest, pathogens) and abiotic (solar radiation, water, temperature) factors in crop systems, threatening crop sustainability and production. More diverse agro-ecosystems with a broader range of traits and functions will be better able to perform under changing environmental condition which is important given the expected changes in biotic and abiotic conditions. It is clear that farmers are facing growing stress from climate change. The greater implementation of diversified agricultural systems may be a productive way to build resilience into agricultural systems. The challenges in increasing adoption of diversified agricultural management strategies are both scientific and policy based. In the scientific realm, the adoption of diversified agricultural systems could be bolstered if farmers had a better idea of how to optimize a diversified structure to maximize production and profits. Crop and landscape simulation models that can model a range of climate scenarios and landscape modeling with farm profitability scenarios would help farmers find optimal strategies for maintaining production and profit. Stakeholder-based participatory research would also be highly beneficial as researchers could model strategies that seem plausible to farmers. Diversified farming strategies are supported by international research efforts, including the International Assessment on Agricultural Knowledge, Science and Technology for Development, a global report of more than 400 scientists that concluded that locally adapted seed and ecological farming can better address the

complexities of climate change, hunger, poverty and productive demands on agriculture in the developing world.

To sum up, all the reviewed studies deal with crop diversification and indicate that crop diversification is continuing over time and most of the states are associated with this phenomenon.

Although, dependence on food crops persists, importance of commercial and horticultural crops is emerging fast. The analyses show that leading states in terms of crop diversification such as Rajasthan, Gujarat, Maharashtra and Karnataka are paving way for other states by achieving diversity and self sufficiency both in the crop sector. The leading green revolution states such as Punjab and Haryana are showing a fatigue in crop sector due to paddy wheat dominance, over exploitation of natural resources, increased burden of debt for the farmers, rapidly rising labor force, declining land man ratio, higher use of fertilizer & pesticides, increasing income inequality. These are the major issues creeping in these states.

Some of the studies analyzed factors affecting crop diversification and concluded that there is a strong correlation between factors like education, distance from main road, distance from nearest city/town, infrastructure, machinery and crop diversification. However, other studies indicate that size of land holding is the main factor which is responsible for crop diversification. In particular, large land size provides farmer an alternative to produce different crops at the same time.

A number of studies have been conducted in India on methodological issues for estimating crop diversification, but most of these studies are either based on secondary data available from different sources for depicting macro scenario at the state and national level. These studies do not provide breakup of household data by socio-economic characteristics such as size of operational holdings. Majority of available micro studies on crop diversification in different strata of households ignored in-depth analysis. Literature based on in depth village studies at the micro level is limited to some states and therefore, there is an urgent need to conduct in-depth micro level studies. Such studies provide important insight that cannot be derived from secondary data based studies due to availability of limited information. The present study aims to address some of the deficiencies in the earlier literature on the subject and will be useful to frame future policy initiatives.

1.3 Objectives of the Study:

Food security, nutritional security, sustainability and profitability are the main focus of present and future agricultural development. The crop rotation of rice-wheat largely adopted in irrigated areas of Haryana has posed serious challenges in future for sustainability of agriculture in the state. Crop diversification through adopting alternative crops and cropping systems could improve productivity and also the agro-eco-systems of the region. Further, irrigation requirements of the area could be reduced through adoption of alternate cropping systems, thereby reducing pressure on depleting water table. In addition, alternate cropping systems based on cash crops/high value crops will help in reducing production risk in mono-cropping and will raise income of the farmers. This study aims to analyze issues related to crop diversification from paddy to alternative/competing crops in kharif season in Haryana.

The specific objectives of the study are as under:

i) To examine the production and procurement pattern of paddy in Haryana.
ii) To workout the relative economics of paddy vis-à-vis alternative crops.
iii) To bring out the constraints in adoption of alternative crops.
iv) To suggest policy measures to overcome the constraints in adoption of alternative crops to paddy in Haryana.

1.4 Study Design and Methodology:

This study is conducted in the state of Haryana. It is based on published and un-published sources of secondary and primary data. The relevant information about the state and districts was obtained from various issues of the Statistical Abstract of Haryana, Government of Haryana, Panchkula. Further, the time series data on area, production and yield of paddy and alternative/competing crops for selected districts and state were also culled out from this source. The required preliminary information regarding the selection of blocks and villages was obtained from the district officials. The meetings with the Deputy Director of Agriculture of selected districts were useful and informative. The crops for the study were decided as per the study design provided by the coordinator.

The scope of the study is confined to kharif crops i.e. paddy and alternative/competing crops such as bajra, maize and cotton grown by the farmers in Haryana. Six districts namely, Panchkula, Sonepat, Faridabad, Palwal, Jind and Fatehabad with diversification of crops in kharif season were selected for in-depth study. The selection of respondents is based on multistage sampling design. At the first and second stages, paddy and alternative crops producing districts and blocks in these districts were selected. At the third stage, villages were selected on the same criterion. A questionnaire was canvassed to the farmers growing these crops. All farm size categories i.e. small, medium and large were covered in the sample (for details see appendix-1). The number of farm households in each category was decided according to their proportion at the district level. The primary data pertaining to the year 2012-13 were collected from 210 farmers.

Analytical Framework

The methodology followed for each aspect is different. For measuring the state and district level growth rates of area, production and yield of paddy and alternative crops for the period 1970-71 to latest available period, following semi-log equation was used

$$\textbf{Log } y = a + bt$$

Where,

y= area/production/yield of the crop

a= intercept

b= slope

t= time

The entire time period for computation of compound growth rates of area, production and yield of various crops is divided into three sub-periods i.e. 1970-71 to 1984-85; 1985-86 to 1999-2000 and 2000-01 to 2011-12. Finally, growth rates were computed for the entire period from 1970-71 to 2011-12.

In Haryana, paddy is the dominant crop during the kharif season. The alternative crops could be bajra, maize and cotton. Although, yield rates of bajra and cotton in the state are second highest in the country, farmers prefer to grow paddy due to higher yields, assured market and net returns. They often use inputs especially irrigation, fertilizer and pesticides indiscriminately in cultivation of paddy due to lack

of knowledge about optimal use. The over use of these resources is resulting in depleting water table and environmental problems in addition to escalated cost of cultivation. In order to save precious resources and environment, it is imperative to analyze resource use efficiency of paddy and alternate crops grown by the sampled farmers in Haryana.

We have used Cobb-Douglas type of yield function to assess the resource use efficiency. This function is widely used in agricultural research and is convenient for the comparison of elasticity coefficients. In order to determine resource use efficiency of major inputs, a double log regression model of the following form was used.

$$y = ax_1^{b1}.x_2^{b2}.x_3^{b3}.x_4^{b4}.x_5^{b5} + u$$

$$\log y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + u$$

Where,

y = Yield of the crop (qtls/ha.)

a = Intercept

x_1 = Human labor (days/ha.)

x_2 = Machine labor (hrs/ha.)

x_3 = Seed (Kg/ha)

x_4 = Fertilizer (Kg./ha.)

x_5 = Irrigation (hrs./ha.)

b_1 - b_5 are regression coefficients

u = Random Error.

The estimated coefficients of the considered independent variables were used to compute the Marginal Value Productivity (MVP) and Marginal Factor Cost (MFC). The resource use efficiency could be judged on the basis of marginal value productivity (MVP), which indicates the increase in the productivity from the use of an additional unit of a given input while keeping the level of other inputs constant. The marginal value productivity (MVP) of the i^{th} input was measured by using the following formula:

$$MVP = bi\ (Y/Xi)\ Py$$

Where Y= Average yield of the crop per hectare at geometric mean level of all inputs.

Xi= Geometric mean level of i^{th} resource,

bi= Production elasticity of i^{th} input,

Py= Unit Price of the product.

Resource use efficiency was measured by comparing the MVP of each resource with corresponding marginal factor cost (MFC) by sampled farmers.

1.5 Organization of the Study

The study is divided into seven chapters. Chapter-1 is introductory and presents an overview of agriculture in Haryana, objectives of the study, literature survey, research methodology and organization of the study. Chapter-2 deals with production status of major kharif crops in Haryana and selected districts. Chapter-3 deals with the main features of selected districts of Haryana. Chapter-4 is devoted to the analysis of socio-economic characteristics of sampled households. Chapter-5 presents empirical results on economics of production of paddy vis-à-vis alternative crops on the basis of field evidence. In addition, we have also gauged into resource use efficiency. Chapter-6 is devoted to the constraint analyses of various alternative crops. The final chapter presents summary and conclusions of the study.

Chapter-2

Production Status of Major Kharif Crops in Haryana

After presenting research methodology adopted for the selection of study area, sampling design, data collection and analytical framework used in the light of specific objectives of the study in Chapter-1, the status of kharif crops grown in Haryana and sampled districts in terms of area, production and yield for the period 1970-71 to 2011-12 is discussed in this chapter which is divided into two sections. One section is devoted to each aspect.

Section-1

State Level Scenario

Area, Production and Productivity of Major Kharif crops in Haryana:

The agricultural economy of Haryana is dominated by food grains. Of these, wheat, paddy and bajra are the major food grains grown in the state. The share of Haryana in all India production of wheat, paddy and bajra was 12.69, 4 and 11.48 per cent respectively during the year 2011-12. After the adoption of new agricultural technology in mid sixties supported by adequate policies, Haryana has emerged as one of the major food grains producing states in the country. Haryana has been contributing significantly to the food basket of the country. As a result, contribution of Haryana in procurement of wheat and paddy for the Public Distribution System (PDS) was 24.45 and 5.73 per cent respectively during 2011-12.

Dominance of wheat and paddy rotation in the crop pattern of Haryana has started creating problems such as soil degradation. Significantly; water table is receding with each passing year due to over exploitation of water. Both these crops are input intensive and therefore, cause imbalance in nutritional structure of soil and pollute the underground water. To overcome these problems, crop diversification can play an important role through diversifying land use pattern.

Diverse agro-climatic conditions of the state are conducive for cultivation of alternate rabi and kharif crops including horticultural crops such as vegetables. Since, one third of the state territory falls within the geographical coverage of the National Capital Region, there is a tremendous scope for commercial cultivation of

vegetable crops, fruits, flowers, etc. In addition, establishment of agro-processing industries has a good potential. Especially, owing to its proximity to Delhi, there is vast potential for processing of fruits and vegetables.

Table 2.1 indicates percentage of gross cropped area devoted to different crops in a region during an agricultural year. The agro-climatic variations in Haryana are large and hence, state is bestowed with a variety of crops. In dry areas of Bhiwani, oilseeds and pulses dominate the crop pattern while in Karnal wheat and paddy are the main crops. Wheat (27.07 Per cent) followed by bajra (15.92 per cent), gram (12.19 per cent) and rice (8.86 per cent) were the principal crops of the state during 1980-81 (Table 2.1). In addition, cotton was also grown on almost 6 percentage points of gross cropped area. The fact remains that crop pattern in Haryana was dominated by food grains, which occupied 72.54 per cent of GCA in 1980-81. The share of food grains dropped to 70.60 per cent in 2011-12. The proportion of area under wheat and rice increased while bajra has indicated a decline of around 7 per cent. It appeared that traditional crops like pulses lost heavily while wheat and rice gained significantly. Pulses lost area by almost 13 per cent between 1980-81 and 2011-12. This shift could be attributed to expanding irrigation facilities in Haryana. After harvesting wheat and paddy, other crops are generally sown as pure crop or mixed crops. The land unsuitable for main crops is often devoted to other crops. Information presented in Table 2.1 suggests that main crops occupy major share of area and rest of GCA is devoted to other crops.

Table: 2.1

Percentage of Gross Cropped Area under Important Crops in Haryana

Year	GCA* ('000 ha.)	Rice	Wheat	Bajra	Maize	Gram	Total Pulses	Other Food Grains	Total Food Grains	Mustard	Cotton	Other Crops
1980-81	5462	8.86	27.07	15.92	1.3	12.19	14.55	4.84	72.54	5.49	5.79	16.18
1990-91	5919	11.17	31.25	10.28	0.58	10.96	12.53	3.1	68.91	8.00	8.29	14.80
2000-01	6115	17.24	38.5	9.94	0.25	2.03	2.56	2.54	71.03	9.08	9.08	13.2
2011-12	6489	19.02	39.01	8.87	0.17	1.22	1.89	1.64	70.60	8.25	9.27	11.88

*Gross Cropped Area

Source: Director of Land Records, Haryana

Area, Production and Yield of Kharif Crops:

An examination of area under important crops in kharif season in Haryana during the triennium ending (TE) 1970-71 in Table 2.2 indicates that bajra was the dominant crop which occupied more than 50 per cent of total kharif acreage. In ranking, paddy and jowar were next and each one was allotted more than 10 per cent of total kharif acreage. In commercial crops, cotton received 11.53 per cent of total acreage. The pulses, though known for nitrogen fixing in the soil occupied merely 1.50 per cent of total kharif area in this period. In a nutshell, pattern of area allocation in kharif season during the TE 1970-71 in Haryana was found skewed towards bajra which requires minimum irrigation.

A further probe of area allocation under important crops in kharif season in TE 1985-86 in Haryana points out that acreage under kharif cereals declined between TE 1970-71 and 1985-86, whereas, share of cotton increased by almost 6 per cent. The area allocated to pulses became less than half despite their nutritional value for human and livestock. Among cereal crops, paddy gained significantly while jowar and bajra lost heavily. Thus, pattern of area allocation under important crops in kharif season in Haryana exhibited perceptible change between TE 1970-71 and 1985-86.

In the new millennium, paddy further gained in total area under kharif season and it reached to around 44 per cent in Haryana. The decline in acreage was visible in the case of bajra and jowar. The second crop which gained in acreage was cotton. These two crops (paddy and cotton) together covered around 66 per cent of total kharif acreage during TE 2000-01 in Haryana.

Recently, the acreage allocation under kharif crops in TE 2011-12 in Haryana indicates marginal change in acreage under paddy, whereas, cotton lost by almost 4 per cent. Maize, a multipurpose crop became almost negligible. However, bajra still occupied around 21 per cent of total kharif area. It is important to note that horticultural crops i.e., fruits and vegetables gained significantly but latter was an important beneficiary by indicating around 12 per cent of kharif area during TE 2011-12 in Haryana. This trend could be due to increasing demand for high value crops arising out of changes in consumption pattern of population.

Table: 2.2
Trends in Area under Major Kharif Crops in Haryana (TE 1970-71, TE 1985-86, TE 2000-01 and TE 2011-12)

('000 hectares)

Year	Paddy	Jowar	Bajra	Maize	Total Kharif Cereals	Mash	Moong	Total Kharif Pulses	Groundnut	Cotton	Total Area under kharif crops	Fruits	Vegetables	Total Area under kharif crops after including fruits and veg.
1968-69	229.00	208.00	874.00	88.00	1399.00	10.10	7.10	17.20	15.50	212.00	1643.70	NA	NA	
1969-70	240.80	231.10	930.70	111.20	1513.80	9.30	23.20	32.50	12.00	194.40	1752.70	NA	NA	
1970-71	269.20	207.30	879.60	114.40	1470.50	8.90	22.50	31.40	10.40	193.40	1705.70	NA	NA	
Avg	**246.33**	**215.47**	**894.77**	**104.53**	**1461.10**	**9.43**	**17.60**	**27.03**	**12.63**	**199.93**	1700.70	10.48*	23.55*	**1734.73**
Share in total area under Kharif Crops	**14.20 (14.48)**	**12.42 (12.67)**	**51.58 (52.61)**	**6.03 (6.15)**	**84.23 (85.91)**	**0.54 (0.55)**	**1.01 (1.03)**	**1.56 (1.59)**	**0.73 (0.74)**	**11.53 (11.76)**	**98.04 (100.00)**	**0.60**	**1.36**	**100.00**
1983-84	560.60	152.00	839.40	54.00	1606.00	7.50	7.50	15.00	7.10	405.30	2033.40	9.78	34.44	**2077.62**
1984-85	557.30	153.10	748.30	61.50	1520.20	5.80	5.70	11.50	8.40	294.60	1834.70	12.59	42.95	**1890.24**
1985-86	584.00	115.60	649.50	54.90	1404.00	5.80	4.20	10.00	10.40	344.10	1768.50	14.51	45.38	**1828.39**
Avg.	**567.30**	**140.23**	**745.73**	**56.80**	**1510.07**	**6.37**	**5.80**	**12.17**	**8.63**	**348.00**	1878.87	**12.29**	**40.92**	**1932.08**
Share in total area under Kharif Crops	**29.36 (30.19)**	**7.26 (7.46)**	**38.60 (39.69)**	**2.94 (3.02)**	**78.16 (80.37)**	**0.33 (0.34)**	**0.30 (0.31)**	**0.63 (0.65)**	**0.45 (0.46)**	**18.01 (18.52)**	**97.25 (100.00)**	**0.64**	**2.12**	**100.00**
1998-99	1086.00	130.00	613.00	20.00	1849.00	2.00	21.00	23.00	1.00	583.00	2456.00	11.83	54.99	**2522.82**
1999-00	1083.10	111.80	586.70	20.10	1801.70	4.20	9.90	14.10	0.70	543.70	2360.20	12.67	50.13	**2423.00**
2000-01	1054.30	109.40	608.30	15.40	1787.40	1.50	5.30	6.80	0.30	555.40	2349.90	11.98	46.88	**2408.76**
Avg.	**1074.47**	**117.07**	**602.67**	**18.50**	**1812.70**	**2.57**	**12.07**	**14.63**	**0.67**	**560.70**	2388.70	12.16	50.67	**2451.53**
Share in total area under Kharif Crops	**43.83 (44.98)**	**4.78 (4.90)**	**24.58 (25.23)**	**0.75 (0.77)**	**73.94 (75.89)**	**0.10 (0.11)**	**0.49 (0.51)**	**0.60 (0.61)**	**0.03 (0.03)**	**22.87 (23.47)**	**97.44 (100.00)**	**0.50**	**2.07**	**100.00**
2009-10	1206.40	77.70	583.80	12.20	1880.10	3.00	14.90	17.90	1.70	505.10	2404.80	41.50	300.90	**2747.20**
2010-11	1243.30	70.80	659.60	9.60	1983.30	1.40	26.00	27.40	2.30	493.30	2506.30	46.30	346.40	**2899.00**
2011-12	1234.10	64.70	576.20	11.00	1886.00	2.00	16.80	18.80	2.10	601.80	2508.70	47.00	356.80	**2912.50**
Avg.	**1227.93**	**71.07**	**606.53**	**10.93**	**1916.47**	**2.13**	**19.23**	**21.37**	**2.03**	**533.40**	2473.27	44.93	334.70	2852.90
Share in total area under Kharif Crops	**43.04 (49.65)**	**2.49 (2.87)**	**21.26 (24.52)**	**0.38 (0.44)**	**67.18 (77.49)**	**0.07 (0.09)**	**0.67 (0.78)**	**0.75 (0.86)**	**0.07 (0.08)**	**18.70 (21.57)**	**86.69 (100.00)**	**1.58**	**11.73**	**100.00**

Source: Various issues of Statistical Abstract of Haryana, Govt. of Haryana.

* Data for 1968-69 to 1970-71are not available, hence data for 1971-72 were used, NA: Not available, figures in parentheses are share in total kharif area excluding fruits and vegetables

To conclude, distribution of area under kharif crops in Haryana between TE 1970-71 and 2011-12 was favorable for paddy, cotton, fruits & vegetables. Bajra, Jowar, maize and pulses were observed as major losers after the spread of green revolution in the state.

After discussing changes in area allocated to important crops in kharif season in Haryana, we now analyze pattern of production of important kharif crops in TE 1970-71, 1985-86, 2000-01 and 2011-12. The pattern of production of important crops in kharif season in Haryana is depicted in Table 2.3. The maximum positive change in production could be noticed for paddy. The share of paddy increased from 32.65 per cent to 70.33 per cent between TE 1970-71 and 2011-12. Other cereal crops such as bajra, maize and jowar lost heavily in terms of proportion in total kharif production during this period. In case of bajra, it turned out less than 25 per cent. The share of total cereals with their declining proportion in kharif production does not show perceptible decline due to significant gains experienced by paddy. The proportion of pulses in total kharif production turned out almost negligible. Cotton emerged as second important crop which gained significantly and its share became 6.93 per cent in TE 2011-12 from 5.18 per cent in TE 1970-71. Thus, distribution of production across important crops in kharif season in Haryana followed the pattern of acreage allocation and that is why paddy and cotton experienced significant gains in their shares during this period.

Having analyzed acreage allocation and distribution of production of important crops in kharif season between TE 1970-71 and 2011-12, probe will be incomplete without considering changes in yield rates of important crops. Trends in yield rates depicted in Table 2.4 indicate that yield rates of each analyzed crop increased significantly during the study period except mash among pulses. However, bajra is the only crop which exhibited triple increase in productivity. It jumped from around 585 kg/ha in TE 1970-71 to 1808 kg/ha in TE 2011-12. The sub-periods of TE 2000-01 and 2011-12 were important since productivity increased from around 594kg/ha to 1809 kg/ha during this period. It could be due to easy availability of inputs and infrastructure.

Table 2.3
Trends in Production of Major Kharif Crops in Haryana (TE 1970-71, TE 1985-86, TE 2000-01 and TE 2011-12)

Year	Paddy	Jowar	Bajra	Maize	Total Cereals	Mash	Moong	Total Pulses	Groundnut	Cotton	Total prod. Of Kharif Crops
1968-69	272.00	25.00	232.00	67.00	596.00	3.20	2.30	5.50	9.40	57.32	668.22
1969-70	372.00	54.00	514.00	137.00	1077.00	3.80	9.50	13.30	9.60	57.73	1157.63
1970-71	460.00	57.00	826.00	130.00	1473.00	3.70	9.40	13.10	8.90	60.01	1555.01
Avg	**368.00**	**45.33**	**524.00**	**111.33**	**1048.67**	**3.57**	**7.07**	**10.63**	**9.30**	**58.36**	**1126.96**
Share in total prod. under Kharif Crops	**32.65**	**4.02**	**46.50**	**9.88**	**93.05**	**0.32**	**0.63**	**0.94**	**0.83**	**5.18**	**100.00**
1983-84	1332.00	20.00	552.00	63.00	1967.00	5.00	5.60	10.60	5.50	96.39	2079.49
1984-85	1363.00	44.00	478.00	80.00	1965.00	3.80	4.30	8.10	6.60	103.36	2083.06
1985-86	1633.00	28.00	315.00	64.00	2040.00	3.80	3.10	6.90	9.10	126.65	2182.65
Avg.	**1442.67**	**30.67**	**448.33**	**69.00**	**1990.67**	**4.20**	**4.33**	**8.53**	**7.07**	**108.80**	**2115.07**
Share in total prod. under Kharif Crops	**68.21**	**1.45**	**21.20**	**3.26**	**94.12**	**0.20**	**0.20**	**0.40**	**0.33**	**5.14**	**100.00**
1998-99	2432.00	25.00	618.00	39.00	3114.00	1.00	5.00	6.00	1.00	148.58	3269.58
1999-00	2583.00	22.00	582.00	48.00	3235.00	0.60	2.00	2.60	0.50	221.68	3459.78
2000-01	2695.00	23.00	656.00	34.00	3408.00	0.30	1.20	1.50	0.20	235.11	3644.81
Avg.	**2570.00**	**23.33**	**618.67**	**40.33**	**3252.33**	**0.63**	**2.73**	**3.37**	**0.57**	**201.79**	**3458.06**
Share in total prod. under Kharif Crops	**74.32**	**0.67**	**17.89**	**1.17**	**94.05**	**0.02**	**0.08**	**0.10**	**0.02**	**5.84**	**100.00**
2009-10	3628.00	39.00	930.00	26.00	4623.00	1.10	6.60	7.70	1.60	326.06	4958.36
2010-11	3465.20	38.00	1183.00	19.00	4705.20	0.50	11.90	12.40	2.40	296.99	5016.99
2011-12	3757.00	33.00	1175.00	30.00	4995.00	0.70	8.00	8.70	2.00	445.57	5451.27
Avg.	**3616.73**	**36.67**	**1096.00**	**25.00**	**4774.40**	**0.77**	**8.83**	**9.60**	**2.00**	**356.21**	**5142.21**
Share in total prod. under Kharif Crops	**70.33**	**0.71**	**21.31**	**0.49**	**92.85**	**0.01**	**0.17**	**0.19**	**0.04**	**6.93**	**100.00**

Source: Ibid

Table 2.4
Trends in Yield for Major Kharif Crops (TE 1970-71, TE 1985-86, TE 2000-01 and TE 2011-12)

(Kgs./ha.)

Year	Paddy	Jowar	Bajra	Maize	Total Kharif Cereals	Mash	Moong	Total Kharif Pulses	Groundnut	Cotton
1968-69	1188	120	265	761	426	317	324	320	606	270
1969-70	1545	234	552	1232	711	409	409	409	800	297
1970-71	1709	275	939	1136	1002	416	418	417	856	310
Avg.	**1480**	**210**	**586**	**1043**	**713**	**380**	**384**	**382**	**754**	**292**
1983-84	2376	132	658	1167	1225	667	747	707	775	238
1984-85	2446	287	639	1301	1293	655	754	704	786	351
1985-86	2796	242	485	1166	1453	655	738	690	875	368
Avg.	**2539**	**220**	**594**	**1211**	**1323**	**659**	**746**	**700**	**812**	**313**
1998-99	2239	192	1008	1950	1684	500	238	261	1000	255
1999-00	2385	197	992	2388	1796	143	202	184	714	408
2000-01	2556	210	1078	2208	1907	200	226	221	667	423
Avg.	**2393**	**200**	**1026**	**2182**	**1795**	**281**	**222**	**222**	**794**	**360**
2009-10	3007	502	1593	2131	2459	367	443	430	941	646
2010-11	2787	537	1794	1979	2372	357	458	453	1043	602
2011-12	3044	510	2039	2727	2648	350	476	463	952	740
Avg.	**2946**	**516**	**1809**	**2279**	**2493**	**358**	**459**	**449**	**979**	**668**

Source: Ibid

The yield rate of paddy, currently most important kharif crop in Haryana changed from 1408 kg/ha in TE 1970-71 to 2946 kg/ha in TE 2011-12. It was largely due to adoption of HYV seeds and availability of assured irrigation. Pulses and groundnut were least beneficiaries of productivity gain in this period. The productivity of cotton increased significantly during the above mentioned period. It jumped from around 1721 kg/ha in TE 1970-71 to 3898 kg/ha in TE 2011-12.

To conclude, monoculture of paddy has dominated in distribution of acreage and production of kharif season crops in Haryana during the above mentioned period. In addition, cotton also gained in area, production and yield during the study period.

Compound Growth Rates of Area, Production and Yield of Important Kharif Crops in Haryana:

After providing details of area, production and yield of important crops grown in kharif season in TE 1970-71, 1985-86, 2000-01 and 2011-12, it would be worthwhile to understand the annual growth of these indicators in the selected sub-periods and entire study period at the state level. Table 2.5 indicates that area under paddy cultivation has increased at the rate of 3.88 per cent per annum during the study period that is the maximum growth experienced by any of the kharif season crop in Haryana. Further, production of paddy has also exhibited an increase of 5.07 per cent per annum. This is contributed by expansion in acreage and growth in yield but former has played a much bigger role. Among the three sub-periods, first period was observed far more important in terms of area expansion and increase in yield in comparison to the remaining sub-periods. Unfortunately, growth in productivity of paddy became negative during the second sub– period (1985-86 to 1999-2000).

Like paddy, area, production and yield of cotton recorded an increase of 2.62, 4.25 and 1.58 per cent per annum during the study period. Clearly, area expansion has played more important role in comparison to yield. The growth of cotton production was found highest (7.46 per cent) between 2000-01 and 2011-12 due to remarkable increase in productivity that was recorded 8.62 per cent per annum. These results are encouraging. It seems that adoption of technology by farmers for cultivation of cotton during this period has played an important role and contributed to the growth.

Table: 2.5

Compound Annual Growth Rates of Area, Production and Yield of Kharif Crops in Haryana (1970-71 to 2011-12)

Crop	1970-71 to 1984-85			1985-86 to 1999-2000			2000-01 to 2011-12			overall, 1970-71 to 2011-12		
	Area	Prod.	yield	Area	Prod.	yield	Area	Prod.	Yield	Area	Prod.	Yield
Paddy	6.21	9.82	3.4	4.98	4.78	-0.18	2.29	3.54	1.22	3.88	5.07	1.14
Jowar	-3.14	-4.32	-1.23	-0.66	-1.31	-0.65	-4.38	6.13	10.99	-2.02	-0.74	1.3
Bajra	-1.17	-1.79	-0.62	-1.16	5.69	6.93	0.55	5.98	5.4	-1.32	2.17	3.54
Maize	-6.06	-6.38	-0.34	-6.64	-1.52	5.48	-6.9	-4.47	2.62	-6.9	-3.79	3.33
Total Kharif Cereals	0.2	3.84	3.63	1.71	4.52	2.76	1.25	3.98	2.69	0.56	3.67	3.08
Mash	-2.39	1.64	4.13	-3.05	-6.71	-3.78	0.32	8.22	7.88	-4.56	-6.2	-1.72
Moong	-9.28	-5.54	4.13	8.01	2.41	-5.19	5.54	16.21	10.1	2.26	0.44	-1.78
Total Kharif Pulses	-5.83	-2.15	3.9	4.33	-0.66	-4.78	4.89	15.32	9.94	0.01	-1.58	-1.59
Groundnut	-1.91	-2.23	-0.33	-12.44	-12.18	0.3	11.26	15.83	4.11	-5.76	-6.24	-0.5
Cotton	1.17	0.08	-1.08	3.94	3.19	-0.72	-1.07	7.46	8.62	2.62	4.25	1.58

Source: Ibid

The third crop with significant area expansion is moong but production of moong increased at the low rate of 0.44 per cent per year between 1970-71 and 2011-12. Among the sub-periods, performance in the first sub-period was found dismal while it was commendable during second and third sub-periods. The scenario of increase in acreage of coarse cereals i.e., jowar, bajra and maize is discouraging despite their nutritional value. However, production of bajra increased at the rate of 2.17 per cent per annum due to commendable growth of 3.53 per cent per annum in yield during this period. Among the losers, groundnut ranked at the top by indicating decline in growth of area, production and yield between 1970-71 and 2011-12.

Procurement Pattern of Paddy

In order to provide food security to billion plus population of the country and to encourage farmers, the government of India continues incentive schemes through procurement of food grains at the Minimum Support Price (MSP). As a result, production of wheat and paddy increased significantly between 1970-71 and 2013-14 due to assured market at MSP. Table 2.6 provides details of paddy procurement by different agencies in Haryana at three points of time 1991-92 to 2001- 2002 and 2011-12. At first point of time, rice millers followed by FCI and Hafed procured more than 90 per cent of total quantity.

Table-2.6

Procurement of Major Kharif Crop-Paddy by Different Agencies in Haryana (1991-92, 2001-02 & 2011-12)

Agency	1991-92		2001-02		2011-12	
	‘000Tonnes	%	‘000Tonnes	%	‘000Tonnes	%
State Government	0.00	0.00	358.25	22.74	1072.45	36.15
FCI	51.00	2.29	194.73	12.36	0.31	0.01
Hafed	48.00	2.16	569.20	36.13	1026.97	34.62
Rice Millers	2124.00	95.55	0.00	0.00	0.00	0.00
HWC	0.00	0.00	169.73	10.77	230.88	7.78
Agro	0.00	0.00	139.87	8.88	385.69	13.00
Con Fed	0.00	0.00	143.55	9.11	250.45	8.44
Total	2223.00	100.00	1575.33	100.00	2966.75	100.00

Source: Ibid

The scenario changed in 2011-12. As a, result, state government and Hafed procured more than two third of total quantity. In addition, Agro, Con-Fed and HWC individually procured more than 200 thousand tonnes of paddy in 2011-12.

Section-2

District Level Scenario

Growth of Area, Production and Yield of Kharif Crops in Selected Districts:

It is already mentioned that we have selected six districts (Panchkula, Sonepat, Faridabad, Palwal, Jind and Fatehabad) for the study. This section presents area, production and yield of major kharif crops for TE 1970-71, 1985-86, 2000-01 and 2011-12 for each district and their compound growth rates for the selected three sub–periods.

An examination of Table 2.7 indicates that paddy and maize were the dominant crops in terms of area allocation in kharif season in Panchkula during TE 1970-71. These crops occupied 9.31 and 8.22 thousand hectares of area. Around one thousand hectares of area was devoted to bajra and pulses. It could be noticed that acreage under paddy improved significantly in TE 1985-86 but further lost in TE 2000-01 and again improved in TE 2011-12. It is clear that area allocation never reached to the level attained in TE 1985-86. The pattern of production coincides with area being low in the TE 1970-71 and at the peak in TE 1985-86 and further declining in TE 2011-12. But, the pattern of productivity of paddy in Panchkula was continuously rising over the study period and attained the highest level in TE 2011-12. The story of bajra is different. The area allocation under this crop declined in TE 1985-86 and 2000-01 but again increased in TE 2011-12. The production of bajra was also recorded highest in TE 2011-12. The same could be observed for yield rates.

The pattern of area allocation under maize in Panchkula district was first declining, then rising and again shrinking. The production also followed the same pattern over this period. The production was recorded highest during TE 2000-01. The area under kharif pulses exhibited a continuous declining trend during the study period and production moved in the similar direction. The productivity although, lower than the national average in TE 1970-71, 2000-01 and 2011-12 indicated good performance in TE 1985-86. The pattern of area, production and yield of total

foodgrains during the study period in Panchkula district was rising in the beginning and then declining after 1985-86. It is heartening to note that productivity of foodgrains in the district was rising throughout this period.

Table 2.7
Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12)
Panchkula District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	9.31	16.77	6.20	8.90
	Production	11.72	37.35	17.33	26.00
	Yield	1259	2227	2796	2921
JOWAR					
	Area				
	Production		NOT AVAILABLE		
	Yield				
BAJRA					
	Area	1.21	0.74	0.53	1.03
	Production	0.60	0.42	0.67	2.00
	Yield	494	571	1250	1935
MAIZE					
	Area	8.22	6.54	9.13	5.87
	Production	10.24	8.97	20.33	12.67
	Yield	1245	1370	2226	2159
PULSES (kharif)					
	Area	1.44	0.82	0.70	0.33
	Production	0.54	0.66	0.40	0.13
	Yield	371	810	571	400
Foodgrains (Kharif)					
	Area	20.20	24.87	16.57	16.13
	Production	23.09	47.40	38.73	40.80
	Yield	1143	1906	2338	2529

Source: Ibid

We have depicted percentage change in area, production and yield of important crops grown during kharif season in Panchkula district in Table 2.8. It indicates that the maximum rise in the area and production was noticed for paddy during the first sub-period which is 1970-71 to 1985-86. The percentage change in area, production and yield of paddy during the entire period was 96,222 and 232 per cent respectively. Bajra was the second crop which indicated continuous rise in area and production but showed an increase of 155 per cent in TE 2011-12 that could be observed lower than TE 2000-01.The area, production and yield of maize increased by 71, 124 and 173 percentage points over the study period in Panchkula district. Among foodgrains, results were found poor for pulses.

We have also computed compound growth rates of area, production and yield of important kharif crops for the three sub- periods and entire period of study (1970-71 to 2011-12) in Panchkula district. These are shown in Table 2.9. It indicates that acreage under paddy in the district grew at an impressive rate of 4.14 and 3.95 per cent per annum during the first and third sub – periods (1970-71 to 1984-85 and 2000-01 to 2011-12) but it declined at a higher rate of 8.14 per cent per annum between 1985-86 and 1999-00. Therefore, growth of acreage under paddy turned out negative for the overall period. The growth pattern of production of paddy during the study period in the district is also similar but it has recorded increase of merely 0.67 per cent per annum due to significant increase in yield. The productivity of paddy has shown best performance in the first sub – period. The second important crop of bajra in the district showed poor performance despite an increase of 11.42 per cent per annum in production and 11.30 per cent per annum in yield during 1985-86 and 1999-00. The performance of maize was found better since it exhibited an increase of 2 per cent per annum in production and 2.23 per cent per annum in yield despite negative growth in acreage during the study period. The growth performance of pulses was poor since area, production and yield indicated negative growth between 1970-71 and 2011-12.

The analysis of overall performance of kharif food grains during the study period in Panchkula district indicates that production increased at the rate of 1.03 per cent per annum due to an increase of 2.06 per cent per annum in productivity.

Table: 2.8

Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Panchkula District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	180	37	144	96
	Production	319	46	150	222
	Yield	177	126	104	232
JOWAR					
	Area				
	Production		NOT AVAILABLE		
	Yield				
BAJRA					
	Area	61	72	194	85
	Production	71	157	300	333
	Yield	116	219	155	392
MAIZE					
	Area	80	140	64	71
	Production	88	227	62	124
	Yield	110	163	97	173
PULSES (kharif)					
	Area	57	85	48	23
	Production	124	60	33	25
	Yield	218	71	70	108
Foodgrains (Kharif)					
	Area	123	67	97	80
	Production	205	82	105	177
	Yield	167	123	108	221

Source: Ibid

Table: 2.9
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Panchkula District, Haryana

Crops/Period	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	4.14	0%	8.08	0%	3.78	3%	-8.14	1%	-7.65	2%	0.52	34%
t-value	6.64		4.59		2.48		-2.95		-2.61		0.99	
BAJRA	-2.77	1%	-2.38	43%	0.39	90%	0.11	96%	11.42	0%	11.30	1%
t-value	-2.96		-0.81		0.13		0.05		4.10		3.05	
MAIZE	-2.43	1%	-2.82	5%	-0.40	74%	4.47	0%	8.98	0%	4.32	0%
	-3.33		-2.16		-0.34		4.52		5.14		3.91	
PULSES	-3.10	2%	1.42	18%	4.66	0%	3.00	3%	-1.24	75%	-4.12	20%
t-value	-2.57		1.40		6.57		2.43		-0.32		-1.36	
FOODGRAINS(KHARIF)	1.12	0%	4.11	0%	2.96	1%	-2.36	11%	-2.09	30%	0.28	68%
t-value	3.77		3.93		2.91		-1.73		-1.09		0.42	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	3.95	0%	4.02	1%	0.07	94%	-1.54	1%	0.44	51%	2.01	0%
t-value	5.36		3.24		0.08		-2.95		0.67		8.21	
BAJRA	10.97	0%	0.00	0%	0.00	0%	-1.23	1%	0.00	0%	0.00	0%
t-value	3.80		0.00		0.00		-2.64		0.00		0.00	
MAIZE	-4.35	1%	-5.00	2%	-0.68	57%	-0.23	41%	2.00	0%	2.23	0%
t-value	-3.49		-2.64		-0.59		-0.83		4.39		8.67	
PULSES	-3.44	33%	3.45	25%	7.14	4%	-3.52	0%	-4.95	0%	-1.49	1%
t-value	-1.02		1.21		2.31		-8.79		-8.00		-2.76	
FOODGRAINS(KHARIF)	0.08	88%	0.51	61%	0.43	61%	-1.00	0%	1.03	1%	2.06	0%
t-value	0.15		0.52		0.53		-4.44		2.81		10.52	

It is surprising to note that growth in acreage of kharif foodgrains was observed negative in Panchkula district during this period.

Next, we present scenario of area, production and yield of important kharif crops in Sonepat district. Table 2.10 shows that acreage under paddy has increased from 8.58 thousand hectares in TE 1970-71 to 92.87 thousand hectares in TE 2011-12. The same rising trend for production could be noticed. But, productivity of paddy increased first and then declined and again increased during TE 2011-12. On the contrary, jowar and bajra were found as significant losers in acreage allocation but production of foodgrains increased after TE 2000-01 and it was due to increase in productivity .The acreage and production of maize declined upto TE 2000-01 but increased afterwards due to positive change in productivity. A look at area, production and yield of kharif foodgrains in the district clearly shows a declining pattern in the beginning and rising further in 2011-12. The same could be noticed for production. It is encouraging to note that yield rates of kharif foodgrains recorded a positive change during this period. It is important to mention that acreage under cotton in Sonepat district declined from 6.81 thousand hectares in TE 1970-71 to 0.60 thousand hectares in TE 2011-12. Although, productivity of cotton increased from 192 qtls/ ha to 756 qts/ha during this period, production declined significantly due to loss in area.

The percentage change in area, production and yield of major kharif crops during the study period in Sonepat district in Table 2.11 shows that area allocated to paddy has increased by 1083 per cent during this period. Second sub- period indicated a higher increase in comparison to first and third sub-periods. An increase of 1680 per cent in production of paddy in the district was highly appreciable. It is however, surprising to note that productivity increased by 155 per cent only in this period. The next foodgrain crop of jowar showed poor results in performance of area and production despite an increase of 226 per cent in productivity between TE 1970-71 and 2011-12. The similar results could be noticed for bajra and maize. The commercial crop of cotton did not differ in this regard since increase in area and production was 10 and 39 per cent respectively during the study period. The productivity of cotton increased significantly (394 per cent) over this period.

Table: 2.10

Area, Production and Yield of Major kharif Crops (1970-71 to 2011-12)
Sonepat District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	8.58	23.23	78.00	92.87
	Production	12.90	53.33	136.67	216.67
	Yield	1503	2296	1752	2333
JOWAR					
	Area	44.14	22.80	11.53	9.13
	Production	9.97	3.33	2.67	4.67
	Yield	226	146	231	511
BAJRA					
	Area	55.47	18.50	6.77	12.40
	Production	36.31	8.00	8.67	25.33
	Yield	655	432	1281	2043
MAIZE					
	Area	3.75	2.13	0.13	0.77
	Production	2.65	1.67	0.33	2.33
	Yield	707	781	2500	3043
COTTON*					
	Area	6.04	3.13	0.83	0.60
	Production	6.81	3.00	2.33	2.67
	Yield	192	163	476	756
Foodgrains (Kharif)					
	Area	111.93	66.67	96.43	115.17
	Production	61.83	66.33	148.33	249.00
	Yield	552	995	1538	2162

Source: Ibid

Table: 2.11
Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Sonepat District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	271	336	119	1083
	Production	414	256	159	1680
	Yield	153	76	133	155
JOWAR					
	Area	52	51	79	21
	Production	33	80	175	47
	Yield	65	158	221	226
BAJRA					
	Area	33	37	183	22
	Production	22	108	292	70
	Yield	66	296	160	312
MAIZE					
	Area	57	6	575	20
	Production	63	20	700	88
	Yield	110	320	122	430
COTTON					
	Area	52	27	72	10
	Production	44	78	114	39
	Yield	85	292	159	394
Foodgrains (Kharif)					
	Area	60	145	119	103
	Production	107	224	168	403
	Yield	180	155	141	391

Source: Ibid

The percentage increase in area, production and yield for all foodgrain crops of kharif was appreciable. It appears that it was achieved due to good performance of paddy.

An examination of growth performance of paddy, bajra, maize, pulses and kharif foodgrains in Sonepat district during the study period indicates (Table 2.12) that paddy is the only crop which exhibited an increase in area at the rate 6.58 per

cent per annum during the study period. Other crops recorded negative growth in area allocation. The production performance of paddy was excellent as it grew at the rate of 8.41 per cent per annum during the study period. The yield growth could be noticed highest for bajra followed by cotton. The growth of area, production and yield of kharif foodgrains in the district was praiseworthy. The contribution of yield was higher than area expansion in production performance. The first sub- period for paddy was far superior than remaining sub- periods.

We had limited data for district Faridabad which is a relatively dry district of Haryana. We have analyzed area, production and yield of paddy, jowar, bajra and kharif foodgrains during the study period. Results shown in Table 2.13 indicate that acreage under paddy has increased from 0.29 thousand hectares in TE 1970-71 to 10.20 thousand hectares in TE 2011-12. The increase in production was commendable. The productivity became 2288 kg/ha in TE 2011-12 from its earlier level of 1217 kg/ha in TE 1970-71. The acreage under jowar and bajra exhibited significant decline. The production of these crops also declined over this period but productivity increased continuously except for jowar in TE 2000-01. At the overall level, area under kharif foodgrains in district Faridabad during the study period declined but production has shown a significant increase due to continuous increase in productivity.

Results in Table 2.14 show that percentage change in acreage allocated under paddy was exemplary in Faridabad district since it rose by 3483 per cent between TE 1970-71 and 2011-12. Similarly, production of paddy also increased by 6545 per cent during the same period. However, productivity change was relatively lower (188%). Thus, production of paddy in this district rose primarily due to area expansion after the availability of irrigation. The percentage increase in area under jowar and bajra was 24 and 19 per cent respectively during this period. Production however, increased by 94 and 55 per cent due to an impressive increase of 384 and 286 per cent in productivity.

Table: 2.12
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Sonepat District, Haryana

Crop/ Period	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	9.28	0%	11.97	0%	2.47	23%	10.69	0%	8.79	0%	-1.71	4%
t-value	6.83		6.90		1.27		7.45		5.95		-2.29	
JOWAR	-3.47	1%	0.00	0%	0.00	0%	-0.97	60%	3.31	46%	4.32	28%
t-value	-2.87		0.00		0.00		-0.54		0.75		1.12	
BAJRA	-4.91	1%	-8.19	7%	-3.45	41%	0.66	81%	3.27	31%	2.59	27%
t-value	-2.93		-1.94		-0.84		0.24		1.06		1.14	
COTTON	-1.54	41%	-2.13	40%	-0.60	71%	-5.29	10%	-3.49	28%	1.90	48%
t-value	-0.84		-0.88		-0.38		-1.79		-1.12		0.73	
FOODGRAINS(KHARIF)	-1.98	13%	0.52	83%	2.55	22%	6.21	0%	8.01	0%	1.70	10%
t-value	-1.62		0.22		1.28		3.89		5.11		1.79	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	3.82	3%	5.99	0%	2.09	6%	6.58	0%	8.41	0%	1.72	0%
t-value	2.51		4.72		2.13		20.30		22.50		5.46	
JOWAR	-3.86	0%	4.92	1%	9.14	0%	-2.72	0%	0.00	0%	0.00	0%
t-value	-4.19		3.24		6.77		-9.29		0.00		0.00	
BAJRA	0.00	0%	11.70	0%	3.23	0%	-3.71	0%	0.26	78%	4.12	0%
t-value	3.16		4.52		4.39		-5.45		0.28		6.34	
COTTON	-7.90	10%	-1.45	71%	7.00	8%	-4.33	0%	-1.41	4%	3.05	0%
t-value	-1.84		-0.38		1.93		-7.67		-2.14		5.65	
FOODGRAINS(KHARIF)	3.27	2%	6.45	0%	3.09	0%	1.12	1%	5.16	0%	4.00	0%
t-value	2.64		4.95		3.87		2.95		12.68		11.80	

Table: 2.13

Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Faridabad District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	0.29	3.71	16.02	10.20
	Production	0.36	8.77	37.99	23.33
	Yield	1217	2365	2372	2288
JOWAR					
	Area	6.44	9.44	10.85	1.57
	Production	1.07	2.37	1.83	1.00
	Yield	166	251	168	638
BAJRA					
	Area	20.99	14.68	8.31	4.00
	Production	10.39	11.14	9.13	5.67
	Yield	495	759	1099	1417
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area				
	Production		NOT AVAILABLE		
	Yield				
COTTON*					
	Area				
	Production		NOT AVAILABLE		
	Yield				
Foodgrains (Kharif)					
	Area	27.72	27.83	35.17	15.77
	Production	11.82	22.28	48.94	30.00
	Yield	426	801	1391	1903

Source: Ibid

Table: 2.14

Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Faridabad District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	1266	432	64	3483
	Production	2459	433	61	6545
	Yield	194	100	96	188
JOWAR					
	Area	147	115	14	24
	Production	222	77	55	94
	Yield	151	67	379	384
BAJRA					
	Area	70	57	48	19
	Production	107	82	62	55
	Yield	153	145	129	286
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area				
	Production		NOT AVAILABLE		
	Yield				
COTTON					
	Area				
	Production		NOT AVAILABLE		
	Yield				
Foodgrains (Kharif)					
	Area	100	126	45	57
	Production	189	220	61	254
	Yield	188	174	137	446

Source: Ibid

The area, production and yield of kharif foodgrains during the study period exhibited increases of 57,254 and 446 per cent respectively. The first and second sub-periods could be noticed far superior than third sub-period.

The growth performance of analyzed crops in Faridabad presented in Table 2.15 shows that paddy is the key crop in this regard. Its area, production and yield grew at the rate of 10.28, 12.60 and 2.10 per cent per annum respectively between 1970-71 and 2011-12. Jowar and bajra exhibited poor performance in production despite more than 1.50 per cent per annum growth in productivity. The negative performance of these crops affected overall scenario of kharif foodgrains in Faridabad district. In particular, growth in area turned out negative. The growth in productivity however, saved the situation and therefore, production increased at the rate of 4.03 per cent per annum during the study period.

Palwal is recently created district in the state of Haryana. The pattern of acreage appeared to be diversified since jowar, bajra and pulses are also cultivated in kharif along with paddy. The acreage under paddy has shown phenomenal increase between TE 1970-71 and 2011-12 since, it increased from a marginal 0.52 thousand hectares to 32.07 thousand hectares in TE 2011-12. The production also followed the same pattern and productivity increased from 1217 kg/ha to 2744 kg/ha during this period. Further, area under jowar and bajra declined significantly over this period but proportionate decline in production was lower due to continuous increase in productivity of these coarse cereals. Pulses have been a part of crop pattern but received only 0.28 thousand hectares in TE 1970-71 and merely 0.17 thousand hectares in 2011-12. Production of pulses also declined but productivity increased from 350 kg/ha in TE 1970-71 to 500 kg/ha in TE 2011-12. This level of yield is low when compared to the national average. The overall area allocated to kharif foodgrains in the district lost but production showed huge gain due to 5 times increase in productivity during the reference period (Table 2.16).

The percentage change observed in area, production and yield of important kharif crops in Palwal district between TE 1970-71 and 2011-12 is given in Table 2.17. Like earlier analyzed districts, paddy was the major gainer. Its area and production increased by astronomical percentage of 5950 and 13412 respectively during this period.

Table: 2.15
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Faridabad District, Haryana

Crop/Period	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	19.48	0%	21.79	0%	1.94	43%	11.47	0%	13.08	0%	1.44	27%
t-value	7.02		7.53		0.81		5.56		5.62		1.15	
JOWAR	4.93	0%	7.12	3%	2.09	45%	1.91	13%	3.43	38%	1.49	65%
t-value	3.59		2.48		0.78		1.63		0.91		0.47	
BAJRA	1.30	33%	3.52	30%	2.19	40%	-1.38	26%	3.85	18%	5.30	2%
	1.02		1.08		0.87		-1.17		1.42		2.68	
FOODGRAINS(KHARIF)	3.07	2%	5.87	7%	2.72	29%	3.03	1%	8.85	0%	5.65	0%
t-value	2.60		1.99		1.11		3.27		4.52		3.40	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	-4.36	1%	-5.89	1%	-1.60	16%	10.28	0%	12.60	0%	2.10	0%
t-value	-2.95		-3.18		-1.52		13.81		14.12		5.63	
JOWAR	-20.24	0%	-7.79	1%	15.61	0%	-1.69	3%	0.03	97%	1.75	1%
t-value	-9.49		-3.09		8.72		-2.23		0.04		2.79	
BAJRA	-4.50	4%	-3.27	17%	1.29	34%	-4.11	0%	-0.99	10%	3.25	0%
t-value	-2.31		-1.49		0.99		-11.58		-1.67		7.87	
FOODGRAINS(Kharif)	-7.88	0%	-5.55	1%	2.52	12%	-0.42	23%	4.03	0%	4.47	0%
t-value	-7.26		-3.25		1.71		-1.23		7.42		11.50	

The productivity however increased by 225 percentage points. The first sub-period was more important in comparison to remaining two sub–periods.

Table: 2.16
Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Palwal District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	0.54	2.71	11.73	32.07
	Production	0.66	6.42	27.81	88.00
	Yield	1217	2365	2372	2744
JOWAR					
	Area	11.86	6.91	7.94	8.30
	Production	1.97	1.74	1.34	4.33
	Yield	166	251	168	522
BAJRA					
	Area	38.63	10.75	6.08	7.70
	Production	19.12	8.16	6.69	14.33
	Yield	495	759	1099	1861
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area	0.28	0.25	0.08	0.17
	Production	0.10	0.13	0.05	0.08
	Yield	350	526	667	500
COTTON*					
	Area				
	Production		NOT AVAILABLE		
	Yield				
Foodgrains (Kharif)					
	Area	51.30	20.63	25.83	48.23
	Production	21.84	16.45	35.89	106.75
	Yield	426	797	1389	2213

Source: Ibid

Table: 2.17

Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Palwal District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	504	432	273	5950
	Production	978	433	316	13412
	Yield	194	100	116	225
JOWAR					
	Area	58	115	104	70
	Production	88	77	324	220
	Yield	151	67	310	314
BAJRA					
	Area	28	57	127	20
	Production	43	82	214	75
	Yield	153	145	169	376
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area	90	32	208	59
	Production	136	40	156	85
	Yield	150	127	75	143
COTTON					
	Area				
	Production		NOT AVAILABLE		
	Yield				
Foodgrains (Kharif)					
	Area	40	125	187	94
	Production	75	218	297	489
	Yield	187	174	159	520

Source: Ibid

It is interesting to note that acreage and production of jowar increased in this district over time. The percentage change in production was above 300 in both the cases and the third sub- period was observed most important in this regard. The story of pulses was the same in district Palwal too as area, production and yields all three showed relatively slow increase during the reference period. The productivity of pulses however, increased by 143 per cent during the study period.

A look at the compound growth rates of area, production and yield of important kharif crops during the reference period in Palwal district indicates (Table

2.18) that area and production of paddy grew at the rate of 10.42 and 12.34 per cent per annum respectively during the study period. The productivity also increased at the rate of 2.29 per cent per year. Among coarse cereals, production of bajra declined at the rate of 0.83 per cent per annum while production of Jowar increased at a slow rate of 0.72 per cent per year. The yield performance of bajra was found far better in comparison to paddy and Jowar. The second sub-period was comparatively important for area expansion under paddy while first sub-period was significant for yield. At the overall level, area allocation under kharif food grains declined at the rate of 0.18 per cent per annum however, commendable growth of 4.52 per cent per annum in yield saved the situation and therefore, production in Palwal district grew at 4.34 per cent per year during the study period.

Jind is one of the agriculturally developed districts of Haryana. The details of area, production and productivity of important kharif crops during TE 1970-71, 1984-85, 2000-01 and 2011-12 are presented in Table 2.19. Like earlier districts, variations in these indicators across crops and time periods are common. The acreage under paddy increased from 9.93 thousand hectares in TE 1970-71 to 112.33 thousand hectares in TE 2011-12. The phenomenal increase in production could be also noticed. The per hectare yield of paddy ranged between 1510 kg./ha and 1937 kg/ha during the selected trienniums. It is surprising to note that yield rate of paddy during TE 2000-01 was lower than TE 1985-86. Like earlier cases, acreage under bajra declined but production became more than double due to significant increase in yield. In Jind, a significant area of 15.72 thousand hectares was allotted to cotton in TE 1970-71 which reached to 52.10 thousand hectares in TE 2011-12. Further, production of cotton also became more than ten times over this period. It was due to increase in area and enhancement in productivity. A glance at the figures regarding the overall kharif foodgrains indicates that area, production and yield, all three increased significantly during the reference period.

Table: 2.18
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Palwal Districts, Haryana

	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	9.32	0%	6.98	7%	1.94	43%	11.47	0%	13.08	0%	1.44	27%
t-value	4.32		1.95		0.81		5.56		5.62		1.15	
JOWAR	-3.99	3%	-1.99	44%	2.09	45%	1.91	13%	3.43	38%	1.49	65%
t-value	-2.53		-0.80		0.78		1.63		0.91		0.47	
BAJRA	-7.32	0%	-5.28	3%	2.19	40%	-1.38	26%	3.85	18%	5.30	2%
t-value	-7.13		-2.52		0.87		-1.17		1.42		2.68	
FOODGRAINS(KHARIF)	-5.64	0%	-3.08	11%	2.72	29%	3.01	1%	8.79	0%	5.61	0%
t-value	-5.51		-1.72		1.11		3.27		4.58		3.47	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	13.41	0%	13.70	0%	0.26	66%	10.42	0%	12.34	0%	2.29	0%
t-value	7.02		6.43		0.46		26.14		21.06		6.46	
JOWAR	1.43	26%	13.40	0%	11.80	0%	-0.70	2%	0.72	28%	1.43	2%
t-value	1.20		7.36		9.65		-2.35		1.09		2.47	
BAJRA	7.78	4%	12.39	1%	4.28	0%	-4.18	0%	-0.83	23%	3.49	0%
	2.31		3.25		4.24		-8.35		-1.21		8.55	
FOODGRAINS(KHARIF)	9.10	0%	13.46	0%	4.00	0%	-0.18	70%	4.34	0%	4.52	0%
t-value	6.64		6.05		4.16		-0.39		7.37		12.14	

One could notice significant percentage change in area, production and yield rates of important kharif crops in Jind between TE 1970-71 and 2011-12 (Table 2.20). An examination of the table indicates that area and production of paddy increased by 1131 and 1949 percentage points during the reference period. The productivity also exhibited a change of 172 per cent over this period. The coarse cereal of bajra, though indicated higher percentage change in productivity, showed relatively lower change in production due to poor increase in area. Among non-foodgrains, cotton exhibited an increase of 331 and 1158 percentage points in area and production during the study period. The percentage change of 349 percent in productivity of cotton was commendable. An observation of total kharif foodgrains in Jind points out that area, production and yield increased by 206, 709 and 344 per cent respectively during this period. The first sub-period was far more important than second and third sub-periods.

The calculated compound growth rates of area, production and yield of important kharif crops in district Jind during 1971-72 and 2011-12 indicate (Table 2.21) that paddy was most important crop in terms of growth performance. Its production grew at the rate of 7.04 per cent per annum during the study period. It was largely due to area expansion at the rate of 5.76 per cent per year. The contribution of yield was also positive and it grew at the rate of 1.21 per cent per year during the same period. The first sub-period was far important in terms of growth in area, production and yield of paddy in comparison to remaining sub-periods. Bajra lost area at the rate of 2.22 per cent per year but production rose at paltry rate of 0.89 per cent per year due to good performance of yield which increased at the rate of 3.16 per cent per year during this period. The growth performance of cotton was also found appreciable since production grew at the rate of 4.19 per cent per annum during the study period. It was however, largely due to higher growth in yield in comparison to area. The overall performance of kharif foodgrains in Jind during the study period points out that production grew at the rate of 4.19 per cent per year and yield performance was primarily responsible for this achievement.

Table 2.19

Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Jind District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	9.93	43.50	113.03	112.33
	Production	15.00	99.67	219.00	292.33
	Yield	1510	2291	1937	2602
JOWAR					
	Area				
	Production				
	Yield				
BAJRA					
	Area	63.40	72.33	37.23	38.80
	Production	36.83	61.00	56.00	75.33
	Yield	581	843	1504	1942
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area				
	Production		NOT AVAILABLE		
	Yield				
COTTON*					
	Area	15.72	26.83	40.53	52.10
	Production	16.03	39.00	75.33	185.67
	Yield	173	247	316	606
Foodgrains (Kharif)					
	Area	73.33	115.83	150.27	151.13
	Production	51.83	160.67	275.00	367.67
	Yield	707	1387	1830	2433

Source: Ibid

Table: 2.20

Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Jind District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	438	260	99	1131
	Production	664	220	133	1949
	Yield	152	85	134	172
JOWAR					
	Area				
	Production		NOT AVAILABLE		
	Yield				
BAJRA					
	Area	114	51	104	61
	Production	166	92	135	205
	Yield	145	178	129	334
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area				
	Production		NOT AVAILABLE		
	Yield				
COTTON					
	Area	171	151	129	331
	Production	243	193	246	1158
	Yield	142	128	192	349
Foodgrains (Kharif)					
	Area	158	130	101	206
	Production	310	171	134	709
	Yield	196	132	133	344

Source: Ibid

Table: 2.21
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Jind District, Haryana

	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	11.99	0%	16.08	0%	3.65	1%	7.46	0%	7.20	0%	-0.24	82%
t-value	10.97		8.08		2.92		5.70		4.73		-0.23	
BAJRA	-0.17	80%	1.54	45%	1.72	37%	-4.13	0%	0.44	83%	4.78	1%
t-value	-0.26		0.79		0.93		-6.09		0.22		2.82	
COTTON	3.25	0%	6.32	0%	2.97	0%	5.61	0%	5.87	1%	0.24	88%
t-value	3.98		6.46		3.88		3.53		2.87		0.15	
FOODGRAINS(KHARIF)	2.42	0%	7.10	0%	4.58	1%	2.44	3%	5.39	0%	2.88	3%
	4.92		4.91		3.27		2.37		3.45		2.42	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	1.81	13%	4.46	1%	2.60	1%	5.76	0%	7.04	0%	1.21	0%
t-value	1.63		3.13		3.55		17.08		14.89		5.00	
BAJRA	-0.27	87%	3.93	16%	4.20	2%	-2.22	0%	0.87	7%	3.16	0%
t-value	-0.17		1.52		2.92		-8.22		1.90		9.42	
COTTON	2.32	3%	10.78	0%	8.26	0%	3.05	0%	5.59	0%	2.47	0%
t-value	2.63		4.90		4.70		9.97		15.83		7.88	
FOODGRAINS(KHARIF)	1.27	13%	4.42	1%	3.11	0%	1.12	0%	4.19	0%	3.04	0%
t-value	1.65		3.03		3.68		5.71		14.03		11.68	

Finally, we discuss area, production and yield of important kharif crops during the study period in district Fatehabad. Like earlier districts, area under paddy increased from 2.55 thousand hectares in TE 1970-71 to 85.37 thousand hectares in TE 2011-12. Production also grew from 4.21 thousand tonnes to 321.33 thousand tonnes during the same period. The productivity also more than doubled. Further, bajra lost heavily in area and production both despite an increase in yield from 505 kg/ha in TE 1970-71 to 2476 kg/ha. in TE 2011-12. As usual, pulses faired adversely and therefore, area and production declined significantly but productivity increased from 435 kg/ha at the first point in TE 1970-71 to 560 kg/ha at the last point in the TE 2011-12. In the array, cotton gained in area and production which increased many folds. The productivity of cotton also increased from 323 kg/ha to 731 kg/ha during the reference period. The overall area and yield of kharif foodgrains increased significantly which pushed production from 34.58 thousand tonnes to 338.80 thousand tonnes during the reference period (Table 2.22).

After providing an overview of area, production and yield of important crops in kharif season during TE 1970-71 and 2011-12, we have presented percentage change in these indicators in Table 2.23. An examination of table indicates that acreage of paddy increased by 3351 percentage points during this period. The production increased by an astronomical percentage of 7634. Further, productivity of paddy also grew by 228 per cent over this period. The first sub-period was more important than remaining two sub-periods. The percentage increase in area and production of bajra was much lower as compared to paddy in the district. But, its productivity increased by 491 percentage points during the study period. The production of pulses increased by 65 per cent over this period largely due to an increase of 129 per cent in productivity. Cotton was a significant beneficiary after paddy. Its production grew by 748 percentage points over this period. The gains in area and yield both were found substantial. The percentage change in area and productivity of total kharif foodgrains during the study period was 148 and 663 per cent respectively. As a result, production grew by 980 per cent during the reference period.

The growth performance of important kharif crops in Fatehabad is presented in Table 2.24. It could be noticed that production of paddy grew at the commendable rate of 11.64 per cent per year between 1970-71 and 2011-12. The area expansion

at the rate of 9.32 per cent per year was the major contributor, although yield also increased at the rate of 2.13 per cent per annum during this period. Among the sub-periods, first sub-period was more important for growth in production of paddy in this district. Next, bajra showed poor performance in growth of area and production because these indicators were observed negative but performance of productivity of bajra was appreciable since it grew at the rate of 3.84 per cent per annum during the reference period. The commercial crop of cotton performed well since its production grew at the rate of 4.44 per cent per annum during the reference period. The contribution of area expansion and yield growth was almost equal. The overall performance of kharif foodgrains in Fatehabad district was worth emulating since production grew at a higher rate of 6.48 per cent per year during the reference period. It is worth noticing that growth in yield of foodgrains in this district was highest among the selected districts while area expanded at the modest rate of 1.38 per cent per year. It is essential to mention that second sub-period (1985-86 to 1999-00) was most important in this case in terms of growth performance of acreage, production and yield.

Table: 2.22

Area, Production and Yield of Major kharif Crops (1970-71 to 2011-12), Fatehabad District, Haryana

Area in '000Ha, Prod.in '000T, Yield in Kg/ha

C R O P		TE 1970-71	TE 1985-86	TE 2000-01	TE 2011-12
RICE					
	Area	2.55	11.77	66.87	85.37
	Production	4.21	35.03	190.33	321.33
	Yield	1652	2977	2846	3764
JOWAR					
	Area				
	Production		NOT AVAILABLE		
	Yield				
BAJRA					
	Area	58.78	39.21	11.70	6.87
	Production	29.66	32.43	16.00	17.00
	Yield	505	827	1368	2476
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area	1.64	0.60	1.27	0.83
	Production	0.71	0.49	0.50	0.47
	Yield	435	826	395	560
COTTON*					
	Area	26.26	65.41	101.80	86.87
	Production	49.93	131.42	231.33	373.67
	Yield	323	342	386	731
Foodgrains (Kharif)					
	Area	62.97	51.57	79.83	93.07
	Production	34.58	67.96	206.83	338.80
	Yield	549	1318	2591	3640

Source: Ibid

Table: 2.23

Percentage Change in Area, Production and Yield of Major Kharif Crops (1970-71 to 2011-12), Fatehabad District, Haryana

C R O P		TE 1970-71 to TE 1985-86	TE 1985-86 to TE 2000-01	TE 2000-01 to TE 2011-12	TE 1970-71 to TE 2011-12
RICE					
	Area	462	568	128	3351
	Production	832	543	169	7634
	Yield	180	96	132	228
JOWAR					
	Area				
	Production		NOT AVAILABLE		
	Yield				
BAJRA					
	Area	67	30	59	12
	Production	109	49	106	57
	Yield	164	165	181	491
MAIZE					
	Area				
	Production		NOT AVAILABLE		
	Yield				
PULSES (kharif)					
	Area	36	212	66	51
	Production	69	101	93	65
	Yield	190	48	142	129
COTTON					
	Area	249	156	85	331
	Production	263	176	162	748
	Yield	106	113	189	226
Foodgrains (Kharif)					
	Area	82	155	117	148
	Production	197	304	164	980
	Yield	240	197	141	663

Source: Ibid

Table: 2.24
Compound Annual Growth Rates (CAGR) of Major Kharif Crops
(1970-71 to 2011-12), Fatehabad District, Haryana

	1970 - 71 to 1984-85						1985-86 to 1999-00					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	10.22	0%	17.50	0%	6.60	0%	13.64	0%	13.51	0%	-0.12	91%
t-value	9.64		14.23		6.58		7.09		7.68		-0.11	
BAJRA	-1.91	5%	0.58	81%	2.53	20%	-6.60	0%	-1.28	68%	5.70	1%
t-value	-2.15		0.24		1.35		-3.49		-0.42		2.96	
COTTON	4.66	1%	5.95	3%	1.23	68%	2.65	0%	0.31	87%	-2.27	25%
t-value	3.36		2.48		0.43		4.43		0.16		-1.20	
FOODGRAINS(KHARIF)	-0.67	38%	4.87	2%	5.58	0%	3.88	0%	9.60	0%	5.51	0%
t-value	-0.90		2.61		3.72		4.35		6.47		5.27	

	2000-01 to 2011-12						1970-71 to 2011-12					
	AREA		PROD.		YIELD		AREA		PROD.		YIELD	
	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %	CGAR %	Sig.at %
RICE	3.61	0%	6.10	0%	2.40	4%	9.32	0%	11.64	0%	2.13	0%
t-value	11.70		6.61		2.35		28.17		32.66		8.09	
BAJRA	-5.46	2%	1.79	54%	7.67	0%	-5.12	0%	-1.48	1%	3.84	0%
t-value	-2.76		0.63		4.76		-14.82		-2.79		10.30	
COTTON	-1.74	5%	6.89	2%	8.79	1%	2.11	0%	4.44	0%	2.28	0%
t-value	-2.18		2.82		3.47		7.35		9.79		4.39	
FOODGRAINS(KHARIF)	2.55	0%	5.86	0%	3.23	1%	1.38	0%	6.48	0%	5.03	0%
t-value	8.30		5.93		3.22		5.86		18.84		20.85	

To conclude, the analyses of area, production and yield of important kharif crops in the selected districts for the period 1970-71 to 2011-12 exhibit significant variations in growth performance across crops and districts,. But, one point is common that paddy and cotton are the major gainers while jowar and bajra are the main losers. In particular, bajra did not show good performance in production despite commendable growth in yield rate. This is largely due to continuous decline in area after availability of assured irrigation in the state of Haryana. In addition to paddy, cotton indicated appreciable performance in some of the selected districts during the reference period.

Chapter-3

Main Features of Selected Districts of Haryana

We have mentioned in the sampling design in chapter-1 that six districts were chosen for the field survey. Now, we present main features of selected districts for the study. In particular, we have included those indicators which affect development of agriculture. Therefore, we have devoted this chapter to briefly analyze the main features of the selected districts for the study.

A brief background of Selected Districts:

Panchkula

Panchkula was formed on 15th August 1995 by carving out the developed blocks of Pinjore, Raipur Rani, Morni & Barwala from Ambala district. Panchkula is located in the north of Haryana. It is surrounded by the Himachal Pradesh in the north and east, Punjab and Union Territory of Chandigarh in the west and by Ambala district in the south as well as in the east. It shares its borders with Chandigarh, Mohali, Ambala and Solan districts. It is located at 30.74 N latitude and 76.80 E longitude and is about 365 meters above the mean sea level.

The name of the district Panchkula originated from five irrigation canals that draw water from the Ghaggar in the uphill section and distribute it from Nada Sahib to Mansa Devi. According to mythology, the district was associated with Pandavas who stayed there for some time during their exile.

According to the Population Census of India, 2011, total population of Panchkula district was 5.61 lakh persons. Out of this, share of urban population was 55.79 per cent while rest of 44.21 per cent was rural based. The population density of the district was 625 persons per sq. km. while sex ratio was 870 females per thousand of males. The literacy rate was observed to be higher than the state level which can be attributed to the higher share of urban population. The total workers in Panchkula comprised 12.62 per cent cultivators, 6.07 per cent agricultural labourers and remaining 81.31 per cent non-agricultural workers.

Around 59.52 per cent of geographical area was cultivated in Panchkula during 2011-12. The average size of holding is 1.76 hectares and below the state level. Irrigation is performed both by tube-wells and canals. The sweet water is

available in plenty throughout the district. The gross area irrigated to total cropped area was 57.1 per cent while that of net irrigated area to the net sown area was 56 per cent during 2011-12. Therefore, cropping intensity was around 168 per cent and lower than the state level. The crop pattern in Panchkula was found skewed in favor of rice and wheat. The yield rate of rice was below the state level (Table 3.1).

Panchkula district has a sub-tropical continental monsoon climate with seasons like summer, winter and monsoon. There is a great variation in temperature ranging from 0 ℃ to 43 ℃. The rainfall is mostly received in the monsoon months. Morni hill is the highest point of the district Panchkula. The Ghaggar river is the only perennial river flowing in the distrtict. Some important streams of the district are Ghaggar, Sirsa and Kaushalya.

The soil in the district is mainly light loam (seoti), piedmont (Ghar and Kandi), Swalik (pahar), silticlay (Naili and chhachhra Dakar), etc. The underground water in the district is fresh and suitable for domestic and irrigation purposes. The underground water level is higher in the southern parts and lower in north and northeast which are hilly tracts.

Infrastructure in Panchkula district comprises banks, primary agricultural co-operative credit societies and regulated markets. The road length per lakh population is around 67 kms.

Sonepat

Sonepat is an ancient town in the state of Haryana. The district Sonepat comprises of three sub-divisions namely, Gannaur, Sonepat and Gohana and seven blocks (Gannaur, Sonepat, Rai, Kharkhoda, Gohana, Kathura and Mundlana). The district was carved out of Rohtak and was made a full fledged district on 22, December, 1972. Sonepat with an area of 2,13,080 hectares lies in the south-east of the state of Haryana, north of the Union Territory of Delhi and is bounded by the districts of Rohtak, Jind and Panipat. It shares an inter-state boundary with district Meerut, Uttar Pradesh. The river Yamuna flows along the eastern boundary of the district and separates it from Uttar Pradesh.

The climate of the district Sonepat is dry with an extremely hot summer and a cold winter. The weather becomes comparatively mild during the monsoon period

(July to September). The post-monsoon months i.e., October and November constitute a transition period, prior to the onset of winter. The district experiences high humidity during the monsoon period. The period of minimum humidity (less than 20%) falls between April and May.

According to the Population Census of India, 2011 total population of the district was 14.5 lakh persons. Of this, urban population formed small part and was 4.53 lakh persons. The district is primarily rural in nature and the major economic activity of the workers is agriculture. The rural population of the district was 9.97 lakh persons. The working population of district Sonepat comprised of 27.21 per cent cultivators, 19.45 per cent agricultural labourers and the rest were non-agricultural workers.

Around 53.48 per cent of geographical area was cultivated in Sonepat during 2011-12. The average size of holding is 1.35 hectares. Agriculture is well developed in the district due to availability of irrigation facilities. Irrigation is carried out by tube-wells and canals. Sweet water is available in plenty throughout the district. The percentage of gross area irrigated to total cropped area is 100 per cent and the same is true for net irrigated area as well. The cropping intensity was around 187 per cent during 2011-12. The crop pattern in Sonepat was found skewed towards rice and wheat. The yield rate of rice was found above the state level while vice-versa was noticed for wheat. The soil of the district has a good alluvial loam with sufficient moisture and is mostly rausli in texture (Table 3.1).

Table: 3.1

Main Features of Selected Districts in Haryana

S. No	Particulars	Panchkula	Sonepat	Faridabad	Palwal	Jind	Fatehabad	Haryana
I	**Population**							
	Population (2011) (lakh)	5.61	14.50	18.10	10.43	13.34	9.42	253.51
	Rural (lakh)	2.48	9.97	3.71	8.06	10.29	7.62	165.09
	% of Rural Population	44.21	68.76	20.50	77.28	77.14	80.89	65.12
	Urban (lakh)	3.13	4.53	14.39	2.37	3.05	1.80	88.42
	% of Urban Population	55.79	31.24	79.50	22.72	22.86	19.11	34.88
	Population Density (per sq. km)	625.00	683.00	2442.00	767.00	494.00	371.00	573.00
	Sex Ratio	870.00	853.00	871.00	879.00	870.00	903.00	877.00
	Literacy Rate 2011 (percent)	81.88	79.12	81.70	69.32	71.44	67.92	76.64
II	**Workers* (% of total workers)**							
	Cultivators	12.62	27.21	4.78	29.56	44.02	35.83	27.82
	Agricultural Labourers	6.07	19.45	5.06	19.60	19.50	26.55	17.14
	Agricultural Workers	18.69	46.66	9.84	49.16	63.52	62.38	44.96
	Non-Agricultural Workers	81.31	53.34	90.16	50.84	36.48	37.62	55.04
III	**Area Cultivated and Irrigation**							
	% of Net Sown Area to Geographical Area	59.52	53.48	49.23	55.61	49.79	53.08	54.14
	Average Size of Holdings (ha.) (2011-12)	1.76	1.35	1.88	1.67	2.61	2.44	2.25
	% of Gross Area Irrigated to Total Cropped Area (2011-12)	57.10	100.00	100.00	94.90	96.90	98.30	87.50
	% of Net Irrigated Area to Net Area Sown (2011-12)	56.00	100.00	100.00	91.70	99.20	96.90	87.40
	Cropping Intensity (%) (2011-12)	168.00	186.98	203.13	179.82	200.84	188.39	184.71
IV	**Percentage of GCA under Important crops**							
	Rice	21.90	29.97	17.69	16.53	24.02	20.64	19.02
	Jowar	0.00	2.37	1.38	4.18	0.00	0.00	1.00
	Bajra	2.62	3.61	6.00	4.08	5.92	1.16	8.88
	Maize	14.05	0.19	0.00	0.00	0.00	0.00	0.17
	Wheat	38.10	51.36	46.92	50.82	45.46	45.59	39.01
	Total Cereals	76.67	87.50	71.99	75.61	75.40	67.39	68.08
	Gram	0.48	0.00	0.00	0.00	0.00	0.09	1.22
	Mash	0.71	0.00	0.00	0.00	0.00	0.00	0.03
	moong	0.00	0.00	0.00	0.15	0.10	0.17	0.26
	Masur	0.48	0.00	0.00	0.00	0.00	0.00	0.06
	Other Pulses	0.71	0.66	0.46	0.46	0.00	0.05	0.33
	Total Pulses	2.38	0.66	0.46	0.61	0.10	0.31	1.90
	Total Foodgrains	79.05	88.16	72.45	76.22	75.50	67.70	69.98
	Rapeseed and Mustard	3.33	0.73	1.08	1.43	0.92	2.09	8.26
	Total Oilseeds	3.57	0.73	1.23	1.48	0.94	2.16	8.41
	American Cotton	0.00	0.25	0.15	0.15	12.72	20.52	8.99
	Desi Cotton	0.00	0.00	0.00	0.00	0.46	1.00	0.28
	Cotton (American + Desi)	0.00	0.25	0.15	0.15	13.18	21.52	9.27

Contd. Table: 3.1

S. No	Particulars	Panchkula	Sonepat	Faridabad	Palwal	Jind	Fatehabad	Haryana
V	**Yield Rates (Kg/ha.)**							
	Rice	2820	2407	2507	2752	2582	3739	3044
	Jowar	0	500	500	500	0	0	500
	Bajra	2040	2309	1523	1929	2079	2230	2040
	Maize	2474	2727	0	0	0	0	2727
	Wheat	3589	5521	4837	5067	5235	5472	5183
	Total Cereals	3075	4174	3953	4145	4148	4859	4096
	Gram	0	0	0	0	0	1202	924
	Mash	303	0	450	4471	0	0	366
	Moong	0	450	600	494	558	528	486
	Masur	935	0	0	1000	1286	1333	893
	Other Pulses	0	2	0	1	0	0	22
	Total Pulses	500	1095	1333	833	400	1231	870
	Total Foodgrains	2997	4151	3936	4118	4143	4843	4010
	Rapeseed and Mustard	1394	1652	1673	1871	1693	1866	1394
	Total Oilseeds	1200	1304	2500	2103	1556	1890	1383
	American Cotton (Lint)	0	705	0	0	696	840	750
	Desi Cotton (Lint)	0	0	0	0	425	383	416
	Cotton (American + Desi in Lint)	0	705	0	0	688	820	739
VI	**Input Use**							
	Fertilizer (kg/ha) (2011-12)	214.64	506.32	367.97	600.20	438.55	506.15	406.50
	Number of Tractors (per 000 ha of NSA) (2011-12)	451.48	99.74	120.34	135.51	59.29	73.49	76.07
VII	**Miscellaneous**							
	No. of Primary Agriculture Cooperative Societies	11	34	30	0	30	30	656
	No. of cooperative societies per lakh population	1014	146	202	36	107	98	137
	Total Road Length per lakh Population (2011-12)	107	98	29	80	85	165	107
	No. of Regulated Markets per lakh ha of Net Sown Area (2011-12)	12	2	6	4	3	3	3

Source: Various Issues of Statistical Abstract of Haryana, Govt of Haryana

The infrastructure in the Sonepat district comprises banks, primary agricultural co-operative credit societies and regulated markets. The road length per lakh population is around 98 kms.

Faridabad

Faridabad was founded in 1607 A.D by Shaikh Farid, treasurer of Jahangir, with the aim of protecting the highway which passed through the town. Shaikh Farid built a fort, a tank and a mosque which are in ruins. The district Faridabad came in existence on 15th August, 1979 as the 12th district of the state. It was carved out from erstwhile Gurgaon district. Faridabad is about 25 kilometers from Delhi in 28^{o} 25' 16" north latitude and 77^{o} 18' 28" east longitude. It is bounded by the Union Territory of Delhi in north, Palwal district in the south, Gurgaon district in the west and state of Uttar Pradesh in the east. The river Yamuna separates the district boundary on eastern side from Uttar Pradesh.

The district accommodates a population of around 18 lakh (Population Census of India, 2011). Almost 80 per cent of population in the district is urbanized. The district has almost flat plains and the river Yamuna flows towards its eastern boundary. Its sex ratio was 871 females against 877 females per 1000 males in the state while literacy rate was approximately 82.0 per cent against 76.64 per cent in the state. It is one of the most densely populated districts in the state.

The geographical area of the district is 1,72,167 hectares. Of this, the net sown area was around 49 per cent during 2011-12. Crop intensity was observed around 203 per cent and the average size of land holding was 1.88 hectares which is below the state level. Rice-wheat rotation is most popular in the crop pattern. Other crops grown in the district are: pulses-wheat, sugarcane-wheat, sorghum-wheat, bajra-wheat and vegetable-wheat. The soil of the district is light to medium in texture particularly sandy (Table 3.1).

The climate of Faridabad district can be classified as tropical steppe, semi-arid and hot which is mainly characterized by the extreme dryness in the air except monsoon months. During three months of south west monsoon (June to September), moist air in the district causes high humidity, cloudiness and rainfall. The period from

October to December constitutes post monsoon season. The cold weather season extends from January to the beginning of April and is followed by summer season which extends up to the last week of June.

Faridabad has well connected network of roads and electricity. All the villages of the district are connected by metalled roads as well as all villages are electrified since 1970. It is well connected with other parts of the country by rail and roads. The district has primary co-operative societies and about 6 regulated markets per lakh hectares of net sown area.

Palwal

Palwal is the 21st district of Haryana in northern India which was carved out from district of Faridabad and Mewat on 13th August 2008. The town is situated 60 km from Delhi on the Delhi Mathura national highway. Palwal is spread over 1,368 sq.kms of area at the bottom of south Haryana. The district is located at a longitude of 76° 59' in the east and the latitude of 28° 40' in the north at a height of around 199 meters from the sea level. Palwal is surrounded by Mewat in the west, Gurgaon in the north-west, Faridabad in the north, Aligarh in the east and Mathura in the south.
The district has geographical area of 1,368 sq. kms and around 77 per cent of the population lives in rural areas. It has recorded a population density of 767 persons per square kilometer. Palwal has a sex ratio of 879 females for every 1000 males and a literacy rate of 69.3 per cent which is lower than the state (Population Census of India, 2011).

The climate of the district is mostly sub-tropical. The minimum temperature during the winter season falls to 3-4 degree celsius and the maximum temperature during the summer season exceeds 45 degree celsius. The climate remains generally dry throughout the year. Palwal faces extreme weather as it remains extremely cold during winter and hot during the summer.
The district has monotonous physiography and alluvium deposits. The alluvial plains have been divided into two units. Khadar that is low flood plain of newer alluvium and Banger which is an upland plain made of older alluvial spread towards west. The slope in the district is towards east. The levelled surface, fertile alluvial soil and facilities of irrigation make the district suited for intensive cultivation. The district

enjoys Perennial River Yamuna bordering on the east that forms narrow but consistent flood plains.

Around 56 per cent of geographical area in the district is under cultivation. The percentage of net area irrigated to net area sown is around 92 per cent. Wheat, rice, jowar and bajra are major crops grown in the district. Wheat (50.82 per cent) followed by rice (16.53 per cent) are the principal crops of the district. In addition, pulses are grown on sizeable share of gross cropped area.

The texture of the soil is sandy to loamy sand in the plains, sandy loam to clay loam in alluvial plains and clay loam in the low lying plains (Table 3.1). Palwal is well connected through road and rail network. It has a good road network within the district and all blocks are well connected to district headquarters.

Jind

Jind district was an integral part of Kurukshetra in the traditional geographical account. The district lies in the North of Haryana between 29.03' and 29.51' north latitude and 75.53' and 76.47' east longitude. The districts of Panipat, Karnal and Kaithal respectively lie on its east and north-east. Its boundary line on the north forms the inter-state Haryana - Punjab border with Patiala and Sangurar districts of Punjab. In the west and south-west, it has a common boundary with district Hissar and Fatehabad and on its south and south-east lie the districts of Rohtak and Sonepat respectively. The district comprises three sub-divisions: Jind, Narwana and Safidon.

According to the Population Census of India, 2011, Jind had a population of 1,36,089 persons. The rural population constituted 77 per cent while 23 per cent of population resides in urban areas. The population density was 494 persons per sq. km. The percentage of literate population to total population in Jind was 72.7 per cent which is slightly lower than the state of Haryana. The sex ratio in the district was 870 females per 1000 males.

Out of total geographical area in Jind, net sown area was 49.79 per cent and tube-wells are the main source of irrigation. The net irrigated area constituted 99.2 per cent of the net sown area. The cropping intensity of the district was around 201

per cent and the average size of operational holding was 2.61 hectares against 2.25 hectares in Haryana.

The share of the gross cropped area under important crops reveals that the cereals covered around 75 per cent of GCA. Oil seeds were grown on marginal lands (0.94 per cent) of GCA. Cotton occupied a sizeable share (13.18 per cent) of GCA. The yield rates of cereals were almost the same as the state.

The climate of Jind district is dry, hot in summer and cold in winter. The year is divided into three seasons. The cold season from November to March is followed by hot season which lasts till the onset of the south-west monsoon.

The area of Jind district is irrigated by two canal systems, viz. the Western Yamuna (Jamuna) Canal and the Bhakra Canal. These two systems are interlinked by the Narwana and Barwala link canals of the Bhakra Canal system. Infrastructure in Jind district comprises banks, primary agricultural co-operative credit societies and regulated markets. The road length per lakh population was around 67 kms.

Fatehabad

The district of Fatehabad was founded by Firoz Shah Tughlak in the 14th century. He named it after his son Fateh Khan and it was carved out of erstwhile Hissar district in 1997. It is located at 29.52° north and 75.45° east with an average elevation of 208 metres. It falls in the south western part of Haryana. It is surrounded by Punjab in north of the district, Hissar in south of the district, Jind in east and Rajasthan and district Sirsa in the west. The geographical area of the district is 2,520 sq kms which is around 5.4 per cent of the state of Haryana.

According to Population Census of India, 2011, Fatehabad had a population of 9.42 lakh persons. The district is basically rural with around 81 per cent of population residing in rural areas. Fatehabad has a literacy rate of around 68 per cent which is below the state level. The higher sex ratio in the district Fatehabad is a positive feature and it is higher than the state level with ratio of 903 females per 1000 males.

Around 53 per cent of the geographical area forms the net sown area. Tube-wells are the main source of irrigation. The net irrigated area constituted 96.9 per

cent of the net sown area and the gross irrigated area constituted even more. The cropping intensity in the district was around 188 per cent.

The share of GCA devoted to different crops in Fatehabad indicates that oilseeds and cotton are also grown along with cereal crops. In particular, cotton covered around 22 per cent of GCA. Oil seeds were grown on 2 per cent of GCA. American cotton is one of the important crops grown in the district and occupied 20.52 per cent of GCA. Thus, foodgrains followed by cotton are the main crops grown in the district. It is worth mentioning that the yield rates of cereals in Fatehabad were higher than the state level. The major reasons for the success could be availability of irrigation and higher consumption of fertilizer (Table 3.1).

The climate of the district is tropical in nature with hot summer and cool winter, with a temperature of 47 degree celsius in June and 2 degree celsius in December and January. Fatehabad district is connected by road with Punjab, Delhi and Sirsa district. A network of metalled roads links all its villages and towns. The National Highway No.10 connects Fatehabad with Delhi and Punjab.The district Fatehabad is an alluvial plain of indo-genetic basin. No perennial river flows through the district, however, a seasonal river i.e, Ghaggar is flowing through Ratia and Jakhal. Bhakra and western Yamuna are two main canals that irrigate most of the fields in the district.In terms of infrastructure, the district Fatehabad is endowed with banks, cooperative agricultural societies and roads. The road length per lakh of population in the district is above the state level.

Chapter-4

Socio-Economic Characteristics of Sampled Farmers

This Chapter presents an analysis of socio-economic characteristics of sampled farm households. In fact, issues related to crop diversification at the micro level considered for analysis in this study are complex and cannot be taken up for investigation in isolation without considering some of the basic characteristics of the sample households. We have included those characteristics that have a definite bearing on production and crop diversification by the farmers.

4.1 Demographic Characteristics:

We begin with analyzing age and education of the head of selected farm households. It plays an important role in adoption of technology and diversification of farming. The distribution of age of the head of farm households presented in Table 4.1 reveals that only 8.10 per cent of heads were found below 30 years in age. However, none of the large farmers belonged to this age group. Around half of the heads were found in the age group of 30-50 years while about 41 per cent were observed above 50 years at the overall level. The range of age group of head of selected farm households showed significant variations across farm sizes. In particular, large farm households showed higher share of heads above 50 years in age.

Education is a catalytic factor in attaining efficiency in management of skills and capacity to improve and innovate. Among the selected households, around half of them attained education upto matric level. Around 11 and 16 per cent heads studied upto primary and secondary level. It is depressing to note that 13.33 per cent heads at the overall level were illiterate despite implementation of Serve Shiksha Abhiyaan in the state of Haryana. The level of education of heads varied across farm sizes. In particular, share of illiterate heads was observed higher in small category in comparison to other categories and vice versa, share of graduate and above superseded in large farm size category.

The main occupation of head of selected farm households was agriculture in case of 96.19 per cent and only 3.81 per cent were engaged in subsidiary occupation at the overall level. None of the head in small farm category took up agriculture as subsidiary occupation while around 5 and 3 per cent of medium and large category farmers adopted supportive activities to augment their family income. During the survey, it was observed that dairying is a popular subsidiary occupation in rural areas of Haryana.

In demographic details, we have also analyzed average size of family and age of family members. This indicates availability of manpower to initiate additional activities related to agriculture. The average size of family was around 7 persons in selected farm households. The category of large farm households indicated higher size (around 9 persons) in comparison to other categories. It could be due to prevalence of joint family system. The average size of family was 5.98 persons in small category while it was 6.89 persons in case of medium category. A positive relationship could be observed in farm size and average size of family in the case of selected farm households. The number of males and females was also observed higher in large size category. Surprisingly, the number of males was higher in each size category and at the aggregate level. This implies a low sex ratio which is indicative of imbalance in the male and female population.

Survey results point out that the practice of employing permanent farm labour is not common among the selected farm households. However, 16 and 31 permanent male labourers were engaged by medium and large category at a wage rate of Rs. 6,625 and Rs. 5,974 per month. The female permanent labourers were only 2 and 7 employed again by medium and large categories. The wage rate of female labourer was found lower than male labourer. This is indicative of gender bias in employment in rural areas of Haryana. In addition to male and female permanent labourers, 10 children were engaged by large farm households and their wage rate was Rs. 2,430 per month during 2012-13.

Table 4.1

General Characteristics of Sampled Households, 2012-13, Haryana

(Percent)

Particulars	Small	Medium	Large	Overall
Age of Head (Years)				
Upto 30	8.51	10.08	0.00	8.10
30 - 50	51.06	51.16	47.06	50.48
Above 50	40.43	38.76	52.94	41.42
All	100.00	100.00	100.00	100.00
Educational status of head of the family				
Illiterate	17.02	13.18	8.82	13.33
Primary	12.77	9.30	14.71	10.95
Matric	55.31	52.72	47.05	52.39
Secondary	12.77	17.05	14.71	15.71
Graduate and above	2.13	7.75	14.71	7.62
Average Family Size (No.)				
Males	3.17	3.71	4.82	3.78
Females	2.81	3.18	4.47	3.30
Total	5.98	6.89	9.29	7.08
Age of family members (Years)				
Upto 18	30.25	30.60	35.76	31.63
18 -35	35.23	33.97	33.86	34.19
35 - 60	25.27	27.22	21.20	25.57
Above 60	9.25	8.21	9.18	8.61
Occupation of Head of family				
Agriculture as Main Occupation	100	94.57	97.06	96.19
Agriculture as Subsidiary Occupation	0.00	5.43	2.94	3.81
Permanent farm labour				
Male				
No.	1	16	31	48
Wages(Rs./month)	6000	6625	5974	6192
Female				
No.	0	2	7	9
Wages(Rs./month)	0	6400	4310	4774
Children				
No.	0	0	10	10
Wages(Rs./month)	0	0	2430	2430

Source: Field Survey

4.2 Land Resources:

After analyzing demographic features of sample farm households, we will examine status of land resources during the reference year. Land details assume a special significance in the rural areas because they indicate the economic and social status of the farmer. The status of land holdings of sampled households indicates that the selected farm households owned 3.85 hectares per household at the aggregate level. As expected, land owned by large farm households was higher than small and medium farmers. Thus, a positive relationship emerged between farm size and land owned by the farm households. An examination of land resources of sampled farmers revealed that all categories of farmers leased in land and it was observed higher in the case of large farmers in comparison to other categories of farmers. Although, the practice of leasing in land was prevalent but leasing out of land was found marginal. The leased out land at the overall level was 0.29 hectare per household. Once again, large category leased out 1.02 hectares per household while it was negligible in the case of small and medium farmers. These results imply that majority of sampled farmers were owner cultivators. A fraction of cultivated land was found leased in. It appeared that the system of leasing out was not popular among the selected farmers. (Table 4.2) In view of Haryana being an agriculturally advanced state, hardly any land was observed as current fallow. This finding was almost uniform for each farm size category.

Farm size plays an important role in decision making about the crop pattern, input use and adoption of technology. An examination of average size of net operated land on sampled farms in Table 4.2 indicates that it was 5.26 hectares per household at the overall level. Large category farmers operated 13.40 hectares per household while small and medium farmers operated around 1 and 5 hectares of land. Thus, disparities in operational holdings across farm categories were found significant. The status of irrigation was an important factor in realizing productivity per unit of land. More than 95 per cent of land operated by farmers at the aggregate level was found irrigated. In particular, land operated by large farm households was fully irrigated. We had also sought information about source of irrigation during our survey. It was observed that tube wells are major source of irrigation. Some farmers combined tubewells and canal for watering their fields. The sources such as tanks are non-existent

Table 4.2

Land Resources of Sampled Households, 2012-13, Haryana

(Hectares per farm)

Particulars	Small	Medium	Large	Overall
Owned land				
Irrigated	1.204	3.367	9.129	3.815
Unirrigated	0.017	0.056	0.000	0.039
Total	1.221	3.423	9.129	3.854
Leased-in land				
Irrigated	0.124	1.301	5.297	1.685
Unirrigated	0.000	0.013	0.000	0.008
Total	0.124	1.314	5.297	1.693
Leased-out land				
Irrigated	0.086	0.169	1.024	0.289
Unirrigated	0.000	0.000	0.000	0.000
Total	0.086	0.169	1.024	0.289
Current Fallow				
Irrigated	0.000	0.009	0.000	0.006
Unirrigated	0.000	0.000	0.000	0.000
Total	0.000	0.009	0.000	0.006
Net Operational land				
Irrigated	1.242	4.508	13.402	5.217
Unirrigated	0.017	0.069	0.000	0.047
Total	1.259	4.577	13.402	5.264

Source: Ibid

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4.3 Farm Power and Machinery:

Land and other resources influence the level and pattern of farm management in rural households. The efficient and optimal use of agricultural land depends on the availability of appropriate farm assets. We have collected data related to the value of major farm assets owned by the surveyed households. In our sampled households, each category of farm households possessed various inventories. Now, we will take up the ownership of farm inventory by the selected farm households during the reference year. These include tractor, trolley, harrow, cultivator, electric motor, diesel engine, submersible pump, spray pump, generator, cart, drip system, storage shed and small tools.

The sampled farm households on an average possessed assets worth Rs 4,03,138 at the overall level. The farm size disparities were very wide. The small category of farm households owned farm assets worth Rs. 99,855 against Rs. 7,64,807 by the large farm category. It may be highlighted that the present value of farm assets increased with increasing size of holding and indicated a positive relationship. As expected, households in small category indicated lowest value of farm assets. While the large category of farm households owned the highest by indicating present value of Rs. 7,64,807 per household (Table 4.3).

The tractor followed by submersible pump emerged as the major assets owned by selected farmers. Tractor followed by the submersible pump valued Rs. 1,91,324 and Rs. 70,486 per farm at the overall level. The storage sheds and trolley appeared to be the next in terms of present value. The selected farmers also owned other items.

Results about the ownership of per household assets for the entire sample covering all farm sizes were on expected lines since large category indicated the highest value of farm assets during the reference year.

Table 4.3
Ownership of Farm Inventory, Sampled Households, 2012-13, Haryana

(Per farm)

Type of Machine	Small		Medium		Large		Overall	
	No.	PV	No.	PV	No.	PV	No.	PV
1. Tractor	0.13	47447	0.67	204767	0.97	339206	0.60	191324
2. Trolley	0.11	10106	0.58	40341	0.91	80235	0.53	40033
3. Harrow	0.09	2894	0.60	18612	0.94	31912	0.54	17248
4. Cultivator	0.11	1787	0.62	8236	0.94	15735	0.56	8007
5. Electric Motor	0.15	2043	0.42	8155	0.85	16765	0.43	8181
6. Diesel Engine	0.09	1319	0.44	6617	0.68	10471	0.40	6055
7. Submersible Pump	0.19	13660	0.74	75853	1.26	128676	0.70	70486
8. Spray Pump	0.13	211	0.60	3661	0.85	12294	0.54	4286
9. Generator	0.00	0	0.04	775	0.18	10559	0.05	2186
10.Cart	0.43	7851	0.36	6787	0.32	7029	0.37	7064
11.Drip System	0.00	0	0.11	3543	0.12	4647	0.09	2929
12.Small Tools	5.00	1133	3.47	888	5.12	1449	4.08	1034
13.Implements/storage shed	0.13	8085	0.35	38876	0.74	97588	0.36	41490
14.Others	0.04	3319	0.05	1202	0.26	8241	0.08	2815
Total		99855		418314		764807		403138

Source: Ibid

4.4 Cropping Pattern:

Crop pattern signifies the proportion of cultivated area under different crops at a point of time. Crop pattern of an area depends on soil, water and temperature. There are two important harvests in Haryana and crops are grown mainly in two seasons- kharif and rabi. With adequate availability of irrigation facility, river beds are most suitable for the cultivation of summer season crops grown between April to July. Farmers decision to grow a particular crop during a season is mostly based on profitability, resource availability, requirement for domestic consumption, payment in kind and feed for the livestock.

Since, one of our main objectives is to assess the cost of cultivation and the returns generated from crops grown by the sampled farmers in kharif reason, it is pertinent to examine crop pattern adopted by the sampled farm households. The information about the crop pattern of selected farmers was collected during the survey. These results are presented in Table 4.4.

According to the survey, paddy in kharif and wheat in rabi dominated the crop pattern of sample farm households at the aggregate level. This result was found uniform for all categories although share of NAS devoted to these crops varied in each farm size. Cotton followed by fodder and maize was observed as the important crops in terms of NAS devoted in kharif season by the sampled households. The area allocated to these crops varied between 3.18 per cent of NAS on large farms to 25.62 per cent of NAS on large farms. Bajra and sugarcane were grown on 4.86 and 4.07 per cent of NAS respectively.

Results show that less than 1 per cent of GCA was devoted to kharif pulses (moong and mash) and rabi pulse (gram) despite their nutritive value, nitrogen fixing capacity and low requirement of irrigation. Farmers also grew fodder in kharif and rabi seasons in order to feed their dairy animals. Since, area under horticultural crops is catching up in Haryana, 1.47 per cent of GCA was devoted to vegetables. It may be noted that proportion of GCA allocated to various crops grown by farmers varied significantly across farm sizes.

In a nutshell, wheat followed by paddy and cotton were the major crops grown by the sampled farmers during the reference year.

Table 4.4

Cropping Pattern of sample households, 2012-13, Haryana

(Percent of Net Area Sown)

Season/crop	Small	Medium	Large	Overall
A. Kharif				
1. Paddy	46.01	44.54	41.39	43.31
2. Maize	17.85	7.07	3.18	6.04
3. Bajra	8.00	6.46	2.40	4.86
4. Jowar Fodder	15.35	9.59	5.46	8.20
5. Cotton	9.40	17.51	25.62	20.42
6. Sugarcane	0.00	3.30	5.60	4.07
7. Moong	0.00	1.54	1.29	1.35
8.Mash	0.00	0.31	0.36	0.31
9.Others	2.74	3.48	6.48	4.68
B. Rabi				
1. Wheat	76.67	81.16	80.46	80.63
2. Gram	0.00	0.00	0.09	0.04
3. Rapeseed & Mustard	0.00	0.91	3.23	1.82
4. Vegetables	3.76	3.04	0.98	2.23
5. Berseem Fodder	10.43	6.42	3.25	5.33
6. Others	4.75	2.81	2.18	2.65
C. Summer Crops				
1. Maize	4.10	0.34	0.36	0.55
2. Fodder	0.00	0.00	0.09	0.04
3. Others	0.26	1.10	0.93	0.99
Net Area Sown (ha.)	**59.17**	**589.28**	**455.69**	**1104.14**

Source: Ibid

The climate of Haryana is suitable for growing a variety of crops but crop pattern is found skewed towards wheat and paddy. We had enquired about the potential of alternative crops to paddy as perceived by sampled households in 2012-13. Results indicate that farmers opted for bajra, maize and cotton as potential alternative crops. In particular, higher proportion of medium and large farmers viewed cotton as a next competing crop. (Table 4.5)

Table 4.5
Potential Alternative Crops to Paddy Crop as Perceived by Sampled Households, 2012-13, Haryana

(Percent multiple response)

Crop	Small	Medium	Large	Overall
Bajra	27.66	36.43	29.41	33.33
Maize	55.32	31.78	23.53	35.71
Cotton	21.28	37.98	73.53	40.00

Source: Ibid

4.5 Production and Disposal/Utilization Pattern:

In the preceding section, we have presented socio-economic characteristics of the sampled farmers, land details, farm assets and crop pattern of the surveyed farmers during the reference year. Now, we are going to analyze main findings of the survey regarding production and disposal of paddy and major alternative crops grown by farmers in the kharif season in Haryana during 2012-13.

The state of Haryana is characterized by three main food grains i.e. wheat, paddy and bajra. Maize is gradually picking up in some areas. Wheat is the main staple diet and rice is gradually occupying an important position. Bajra can be regarded as an inferior cereal in comparison to wheat and rice and can be considered as the diet of the poor. As a result, these three cereals occupy an important position in terms of production and human consumption. Wheat and bajra are used as animal feed too. In such circumstances, retention for consumption of family, seed requirement, animal feed, part payment of wages in kind to the hired labourers and retention for payment of rent in kind in the case of leased in land assume special significance in policy initiatives.

Now, we present details of production and retention for various purposes for paddy and alternative crops grown in kharif season during the reference year. The production of paddy was around 101 qtls per farm on sampled farms during 2012-13. Farm size variations were observed wide. The small farmers produced around 27 qtls against 243 qtls per farm produced by large farmers during the reference year. The pattern of retention of paddy by the sampled farmers presented in Table 4.6 reveals that per farm retention of paddy for domestic consumption by the farmers at

the aggregate level was 2.58 qtls. Farm size variations were not wide since all categories retained more than 2 qtls for variety of uses. In retention, self consumption dominated while other requirements were observed marginal. This result was uniform for all categories of farmers. The quantity of paddy sold was around 99 qtls per farm during the reference year. Since, large category farmers produced the maximum, they also dominated in sales. It may be noticed that retention for other purposes such as seed, feed and payment in kind was observed marginal in all categories.

Table 4.6

Production and Retention Pattern of Paddy, Sampled Households, 2012-13, Haryana

(Qtl / farm)

Crop : Paddy	Small		Medium		Large		Overall	
	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%
Production	27.44	100.00	90.38	100.00	243.68	100.00	101.11	100.00
Retention for								
Self consumption	1.94	7.07	2.25	2.49	3.05	1.25	2.3	2.27
Seed	0.18	0.66	0.13	0.14	0.29	0.12	0.17	0.17
Feed	0	0.00	0	0.00	0	0.00	0	0.00
Payment in Kind	0.06	0.22	0.09	0.10	0.21	0.09	0.11	0.11
Total Retention	2.18	7.94	2.47	2.73	3.55	1.46	2.58	2.55
Total Quantity Sold	25.26	92.06	87.91	97.27	240.13	98.54	98.53	97.45

Source: Ibid

Table 4.7

Production and Retention Pattern of Bajra, Sampled Households, 2012-13, Haryana

(Qtl / farm)

Crop : Bajra	Small		Medium		Large		Overall	
	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%
Production	1.97	100.00	5.98	100.00	6.82	100.00	5.22	100.00
Retention for								
Self consumption	0.15	7.61	0.46	7.69	0.59	8.65	0.41	7.85
Seed	0.00	0.00	0.02	0.33	0.00	0.00	0.01	0.19
Feed	0.09	4.57	0.48	8.03	0.60	8.80	0.41	7.85
Payment in Kind	0.00	0.00	0.06	1.00	0.00	0.00	0.04	0.77
Total Retention	0.24	12.18	1.02	17.06	1.19	17.45	0.87	16.67
Total Quantity Sold	1.73	87.82	4.96	82.94	5.63	82.55	4.35	83.33

Source: Ibid

Results further show (Table 4.7) that production of bajra was 5.22 qtls per farm at the overall level during the reference year. The small category produced 1.97 qtls per farm while large farmers grew 6.82 qtls per farm. Findings show that retention of bajra was less than one qtl per farm at the aggregate level and it was around the same for medium and large category of farmers during 2012-13. Like paddy, self consumption played a dominant role in retention. It may be further noticed that retention of bajra for other purposes was less than half a qtl during the reference year.

Some farmers grow maize during kharif in Haryana. The production of maize per farm was 8.67 qtls at the aggregate level. The small farm category produced 6.32 qtls against 8.94 qtls by the large category. The per farm retention for self consumption, seed, feed, payment in kind was 0.59 qtl per farm during the reference year. Like paddy and bajra, requirement for self consumption was dominant. It may be noticed that small farmers kept 0.87 qtl per farm for self consumption while large farmers retained only 0.20 qtl for this purpose. The per farm sale of maize was observed 8.08 qtls on sampled farms during the reference year (Table 4.8).

Table 4.8

Production and Retention Pattern of Maize, Sampled Households, 2012-13, Haryana

(Qtl / farm)

Crop : Maize	Small		Medium		Large		Overall	
	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%
Production	6.32	100.00	9.45	100.00	8.94	100.00	8.67	100.00
Retention for								
Self consumption	0.87	13.77	0.45	4.76	0.20	2.24	0.49	5.65
Seed	0.03	0.47	0.00	0.00	0.00	0.00	0.01	0.12
Feed	0.02	0.32	0.04	0.42	0.03	0.34	0.04	0.46
Payment in Kind	0.05	0.79	0.03	0.32	0.11	1.23	0.05	0.58
Total Retention	0.97	15.35	0.52	5.50	0.34	3.80	0.59	6.81
Total Quantity Sold	5.35	84.65	8.93	94.50	8.60	96.20	8.08	93.19

Source: Ibid

Cotton is a commercial crop cultivated largely by the farmers in some areas of Haryana. It is due to suitability of soil and low requirement of water. The selected

farmers produced 22.34 qtls of cotton per farm during the reference year. Further, large variations in production of cotton could be observed across farm sizes. None of the farmers retained cotton for self consumption and other purposes. Therefore, entire quantity of the produce was sold in the market by all categories of households during the reference year (Table 4.9).

Table 4.9
Production and Retention Pattern of
Cotton, Sampled Households, 2012-13, Haryana

(Qtl / farm)

Crop : Cotton	Small		Medium		Large		Overall	
	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%	Qtl / farm	%
Production	2.39	100.00	16.61	100.00	71.63	100.00	22.34	100.00
Retention for								
Self consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Payment in Kind	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Retention	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Quantity Sold	2.39	100.00	16.61	100.00	71.63	100.00	22.34	100.00

Source: Ibid

Next, we analyze disposal pattern of paddy and other alternative crops grown by farmers in Haryana during 2012-13. Results show (Table 4.10) that around 17,162 qtls of basmati and 3634 qtls of non-basmati paddy was disposed at the overall level during the reference year. The small category farmers disposed 655 qtls and 532 qtls of these varieties of paddy, whereas, the medium category farmers disposed 8343 and 2996 qtls respectively. It may be noticed that the disposal was 8265 qtls and 106 qtls of basmati and non-basmati paddy by large category farmers which was lower than the quantity disposed by the medium category farmers. Further, all the categories of farmers disposed basmati and non-basmati paddy primarily to local traders. The price per quintal realized by large category farmers was Rs. 3,604 /qtl for basmati paddy, which was lower than the price received by the medium category farmers during the reference year. Overall, it can be noticed that the quantity of paddy disposed by all categories of farmers to local traders was the highest.

Most of the farmers sold their produce of paddy to the local traders, while, some farmers disposed their produce to government agencies, processor/miller, private companies & any other agency. If we consider produce sold by farmers to the government agencies, it may be noticed that non-basmati paddy disposed by small category farmers to government agencies was 233 qtls against 1108 qtls by the medium category farmers. The similar trend can be observed that produce sold by medium category farmers to the government agencies was more than the produce sold by large category farmers which was 106 qtls. The pattern of disposal of paddy clearly indicates that there is no relationship between farm size and price received by the farmers for their produce. Small category farmers received lowest price for basmati paddy (Rs. 3,530/qtl), whereas, medium category farmers received highest price of Rs. 3,730 /qtl during 2012-13. In a nutshell, each category of farmers realized more than double price for basmati variety in comparison to non-basmati variety.

Table 4.10

Disposal Pattern of Paddy, Sampled Households, 2012-13, Haryana

Item	Small		Medium		Large		Overall	
	Basmati	Non-Basmati	Basmati	Non-Basmati	Basmati	Non-Basmati	Basmati	Non-Basmati
1. Local trader								
Quantity (qtls.)	608.1	299.5	8095.0	1887.6	7934.5	0.0	16637.6	2187.1
Price (Rs./qtl)	3528	1336	3718	1427	3625		3666	1414
2. Govt. agency								
Quantity (qtls.)	0.0	232.5	0.0	1108.0	0.0	106.0	0.0	1446.5
Price (Rs./qtl)		1280		1280		1280		1280
3. Processor/Miller								
Quantity (qtls.)	0.0	0.0	59.0	0.0	0.0	0.0	59.0	0.0
Price (Rs./qtl)			3800				3800	
4. Pvt. Company								
Quantity (qtls.)	47.0	0.0	188.5	0.0	230.0	0.0	465.5	0.0
Price (Rs./qtl)	3551		4225		2900		3502	
5. Any Other								
Quantity (qtls.)								
Price (Rs./qtl)								
6. Total								
Quantity (qtls.)	655.1	532.0	8342.5	2995.6	8164.5	106.0	17162.1	3633.6
Price (Rs./qtl)	3530	1311	3730	1372	3604	1280	3662	1361

In terms of produce sold by all the category of farmers to processor/ miller, it may be noticed that the small & large category farmers did not dispose any of their produce to processor/ millers, while, the medium category farmers disposed a small quantity of paddy i.e., 59 qtls to processor/ millers and realized a higher price of Rs. 3,800/qtl. Results further show that small, medium and large category farmers disposed a part of their produce to the private companies. It may be noticed that the large category farmers disposed 230 qtls of paddy to private companies and received a price of Rs. 2,900/qtl for the quantity disposed.

In a nutshell, it can be noticed that the medium category farmers disposed the maximum quantity of paddy 11,338 qtls against the lowest quantity 1,187 qtls disposed by the small category farmers. The large category farmers disposed 8,271 qtls of produce, whereas, in terms of price per qtl, large category farmers received the maximum price of Rs. 3,574/qtl for their produce against Rs. 2,536/qtl which is the price received by the small category farmers.

In the preceding analysis, we have discussed disposal pattern of paddy for the reference year. Now, we would analyze disposal pattern of bajra for the year 2012-13 in Table 4.11. It indicates that same pattern of disposal could be observed as in the case of paddy. Small category farmers disposed 81.5 qtls of bajra against 640 qtls disposed by medium category farmers to the local traders. The quantity of bajra disposed by large category farmers was 191.5 qtls and the overall quantity of bajra disposed by all categories of farmers to the local traders was 913 qtls.

It can be further noticed that there is a considerable difference in the prices received by all categories of farmers by disposing bajra to local traders. Small category farmers realized a price of Rs. 1,087/qtl from the disposal of bajra against Rs. 1,136/qtl received by large category farmers. Results show (Table 4.11) that there has been nil disposal of bajra by farmers to the government agencies, processor/miller and private companies. In a nutshell, it may be noticed that the maximum amount of bajra was disposed by medium category farmers at 640 qtls against 81 qtls disposed by small category farmers at the overall level.

So far, we have analyzed disposal pattern of paddy & bajra. Now, we will analyze the disposal pattern of maize by the sampled households in Haryana for the year 2012-13.

Table 4.11
Disposal Pattern of Bajra, Sampled Households, 2012-13, Haryana

Item	Small	Medium	Large	Overall
1. Local trader				
Quantity (qtls.)	81.5	640.2	191.5	913.2
Price (Rs./qtl)	1087	1106	1136	1110
2. Govt. agency				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
3. Processor/Miller				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
4. Pvt. Company				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
5. Any Other				
Quantity (qtls.)				
Price (Rs./qtl)				
6. Total				
Quantity (qtls.)	81.5	640.2	191.5	913.2
Price (Rs./qtl)	1087	1106	1136	1110

Source: Ibid

Results show (Table 4.12) that aggregate disposal of maize at the overall level was 1,696 qtls during the reference year. The small category farmers disposed 251 qtls of maize against 1,004 qtls disposed by medium category farmers to the local traders. Large category farmers disposed 292 qtls of maize and all the categories of farmers collectively disposed 1,548 qtls of maize to the local traders during the reference year. The average price received at the overall level by disposing maize to local traders was Rs. 1,271/qtl. It may be noticed that the small category farmers received the highest price of Rs.1,349/qtl against large category farmers who received Rs. 1,236/qtl.

Table 4.12
Disposal Pattern of Maize, Sampled Households, 2012-13, Haryana

Item	Small	Medium	Large	Overall
1. Local trader				
Quantity (qtls.)	251.2	1004.4	292.4	1547.9
Price (Rs./qtl)	1349	1262	1236	1271
2. Govt. agency				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
3. Processor/Miller				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
4. Pvt. Company				
Quantity (qtls.)	0.0	148.0	0.0	148.0
Price (Rs./qtl)		1207		1207
5. Any Other				
Quantity (qtls.)				
Price (Rs./qtl)				
6. Total				
Quantity (qtls.)	251.2	1152.4	292.4	1695.9
Price (Rs./qtl)	1349	1255	1236	1266

Source: Ibid

Results further show that there has been nil disposal of maize by all the categories of farmers to government agencies and processor/millers during the reference year. However, there has been disposal of 148 qtls of maize by the medium category farmers to private companies and they realized a price of Rs 1,207/qtl for the disposal of maize.

In brief, it may be observed that the medium category farmers disposed maximum amount of maize (1,152 qtls) against 251 qtls disposed by small category farmers. Large category farmers disposed 292 qtls of maize during the reference year.

Now, we present disposal pattern of cotton by the sampled household in Haryana during the reference year. Results show (Table 4.13) that disposal of cotton to local traders by small category farmers was the lowest at 105 qtls against 2,435 qtls by large category farmers. Table shows that the disposal of cotton by all the categories of farmers to the local traders was 4,682 qtls.

Table 4.13
Disposal Pattern of Cotton, Sampled Households, 2012-13, Haryana

Item	Small	Medium	Large	Overall
1. Local trader				
Quantity (qtls.)	104.5	2142.4	2435.2	4682.1
Price (Rs./qtl)	5021	5072	4853	4957
2. Govt. agency				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
3. Processor/Miller				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
4. Pvt. Company				
Quantity (qtls.)	0.0	0.0	0.0	0.0
Price (Rs./qtl)				
5. Any Other				
Quantity (qtls.)				
Price (Rs./qtl)				
6. Total				
Quantity (qtls.)	104.5	2142.4	2435.2	4682.1
Price (Rs./qtl)	5021	5072	4853	4957

Source: Ibid

It may also be noticed that there has been nil disposal of cotton by all the category of farmers to the government agencies, processor/millers and private companies. In terms of price realization we can conclude that the large category farmers received the lowest price (Rs. 4,853/qtl) for their produce of cotton against medium category farmers who received the highest price (Rs.5,072/qtl) during 2012-13.

Chapter-5

Economics of Production of Paddy vis-à-vis Alternative Crops in Haryana

Economics or profitability of various crops is the most important determinant of production of agricultural commodities governing the behaviour of producers. In reality, perceptions of profitability derive crop options. Farmers grow crops, which offer the highest returns per unit of their precious resources such as land and expensive inputs. Profitability being a catalytic factor in increased production of agricultural commodities, it is proposed to analyze related issues such as input use pattern, cost of cultivation and economics of production of paddy vis-à-vis alternative crops grown in kharif season on the sampled farms in Haryana during 2013-14. In addition, we have also examined resource use efficiency in cultivation of included crops.

In this chapter, analysis of gross and net returns from cultivation of selected crops is based on data collected during the field survey in selected six districts of Haryana. The discussion is confined to paddy, maize, bajra and cotton in kharif season. Further, net returns from these four selected crops are computed. The variable costs constituted human labour (hired and family), machine labour, seed, fertilizer, plant protection, manure, irrigation and interest on working capital. The net returns for each crop were worked out by subtracting costs from gross returns. Gross returns for these crops were calculated on the basis of the value of the main product and by product. It may be mentioned that net returns and profitability are used interchangeably in the analysis.

Now, we present results of primary data on various aspects related to paddy, bajra, maize and cotton grown on sampled farms during the year 2013-14. Specifically empirical findings on input use pattern, cost of cultivation, economics of production and resource use efficiency of paddy vis-à-vis alternative crops (bajra, maize and cotton) are discussed in the following sections.

5.1 Input Use Pattern of Major Kharif Crops:

The utilization of HYV seeds, fertilizer, pesticides, tractor and tube wells play an important role in boosting the agricultural development of a region. Haryana is using these inputs for a long time. The consumption of fertilizer in the state was 386

kg./ha. during 2010-11. The nitrogenous fertilizers were preferred over phosphatic and potassic fertilizer. The state of Haryana has already moved towards agricultural mechanization. Use of tractors, tube wells and pumping sets is common in the state. It may be pointed out that Haryana is ahead of other states in the production as well as distribution of high yielding variety seeds. These were used on 98.5, 66.7 and 97.6 per cent of cultivated area in case of wheat, rice and bajra, while for maize it was 70.0 per cent during 2009-10.

We begin with paddy which is the most important among kharif crops in Haryana. It is also one of the key crops grown world over and central to the lives of billions of people in the world. Around 9 per cent of arable land of the world is devoted to this single crop. Asia accounts for over 90 per cent of the world's production with India, China and Indonesia as the major producers. However, a small proportion of production is traded in the world market. India is one of the major exporters of rice in the world. It can be grown under diverse conditions but requires a lot of irrigation. The varieties of rice are short, medium or long grain, aromatic, waxy (sticky) or non-waxy.

With this brief introduction, we present inputs used in cultivation of paddy by sampled farmers (Table 5.1). Paddy growers used 58.6 man days of human labour per hectare including hired and family. The small category used higher human labour than average while large category of farms used lower human labour per hectare during 2012-13. This difference is due to availability of family labour. Normally, it is higher in case of small farm families because they do not have alternative gainful employment opportunities owing to lack of skill and training. On the contrary, family members from large households would consider status value of the job due to preference for leisure and substantial access to relatively skilled and remunerative jobs. As expected, share of family labour was highest in case of small farmers. The use of machine labour per hectare and farm size was found negatively correlated. This indicates even higher preference of small farm households for mechanization of operations for preparation of land to application of inputs. This result is contrary to expectations. In fact, it requires greater investment of capital to own tractor, power sprayer, harvest combine, pump sets (diesel and electrical), planters, etc. However, mechanization of operations may not replace human labour since it improves production and productivity of crops by in time completion of various operations. It is

also essential in the economy like Haryana where human labour is in short supply. There was marginal difference in quantity of seed used. Farmers also used manure along with chemical fertilizer such as urea, DAP and MOP, etc. Among chemical fertilizer, urea and DAP were the major constituents. Further, plant protection was resorted by all categories of farmers. On an average, farmers applied irrigation for around 43 hrs/ha. and it was maximum by small category of farmers.

Table 5.1
Input Use Pattern for Cultivation of Paddy,
Sampled Households, 2012-13

(Perhectare)

Particulars	Unit	Small	Medium	Large	Overall
1. Human Labor	Mandays	72.1	62.2	51.8	58.6
i) Hired		57.4	54.9	48.2	52.4
ii) Family		14.8	7.3	3.6	6.2
2. Machine Labor	Hours	88.2	80.6	75.0	78.8
3. Seed	Kg.	11.1	11.4	11.4	11.4
4. FYM	Kg.	1395.8	1295.9	1108.2	1227.6
5. Fertilizer	Kg.				
i) Urea		229.4	221.6	245.8	231.6
ii) CAN		4.4	0.4	4.1	2.1
iii) DAP		116.1	110.8	92.7	104.0
iv) MOP		6.4	17.3	17.2	16.6
v) SSP		3.9	14.0	20.3	15.9
vi) Other		14.0	11.0	10.0	10.8
vii) Micro nutrients		0.9	2.8	3.1	2.8
6. Plant protection	Rs.	1803	2610	2923	2688
7. Irrigation	Hours	49.1	43.5	40.8	42.7
8. Any other					

Source: Field Survey

Bajra is one of the major coarse cereal crops and also drought resistant among cereals and millets. It is the basic staple food of the poor. It can be used in many forms for human consumption as bread, porridge and steamed. India is the largest producer of bajra with 7.20 million hectares of area, 8.74 million tonnes of production and an average productivity of 1214 kg/ha. Haryana contributes 5.69 and 9.04 per cent to all India area and production with a productivity ranking as second among the major growing states.

Table 5.2
Input Use Pattern for Cultivation of Bajra, Sampled Households, 2012-13 (Per hectare)

Particulars	Unit	Small	Medium	Large	Overall
1. Human Labor	Mandays	22.3	20.3	21.3	20.7
i) Hired		15.7	16.7	18.5	17.0
ii) Family		6.5	3.6	2.8	3.7
2. Machine Labor	Hours	10.6	24.2	13.8	20.9
3. Seed	Kg.	5.3	3.8	3.3	3.9
4. FYM	Kg.	422.4	131.4	0.0	130.3
5. Fertilizer	Kg.				
i) Urea		116.2	103.3	91.9	102.1
ii) CAN		0.0	2.0	0.0	1.4
iii) DAP		40.1	53.9	57.2	53.4
iv) MOP		0.0	0.0	4.6	0.9
v) SSP		0.0	0.0	4.6	0.9
vi) Other		0.0	0.1	0.0	0.1
vii) Micro nutrients		0.0	0.0	0.0	0.0
6. Plant protection	Rs.	63	156	183	153
7. Irrigation	Hours	1.3	2.1	2.5	2.1
8. Any other					

Source: Ibid

Farmers in Haryana treat bajra as a low value crop and therefore, they apply minimum doses of inputs. The cultivators used 21 man days per hectare of human labour with maximum being used by the small category on sampled farms during 2012-13. The use of machine labour was 20.9 hrs/ha. at the aggregate level and medium category households used higher than other categories of farm households. It may be observed that small category applied relatively large quantity of seeds. It may be pointed out that large farmers did not apply manure. All farmers used chemical fertilizer. Urea followed by DAP were the main variants. It is useful to mention that none of the sampled farmers applied micro nutrients in cultivation of bajra. The amount spent on plant protection was Rs. 153/ha. at the overall level and large category incurred higher expenditure on this item in comparison to other categories. The use of irrigation was marginal irrespective of farm categories (Table 5.2)

Maize is not a popular coarse cereal grown by the farmers in Haryana despite its multiple uses for human consumption, poultry feed and as a mixture in bio fuels. We have presented information on input use in cultivation of maize by sampled farmers in Table 5.3.

Table 5.3
Input Use Pattern for Cultivation of Maize, Sampled Households, 2012-13 (Per hectare)

Particulars	Unit	Small	Medium	Large	Overall
1. Human Labor	Mandays	52.4	29.3	27.5	32.6
i) Hired		20.5	22.2	26.8	22.9
ii) Family		31.9	7.2	0.7	9.7
2. Machine Labor	Hours	27.1	15.0	10.3	15.9
3. Seed	Kg.	19.9	14.6	6.6	13.7
4. FYM	Kg.	454.4	120.0	621.2	281.7
5. Fertilizer	Kg.				
i) Urea		191.7	171.2	182.9	177.0
ii) CAN		0.2	0.0	34.5	7.5
iii) DAP		142.0	83.4	93.2	94.8
iv) MOP		4.7	39.0	45.2	34.9
v) SSP		4.7	4.7	1.2	3.9
vi) Other		2.1	2.9	1.0	2.4
vii) Micro nutrients		0.5	0.4	0.0	0.3
6. Plant protection	Rs.	798	1449	869	1220
7. Irrigation	Hours	6.6	2.7	2.1	3.2
8. Any other					

Source: Ibid

It indicates that farmers utilized 32.6 man days of human labour per hectare at the aggregate level. The small category farmers used more of family labour than other categories of farmers. It could be due to availability of family labour. On an average,15.9 hrs/ha. of machine labour was used for various operations. The small category used machine labour of around 27 hrs/ha against almost 10 hrs/ha. by large category. On an average, farmers applied 13.7 kg/ha of seed but large category used less of it. It could be due to difference in variety grown by them. Contrary to earlier results for paddy and bajra, large category of farmers applied highest quantity of FYM in comparison to other categories. The chemical fertilizer was applied by all categories and again, urea, DAP and MOP were the major variants. Further, farmers hardly applied any micro nutrients while each category incurred more than Rs.750 on plant protection. The medium category of farmers spent higher amount than other categories. A little use of irrigation for growing maize was common and it was higher for small farmers in comparison to other categories.

Cotton is a major commercial crop which has been generating employment opportunities in Haryana in spite of technological advancement. The problems of

insect/pests sometimes discourage farmers to grow cotton. Table 5.4 presents information on input use by sampled farmers in cultivation of cotton. It may be noted that cultivators used 63.2 man days of human labour per hectare at the aggregate level. Further, small category used higher human labour than other farm categories. Most of the farmers used hired labour for picking cotton. The machine labour was used by all categories and it was 28.5 hrs/ha. at the overall level. Seed is the vital input and therefore, marginal variations were found in quantity of seed application across farm sizes. The application of FYM was common, however, small category used higher quantity than other categories of farmers. Among chemical fertilizer, urea, DAP, MOP and SSP were used by farmers. It is worth noticing that farmers used several variants of fertilizer for this crop. Even micro nutrients were applied by all categories of farmers. One could observe huge expenditure on plant protection irrespective of farm category. It was as high as Rs. 4554/ha. at the aggregate level. It can be justified since cotton is easily prone to pest attacks. Irrigation was also applied by all categories but small farmers used more of it in comparison to other categories.

Table 5.4
Input Use Pattern for Cultivation of Cotton,
Sampled Households, 2012-13 (Per hectare)

Particulars	Unit	Small	Medium	Large	Overall
1. Human Labor	Man days	77.1	62.3	63.2	63.2
i) Hired		60.1	54.5	59.4	57.2
ii) Family		17.0	7.9	3.8	6.0
2. Machine Labor	Hours	47.5	25.1	30.5	28.5
3. Seed	Kg.	2.5	2.4	2.3	2.3
4. FYM	Kg.	359.4	261.6	239.8	252.8
5. Fertilizer	Kg.				
i) Urea		211.2	241.8	235.5	237.8
ii) CAN		0.0	1.9	5.6	3.8
iii) DAP		125.8	116.3	116.9	116.9
iv) MOP		27.9	33.0	36.8	34.9
v) SSP		49.4	32.5	53.7	43.9
vi) Other		5.5	7.8	4.7	6.1
vii) Micro nutrients		5.4	4.5	1.5	3.0
6. Plant protection	Rs.	5636	4576	4483	4554
7. Irrigation	Hours	12.8	7.0	9.6	8.5
8. Any other					

Source: Ibid

5.2 Cost of Cultivation of Paddy vis-à-vis Alternative Crops:

We have already analyzed input use in cultivation of paddy and alternative crops on the sampled farms in Haryana during 2012-13. The details of cost incurred by the paddy growers on various inputs are presented in Table-5.5.The per hectare cost of cultivating paddy was Rs. 35,581 on sampled farms. Clearly, the maximum proportion of cost was observed on human labour (42.45 per cent). In the array, machine labor and fertilizer were the major items of cost in paddy cultivation. Around 20.81 per cent of total cost was spent on plant protection. The cost of FYM was merely Rs. 682 per hectare. The low amount spent on FYM was due to preference of paddy growers for chemical fertilizers. Since, paddy is a water intensive crop, expenditure of Rs. 3,266 per hectare was incurred on irrigation. It may be further noticed that expenditure incurred on various items varied across farm size. In case of human labour, small farmers incurred higher cost in comparison to other categories. As expected, component of family labour in total cost of human labour per hectare was found the maximum in case of small farmers. This could be due to availability of the family labour. On the other hand, cost of family labour was merely Rs. 751 per hectare in case of large category. Similarly, small farmers spent relatively higher amount on machine labour and seed. The medium farmers incurred higher cost on FYM and fertilizer in comparison to small and large category of farmers.

Table 5.5
Cost of Cultivation (Variable Cost) of Paddy,
Sampled Households, 2012-13 (Rs./hectare)

Particulars	Small		Medium		Large		Overall	
	Rs/ha	%	Rs/ha	%	Rs/ha	%	Rs/ha	%
1. Human Labor								
i) Hired	14341	35.08	14166	38.06	13003	39.96	13717	38.55
ii) Family	3801	9.30	1598	4.29	751	2.31	1389	3.90
2. Machine Labor	9751	23.85	7921	21.28	6351	19.52	7406	20.81
3. Seed	1325	3.24	1094	2.94	890	2.74	1027	2.89
4. FYM	650	1.59	717	1.93	637	1.96	682	1.92
5. Fertilizer	4832	11.82	5020	13.49	4535	13.94	4818	13.54
6. Plant protection	1803	4.41	2610	7.01	2923	8.98	2688	7.55
7. Irrigation	3741	9.15	3478	9.35	2903	8.92	3266	9.18
8.Interest on working capital	638	1.56	613	1.65	547	1.68	588	1.65
Total Cost	40883	100.00	37216	100.00	32541	100.00	35581	100.00

Source: Ibid

A look at the expenditure on plant protection reveals that large category farmers incurred higher expenditure on this item than other categories. This could be due their sound financial position and affordability. Once again, per hectare expenditure by small farmers on irrigation could be noticed higher than remaining categories. The per hectare total cost of cultivation of paddy varied across farm size due to differences in expenditure incurred on various items of cost. It was observed higher in case of small farmers in comparison to other categories during 2012-13.

The information related to expenditure incurred by the growers of bajra on various inputs used by them is presented in Table 5.6. Clearly, per hectare cost of bajra cultivation on sampled farms was much lower in comparison to paddy. It was Rs. 11,039 per hectare at the aggregate level. Among different categories of farmers, medium farmers incurred an amount of Rs. 11,191 which is observed higher in comparison to small and large categories of farmers. The cost of human labour per hectare in bajra cultivation was higher on small farms as compared to other categories. However, expenditure incurred by large farmers on hired human labour surpassed the remaining categories while the opposite could be observed in case of family labour. The per hectare expenditure on family labour by small category was Rs. 1,727 against Rs. 645 by large category. Further, medium category spent higher amount on machine labour and seed. A small expenditure was incurred on FYM by each category due to preference for chemical fertilizer. On the other hand, at least Rs. 1,579 were spent on fertilizer. Further, plant protection and irrigation emerged as the small components of cost of bajra cultivation. This finding is uniform for all categories of farmers. In a nutshell, cultivation of bajra emerged as lower input intensive crop and therefore, cost of cultivation per hectare was also found around one third of paddy on sampled farms in Haryana during 2012-13.

Next, we examine cost of cultivation of maize on sampled farms during 2012-13. Maize is emerging as an important crop in kharif season in Haryana due to its multiple uses as foodgrain, cobs, pop-corn and poultry feed. The cost composition of maize is provided in Table 5.7. It is evident that human labour including hired and family labour is the most important constituent in total cost. The sampled farmers incurred around Rs. 8000/ha. on this single item. The division of hired and family

labour on different farm sizes was found on expected lines i.e. higher share of family labour on small farms and vice versa on large farms. In the array, seed and fertilizer are the next ranking items of cost. Like earlier analyzed crops, a small amount was incurred on FYM due to preference of farmers for chemical fertilizer. The per hectare expenditure on irrigation could be noticed below Rs. 500. An average expenditure of Rs. 1,220 was incurred on plant protection and it could be observed highest in case of medium category of farmers. The total cost per hectare of maize cultivation was Rs. 22,613 on the sampled farms in Haryana during 2012-13. The small followed by large category incurred higher cost per hectare in comparison to medium category. To be brief, human labour, seed, fertilizer and machine labour emerged as major components of cost in cultivation of maize on sampled farms in Haryana during 2012-13.

Table 5.6

Cost of Cultivation (Variable Cost) of Bajra, Sampled Households, 2012-13 (Rs/hectare)

Particulars	Small		Medium		Large		Overall	
	Rs/ha	%	Rs/ha	%	Rs/ha	%	Rs/ha	%
1. Human Labor								
i) Hired	4509	40.72	4773	42.65	5054	48.17	4807	43.55
ii) Family	1727	15.60	903	8.07	645	6.15	923	8.36
2. Machine Labor	2095	18.92	2243	20.04	1510	14.39	2081	18.85
3. Seed	577	5.21	735	6.57	589	5.61	691	6.26
4. FYM	211	1.91	66	0.59	0	0.00	65	0.59
5. Fertilizer	1579	14.26	1756	15.69	1989	18.96	1788	16.20
6. Plant protection	63	0.57	156	1.39	183	1.74	153	1.39
7. Irrigation	152	1.37	383	3.42	353	3.36	357	3.23
8.Interest on working capital	161	1.45	177	1.58	169	1.61	174	1.58
Total Cost	11074	100.00	11191	100.00	10493	100.00	11039	100.00

Source: Ibid

Table 5.7

Cost of Cultivation (Variable Cost) of Maize, Sampled Households, 2012-13 (Rs/hectare)

Particulars	Small		Medium		Large		Overall	
	Rs./ha	%	Rs./ha	%	Rs./ha	%	Rs./ha	%
1. Human Labor								
i) Hired	5516	21.68	6339	29.15	7646	33.18	6492	28.71
ii) Family	4471	17.57	1364	6.27	207	0.90	1605	7.10
2. Machine Labor	4968	19.53	3344	15.38	1943	8.43	3297	14.58
3. Seed	3770	14.82	4629	21.29	7316	31.75	5076	22.45
4. FYM	275	1.08	79	0.36	345	1.50	168	0.74
5. Fertilizer	4592	18.05	3797	17.46	4047	17.56	3977	17.59
6. Plant protection	798	3.14	1449	6.66	869	3.77	1220	5.40
7. Irrigation	691	2.72	395	1.82	276	1.20	416	1.84
8.Interest on working capital	361	1.42	351	1.61	393	1.71	361	1.60
Total Cost	25442	100.00	21747	100.00	23042	100.00	22613	100.00

Source: Ibid

Table 5.8

Cost of Cultivation (Variable cost) of Cotton, Sampled Households, 2012-13 (Rs/hectare)

Particulars	Small		Medium		Large		Overall	
	Rs./ha	%	Rs./ha	%	Rs./ha	%	Rs./ha	%
1. Human Labor								
i) Hired	15139	32.73	13899	37.41	15492	38.46	14754	37.83
ii) Family	4601	9.95	1999	5.38	1177	2.92	1638	4.20
2. Machine Labor	8055	17.42	5029	13.54	7182	17.83	6219	15.95
3. Seed	4654	10.06	4537	12.21	4578	11.36	4561	11.70
4. FYM	180	0.39	194	0.52	176	0.44	184	0.47
5. Fertilizer	5231	11.31	5359	14.42	5289	13.13	5320	13.64
6. Plant protection	5636	12.19	4576	12.32	4483	11.13	4554	11.68
7. Irrigation	2040	4.41	955	2.57	1234	3.06	1126	2.89
8.Interest on working capital	716	1.55	605	1.63	673	1.67	643	1.65
Total Cost	46252	100.00	37153	100.00	40284	100.00	38999	100.00

Source: Ibid

It is a common knowledge that cotton is input intensive crop and therefore, relative cost of cultivation is higher in comparison to alternative kharif crops. An examination of Table 5.8 indicates that per hectare cost of cultivation of cotton at the aggregate level was Rs. 38,999. The small followed by large category incurred higher total cost in comparison to medium category. Like paddy, bajra and maize, the maximum share of cost was incurred by farmers on human labour. The cost of hired human labour was little higher on large farms when compared to small farms.

On the other hand, cost of family labour was the maximum on small farms. This result is on the expected lines. In the cost composition, machine labor, fertilizer and plant protection were the next ranking inputs. Farm size variations were found common in the expenditure incurred on these items. In particular, small farmers incurred higher expenditure on machine labour and seed in comparison to remaining categories of farmers. On the contrary, they spent lower amount on FYM and fertilizer than average at the overall level. Further, plant protection emerged as an important constituent of cost due to higher susceptibility of cotton to insect/pests and diseases. In brief, cost of cultivation per hectare of cotton was higher on all farm sizes due to sizeable expenditure on human labour, machine labour, fertilizer and plant protection. During the survey, farmers reported that picking of cotton is very expensive due to shortage of human labour in Haryana.

To conclude, cost of cultivation varies from one crop to another. The farm size variations are common. Among included crops, cost of cultivation was found higher in case of paddy and cotton due to expenditure on irrigation in the first case and pesticides in the second case in addition to human labour being the major component.

5.3 Economics of Paddy vis-à-vis Alternative Crops

It is now universally recognized that monoculture of wheat and rice rotation cannot provide nutritional severity to population and sustainability to agriculture in India and particularly in green revolution states of Hayana and Punjab. Crop diversification away from paddy is being suggested as a way out to solve these problems. The cultivation of alternative crops in kharif including vegetables and fruits has ample scope when profitability/returns from alternative crops are ensured to farmers through effective price policy and availability and affordability of technology for better yield levels. In this backdrop, we have examined the comparative returns from paddy and alternative crops i.e. bajra, maize and cotton on sampled farms in Haryana during 2012-13.

Table 5.9 presents yield, gross and net returns from paddy, bajra, maize and cotton cultivation on sampled farms. The per hectare yield of paddy on sampled farms was 44.4 qtls. Clearly, small farmers grew around 47 qtl./ha. in comparison to 44 qtl/ha. by large category of farmers. At the aggregate level, farmers realized a

price of Rs. 3,262/qtl. It was lower in case of small category because they grew common variety of paddy on sizeable land and sold to the government agencies at the MSP. They also cultivated basmati which fetched higher prices. The per qtl price received by large farmers could be noticed higher due to concentration of basmati on their fields. The sampled farmers reaped gross returns of Rs.1,44,840/ha at the overall level. It was higher in case of large category in comparison to remaining categories of farmers. After subtracting variable cost, farmers realized net returns of Rs. 1,09,258/ha. by cultivating paddy. Among farm size categories, large farmers realized higher net returns due to their preference for cultivation of basmati variety.

Table 5.9
Economics of Paddy vis-à-vis Alternative Crops, Sampled Households, 2012-13

Particulars	Small	Medium	Large	Overall
Paddy				
Yield (qtl/ha)	47.4	44.4	43.9	44.4
Price (Rs./qtl)	2524	3103	3602	3262
Gross returns (Rs./ha)	119564	137823	158253	144840
Total Variable cost (Rs./ha)	40883	37216	32541	35581
Returns over variable cost (Rs./ha)	78681	100607	125713	109258
Bajra				
Yield (qtl/ha)	19.5	20.6	21.2	20.7
Price (Rs./qtl)	1088	1110	1138	1114
Gross returns (Rs./ha)	21246	22886	24170	23003
Total Variable cost (Rs./ha)	11074	11191	10493	11039
Returns over variable cost (Rs./ha)	10173	11695	13677	11964
Maize				
Yield (qtl/ha)	28.1	29.2	21.0	27.3
Price (Rs./qtl)	1341	1258	1233	1267
Gross returns (Rs./ha)	37709	36787	25870	34563
Total Variable cost (Rs./ha)	25442	21747	23042	22613
Returns over variable cost (Rs./ha)	12267	15041	2827	11950
Cotton				
Yield (qtl/ha)	20.2	20.8	20.9	20.8
Price (Rs./qtl)	4925	5072	4853	4955
Gross returns (Rs./ha)	99570	105296	101232	103051
Total Variable cost (Rs./ha)	46252	37153	40284	38999
Returns over variable cost (Rs./ha)	53318	68143	60947	64052

Source: Ibid

A look at the results for bajra in the same table makes clear that bajra emerged as a modest crop with low variable cost and gross/net returns on sampled farms The average yield of bajra could be observed 20.7 qtls/ha at the aggregate level. The large category reaped marginally higher yield in comparison to small and medium categories. The price received by farmers after selling bajra was Rs. 1,114/qtl. The differentials in per unit price realized made difference in gross returns. The net returns from bajra cultivation were found a modest sum of Rs. 11,964. Evidently, large farmers reaped higher profits per unit of land in comparison to other categories.

An examination of same table indicates that productivity of maize was 27.3 qtl/ha at the aggregate level on the sampled farms in Haryana. The medium farmers produced maximum maize per unit of land. On the other hand, small farmers realized higher price per qtl in comparison to medium and large farm categories. Evidently, gross returns per hectare by cultivating maize were found Rs. 34,563 at the aggregate level. The small farm category reaped the maximum gross returns. After subtracting variable cost from gross returns, farmers earned a profit of Rs. 11,950/ha and it was highest in case of medium farmers.

Finally, we analyze profitability/net returns from cotton cultivation. The average yield of cotton was 20.8 qtl/ha on sampled farms. It was almost uniform across farm sizes. The farmers realized an average price of Rs. 4,955/qtl. Further, medium farmers received Rs. 5,072/qtl. The gross returns from cultivating cotton on sampled farms at the aggregate level were found Rs. 1,03,051/ha. The medium farmers realized higher gross returns in comparison to small and large farm categories. After subtracting variable cost, farmers earned a profit of Rs. 64,052/ha and once again, it was higher on medium farms in comparison to remaining categories.

5.4 Resource Use Efficiency of Major Kharif Crops:

The rationality of resource use in agriculture assumes special significance for increasing production and farm income. The optimum use of resources is also important from social and political considerations. In economics, optimum use of factors implies equality in marginal productivity and marginal cost. The inequality represents inefficient use of the factors/resources.

It is already mentioned in chapter one that we have formulated Cobb Douglas type of model to measure resource use efficiency of human labour, machine labour, seed, fertilizer and irrigation in cultivation of paddy, bajra, maize and cotton. The yield is used as dependent variable and above mentioned factors as independent variables. We have further computed Marginal Value Productivity (MVP) and Marginal Factor Cost (MFC) of included resources. The pesticides were omitted from the model since we do not have survey data on quantity of pesticides used by the growers and therefore, per unit price/marginal factor cost (MFC) could not be computed. Owing to this limitation, this variable could not be entered in the model. Normally, MVP = MFC signifies that resource is optimally used. In case of higher MVP, resource is underutilized and its usage should be increased. The vice versa is true when MVP is lower than MFC of the resource and its usage should be reduced.

We begin with presenting the regression results of paddy which is the dominant kharif crop in irrigated areas of Haryana. The variables with statistically significant influence on yield of paddy are human labour, machine labour, fertilizer and seed at the overall level. Surprisingly, irrigation is insignificant. The highest coefficient of seed (0.40) indicates that one per cent change in seed would increase yield by 0.40 per cent. The coefficient of human labour (0.27) also indicates positive change in yield. Similarly, statically significant coefficients of fertilizer (0.16) and machine labour (0.13) indicate their positive impact on the yield of paddy. The model explains 88 per cent variation in yield. The remaining 12 per cent could be due to unaccounted variables or due to qualitative variables which are not included in the model (Table 5.10). An examination of $\sum b_i$ indicates constant returns to scale at the aggregate level and for the small category of farmers. The summation of b_i is however, between 0.94 and 0.99 for medium and large categories. This implies a situation nearing the constant returns to scale in cultivation of paddy by the sampled farmers.

We have also carried out this exercise separately for small, medium and large group of farmers cultivating paddy. It may be noticed that value of regression coefficients and significance of included independent variables were found different across various farm categories. For small farmers, human labour and fertilizer were found positive, statistically significant and value of these coefficients was 0.34 and 0.37 respectively. The model explained 78 per cent of variation in the yield of paddy.

The regression results for medium and large farm size categories were also found different. In case of medium farmers, seed (0.50), human labour (0.28) and irrigation (0.11) were found statistically significant and the model explained more than 80 per cent variation in yield of paddy. On the other hand, only machine labour (0.62) and irrigation with negative value (-0.36) were found statistically significant variables for the large farm size category. Particularly, higher coefficient of machine labour pointed out gradual replacement of human labour by machine labour due to availability of finance and shortage of human labour in the state. The coefficient of irrigation was negative. It implies that large farmers are over using this resource and any addition would lead to lowering productivity of paddy. The model explained 81 per cent variation in the yield of paddy.

In Haryana, paddy is the dominant crop during kharif season. The alternative crops are bajra, maize and cotton. Although, yield rates of paddy, bajra and cotton in Haryana are second highest in the country, farmers prefer to grow paddy due to higher yield, assured market and net returns. They often over use irrigation water, fertilizer and pesticides due to lack of knowledge about optimal use. The over use of these resources is resulting in depleting water table and environmental problems in addition to escalated cost of cultivation. In order to save precious resources and environment, it is imperative to analyze the resource use efficiency of paddy and alternative crops grown by the sampled farmers in Haryana.

We have already explained the results of regression model, Table 5.11 presents the estimated MVPs and MFCs of included resources used by the farmers in cultivation of paddy. First, MVPs of included resources i.e. human labour, seed, fertilizer and irrigation are considerably above their MFCs at the aggregate level. These are the inputs which are in the hands of farmers. Therefore, it cannot be referred as inefficiency of the farmers. Therefore, they need to adjust their usages. It may be inferred that there is not a single instance when resource is optimally used. Most of the resources are underutilized since their MVPs are higher than MFCs and therefore, farmers should increase their usages. The MVPs and MFCs of included resources across farm size differ considerably. In case of machine labour, MVP is negative for small size farms. It implies that this factor is being over used by this group and therefore, any increase would not augment marginal productivity. On the other hand, MVP of machine labour is lower than MFC in case of medium farms.

Table 5.10
Results of Regression Analysis for Paddy

Particulars	Small	Medium	Large	Overall
Intercept	-0.66	0.45	-0.54	0.07
Human Labor (man days)	0.34*	0.28*	0.35	0.27*
Machine labor (hours)	-0.04	0.02	0.62*	0.13*
Seed (Kg.)	0.17	0.50**	0.07	0.40*
Fertilizer (Kg)	0.37*	0.08	0.26	0.16*
Irrigation (hrs)	0.17	0.11*	-0.36*	0.03
R^2	0.78	0.82	0.81	0.88
∑bi	1.01	0.99	0.94	1.00

* Significant below 1 per cent level ** Significant below 10 per cent level

Table 5.11
Marginal Value Product (MVP) and Marginal Factor Cost (MFC) of Important Inputs for Paddy, Sampled Households, 2012-13

Particulars	Small	Medium	Large	Overall
Human Labor				
MVP (Rs.)	568.09	616.07	1058.87	670.75
MFC (Rs.)	251.55	253.52	265.69	257.62
MVP:MFC	2.26	2.43	3.99	2.60
Machine Labor				
MVP (Rs.)	-59.15	29.68	1305.76	243.22
MFC (Rs.)	110.56	98.32	84.70	93.99
MVP:MFC	-0.54	0.30	15.42	2.59
Seed				
MVP (Rs.)	1814.21	6030.63	1010.71	5032.43
MFC (Rs.)	119.35	96.07	77.90	90.18
MVP:MFC	15.20	62.77	12.97	55.81
Fertilizer				
MVP (Rs.)	25.46	6.92	27.84	14.84
MFC (Rs.)	3.12	3.46	3.48	3.44
MVP:MFC	8.15	2.00	8.01	4.31
Irrigation				
MVP (Rs.)	416.05	359.47	-1392.66	114.16
MFC (Rs.)	76.12	79.98	71.19	76.42
MVP:MFC	5.47	4.49	-19.56	1.49

In this case, usage of this resource should be reduced by the farmers to gain efficiency. Further, MVP of irrigation on large farms is negative and several times above MFC. It suggests that irrigation is being over used by this group and therefore,

marginal productivity with any increase will be negative. In a nutshell, resource use efficiency of paddy producers was not found optimal. Most of the resources are underutilized and hence, farmers should increase their usage to attain resource efficiency in cultivation of paddy in Haryana. It is essential to mention that irrigation water is being over used by large farmers and an immediate policy action is required to reduce the usages.

Bajra is the most important coarse cereal of kharif season in Haryana. It is grown for self consumption and commercial purpose. After paddy, bajra has a dominant share in GCA in kharif season in terms of area allocation. Since, considerable proportion of bajra growers did not use irrigation, this variable could not be entered in the model. The regression results presented in Table 5.12 show that coefficient of human labour with respect to yield of bajra was positive, high (0.80) and statistically significant. The coefficient of human labour was observed even higher (1.052) and statistically significant for large farmers. The seed was another variable which was statistically significant at the aggregate level and for the medium category farmers. The coefficient of seed was however, negative for large farmers. In other words, yield of bajra would rise if human labour and quantity of seed is raised. The independent variable of fertilizer although shown as important factor to raise yield in some studies turned out negative at the overall level and in medium size group. The included five variables explained 56 per cent variation in the yield of bajra on sampled farms, whereas, these variables explained 69 per cent in case of large farmers. The returns to scale measured by adding coefficients were found diminishing in case of small farms while large farms recorded increasing returns to scale. These were found almost constant at the aggregate level.

Having analyzed results of regression model for bajra, Table 5.13 presents information about MVPs and MFCs of analyzed resources used by sampled farmers in cultivation of bajra. It may be observed that MVPs of human labour and seed are considerably above their MFCs at the overall level. This implies that marginal productivity of these factors exceeds the cost and therefore, resources are underutilized. On the other hand, MVP of machine labour is much below its cost. It means that the resource is over utilized and its usage by the farmers should be reduced in order to attain resource use efficiency.

Table 5.12
Results of Regression Analysis for Bajra

Particulars	Small	Medium	Large	Overall
Intercept	-0.814	0.631	-4.731	0.434
Human Labor (man days)	0.413	0.724*	1.052*	0.795**
Machine labor (hours)	-0.071	0.012	-0.093	0.012
Seed (Kg.)	0.022	0.357*	-0.457	0.258*
Fertilizer (Kg)	0.485	-0.071*	1.023	-0.055
R^2	0.30	0.57	0.69	0.56
∑bi	0.85	1.02	1.53	1.01

* Significant below 1 per cent level
** Significant below 10 per cent level

Table 5.13
Marginal Value Product (MVP) and Marginal Factor Cost (MFC) of Important Inputs for Bajra, Sampled Households, 2012-13

Particulars	Small	Medium	Large	Overall
Human Labor				
MVP (Rs.)	393.47	817.88	1190.57	885.15
MFC (Rs.)	279.86	280.20	266.99	277.39
MVP:MFC	1.41	2.92	4.46	3.19
Machine Labor				
MVP (Rs.)	-142.83	11.13	-162.23	13.38
MFC (Rs.)	198.40	92.64	109.24	99.59
MVP:MFC	-0.72	0.12	-1.49	0.13
Seed				
MVP (Rs.)	26.36	775.35	-972.11	518.65
MFC (Rs.)	109.20	191.64	176.30	179.01
MVP:MFC	0.24	4.05	-5.51	2.90
Fertilizer				
MVP (Rs.)	17.80	-5.62	156.31	-4.41
MFC (Rs.)	3.09	6.27	12.57	6.41
MVP:MFC	5.75	-0.90	12.43	-0.69

Among the analyzed resources, MVP of fertilizer is negative and therefore, utilization of this resource needs adjustment. Farm size results of resources use efficiency of included factors are mixed. The MVPs of human labour are above one in all cases. The marginal productivity of seed also exceeds MFC on medium farms and of fertilizer on small and large farms. In brief, none of the resource was used in

an optimal manner and therefore, sampled farmers need adjustment in their usages to attain efficiency.

We have also carried out regression analysis for maize, the second alternative foodgrain crop in kharif season in Haryana. Surprisingly, its relative share in area allocation under kharif crops in Haryana is low despite being a multipurpose crop. Since, considerable proportion of maize growers did not use irrigation, this variable could not be entered in the model

The regression results of maize are presented in Table 5.14.The coefficients of human labour (0.35), seed (0.37) and fertilizer (0.40) are positive and statistically significant. This implies that these inputs would influence yield positively if an extra unit is added. Further, one per cent change in these inputs would increase yield by respective percentage points. It may be noticed that value of regression coefficients and significance of selected independent variables was found different across various farm size categories. For small farmers, coefficients of human labour and seed were positive and statistically significant. The value of these coefficients was 0.30 and 0.26 respectively. The regression results for medium category of farmers were on the similar pattern except higher value of these coefficients. One per cent change in human labour and seed would influence yield of maize by 0.34 and 0.46 per cent respectively. In case of large farm category, coefficient of only one input that is human labour turned out positive, high and statistically significant. The adjusted $\overline{R}^2$ at the overall level was 0.74 which indicates that included variables explain 74 per cent variation in yield of maize. However, it was as high as 0.98 in case of large farm category. An examination of sum of regression coefficients indicates that returns to scale were almost constant for small and medium farm categories and diminishing for large farm category. At the aggregate level, $\sum b_i$ was slight above one and therefore, indicative of increasing returns to scale by cultivating maize on sampled farms in Haryana. Also, results indicated increasing returns for medium category whereas, returns were found constant for small and diminishing for large size category of farmers. After explaining results of regression model for maize, we gauge the MVPs and MFCs of included factors and their resource use efficiency. Table 5.15 presents these results.

Table 5.14
Results of Regression Analysis for Maize

Particulars	Small	Medium	Large	Overall
Intercept	-0.89	-0.55	0.24	-1.16
Human Labor (man days)	0.30*	0.34*	0.79*	0.35*
Machine labor (hours)	0.12	0.05	0.41	0.00
Seed (Kg.)	0.26*	0.46*	-0.56	0.37*
Fertilizer (Kg)	0.32	0.25	0.09	0.40*
R^2	0.57	0.71	0.98	0.74
∑bi	1.00	1.09	0.72	1.12

* Significant below 1 per cent level ** Significant below 10 per cent level

Table 5.15
Marginal Value Product (MVP) and Marginal Factor Cost (MFC) of Important Inputs for Maize, Sampled Households, 2012-13

Particulars	Small	Medium	Large	Overall
Human Labor				
MVP (Rs.)	214.61	429.66	740.60	366.90
MFC (Rs.)	190.76	262.47	285.33	248.43
MVP:MFC	1.13	1.64	2.60	1.48
Machine Labor				
MVP (Rs.)	168.20	111.08	1022.70	5.92
MFC (Rs.)	183.22	223.58	188.93	207.79
MVP:MFC	0.92	0.50	5.41	0.03
Seed				
MVP (Rs.)	274.13	365.36	-513.80	330.62
MFC (Rs.)	189.38	316.03	1104.17	369.52
MVP:MFC	1.45	1.16	-0.47	0.89
Fertilizer				
MVP (Rs.)	15.22	21.90	2.31	22.98
MFC (Rs.)	6.10	9.27	4.49	6.91
MVP:MFC	2.50	2.36	0.51	3.33

First, MVPs of included resources show a mixed pattern. The MVP of human labour was found higher than its marginal cost and therefore, this resource is underutilized and its usage should be increased to attain optimality. The similar is true for fertilizer. On the other hand, MVPs of machine labour and seed were estimated lower than one. This indicates that these resources are over utilized and its usage should be reduced to attain resource use efficiency. The MVPs and MFCs of analyzed factors across different farm sizes varied considerably. The highest MVP

could be observed for machine labour in case of large farmers. This implies that they are under utilizing this resource and adjustment is required in its usage to attain efficiency. On the contrary, the lowest ratio of MVP and MFC could be observed in medium size category. It points out over use and therefore, its usage should be reduced to achieve optimality. In brief, none of the included resources was used optimally by sampled growers and therefore, adjustment is needed in the usage to attain optimal resource use.

Finally, we have elicited the results of regression analysis carried out for cotton, the most important commercial crop grown by farmers in kharif season in Haryana. Results show (Table 5.16) that human labour emerged as the most important variable influencing the yield of cotton. Its coefficient turned out positive, high (0.83) and statistically significant at the overall level. It implies that one percent increase in human labour would enhance productivity of cotton by 0.83 per cent. The coefficient of human labour turned out even higher (0.96) and statistically significant in case of medium group. Seed is the second independent variable with positive and statistically significant coefficient (0.27). Nonetheless, coefficient of seed was observed highest (0.58) and statistically significant in case of large farms. The coefficient of fertilizer was negative and insignificant. Surprisingly, coefficient of irrigation was marginal and negatively related to yield. In case of negative coefficients, farmers are over using these inputs and any increase would not yield positive contribution to yield. The included five variables in the model explained at least 85 per cent variation in yield of cotton in each size group. The higher elasticity of human labour and seed with respect to yield reiterates the role of these factors in augmenting yield in the state. The returns to scale, measured by adding regression coefficients of included variables in the model exceed constant returns by 0.03 at the overall level while the sum of these coefficients in case of small and medium farms was 1.03 and 1.05 respectively which is indicative of increasing returns to scale. On the other hand, $\sum b_i$ was below 1 for large farms and therefore, implied diminishing returns to scale in cultivation of cotton.

We have also measured resource use efficiency of included factors by comparing MVPs and MFCs of these factors. These results for cotton are presented in Table 5.17.The MVP of human labour was higher than MFC at the aggregate level and for each farm size group. It implies that marginal productivity of this resource is

higher than the marginal cost and therefore, farmers should increase usage in order to attain efficiency. The MVP of machine labour was lower than MFC which indicates over utilization of this resource and therefore, its usage should be reduced by farmers at the overall level. The ratio of MVP and MFC of machine labour turned out 4.04 in case of small farms and this implies that resource is underutilized and hence, farmers should augment its usage. The next independent variable seed indicated higher MVP than MFC for all farm size groups and at the aggregate level. This is indicative of under utilization and farmers are suggested to augment the usage. In the array, MVP of fertilizer turned out negative in all cases but it was higher than MFC. Further, MFC of irrigation was estimated higher than MVP on each farm size and at the overall level but it turned out negative in three cases out of four analyzed cases. This indicates the overuse and therefore, it should be reduced for attaining efficiency. In brief, none of the analyzed resource was used at optimal level by cotton growers and therefore, they need to make adjustments in order to attain resource use efficiency.

Table 5.16
Results of Regression Analysis for Cotton

Particulars	Small	Medium	Large	Overall
Intercept	0.13	-0.93	1.61	-0.29
Human Labor (man days)	0.59	0.96*	0.33	0.83*
Machine labor (hours)	0.33	0.02	-0.03	0.01
Seed (Kg.)	0.33	0.14	0.58*	0.27*
Fertilizer (Kg)	-0.20	-0.04	-0.03	-0.08
Irrigation (hrs)	-0.010	-0.03*	0.009	-0.011
R^2	0.85	0.85	0.88	0.90
∑bi	1.03	1.05	0.87	1.03

* Significant below 1 per cent level

To conclude, the regression results of the Cobb Douglas model fitted for paddy, bajra, maize and cotton for each farm size and at the aggregate level significantly varied and turned out mixed. The model explained around 90 per cent variation in yield of cotton and paddy. It may be highlighted that regression coefficient of irrigation in some cases turned out negative. This finding is very important for policy purpose since large farmers growing paddy and cotton growers

have over used this precious resource at the overall level and therefore, its marginal productivity turned out negative. Hence, immediate policy action is required to reduce use of water in paddy cultivation by large farmers and cotton growers.

Table 5.17
Marginal Value Product (MVP) and Marginal Factor Cost (MFC) of Important Inputs for Cotton, Sampled Households, 2012-13

Particulars	Small	Medium	Large	Overall
Human Labor				
MVP (Rs.)	755.18	1627.03	532.57	1356.47
MFC (Rs.)	255.89	255.01	263.72	259.55
MVP:MFC	2.95	6.38	2.02	5.23
Machine Labor				
MVP (Rs.)	684.71	65.66	-93.83	45.42
MFC (Rs.)	169.47	200.36	235.12	218.39
MVP:MFC	4.04	0.33	-0.40	0.21
Seed				
MVP (Rs.)	3371.37	2347.57	20058.27	5044.18
MFC (Rs.)	1856.63	1858.50	2030.58	1944.06
MVP:MFC	1.82	1.26	9.88	2.59
Fertilizer				
MVP (Rs.)	-25.98	-6.66	-3.84	-11.38
MFC (Rs.)	6.99	8.08	7.94	7.98
MVP:MFC	-3.72	-0.82	-0.48	-1.43
Irrigation				
MVP (Rs.)	-18.23	-136.24	66.09	-50.53
MFC (Rs.)	159.86	135.58	128.28	132.21
MVP:MFC	-0.11	-1.00	0.52	-0.38

An examination of resource use efficiency in cultivation of above mentioned four crops revealed that not a single included resource is being used at the optimal level. Some of them are under used while others are over used. Therefore, growers of paddy, bajra maize and cotton require adjustments in usages of human labour, machine labour, seed, fertilizer and irrigation to attain resource use efficiency in Haryana.

Chapter-6

Constraint Analysis of Paddy and Alternative Crops

Introduction:

Haryana was a non-paddy producing state prior to the advent of the Green Revolution. The crop was grown in some parts and therefore, the area under paddy was only 246 thousand hectares during TE 1970-71 which increased several folds and became 1227 thousand hectares in TE 2011-12. This is due to a gradual increase in profitability of paddy in comparison to alternative kharif crops. The farmers therefore, are not ready to switch over to alternative kharif crops despite the advocacy by policy makers and agricultural scientists. Paddy consumes around 3,000 liters of water per kilo of rice produced. As a result, ground water level has reached to a critical stage in major growing areas. This is a great challenge for sustainability of agriculture and paddy in particular in future.

There were many crops grown in Haryana during kharif season before emergence of paddy. The area under these crops can be again increased in their traditional areas if prices become remunerative, market is assured, yield variability is reduced and value addition is taken up on a larger scale.

The degree of production risk in alternative crops is higher due to biotic and abiotic constraints. Climate change is further aggravating the risk. It is essential to improve productivity and reduce yield and price risk for alternative crops to encourage farmers to reduce area under paddy. In this back drop, it is important to understand the perceptions of sampled farmers about biotic and aboitic constraints of various kharif crops. We propose to discuss opinions of the farmers on these issues in this chapter.

Crops are affected negatively by aboitic and biotic stresses. Aboitic stress occurs in many forms such as drought, salinity, high temperature, high rainfall, high wind and flood, etc. Aboitic stresses are harmful for the growth and productivity of crops. For instance, rice is highly susceptible to temperature stress during the reproductive and ripening stages. On the other hand, biotic stress is a stress that occurs as a result of harm done to crops by living organisms such as insect/pests, diseases and weeds. The relationship between biotic stress and yield of crops affects decisions of the growers, quality of the produce and profitability.

In the present study, we have used qualitative responses of the sampled farmers to analyze perceptions regarding stresses in the form of constraints. Agricultural crops are affected from different abiotic and biotic stress conditions. Now, we present details of information gathered from the sampled farmers on related issues to these constraints.

6.1 Reasons for Cultivating Alternative Crops:

Agriculture is a risky business because it deals with uncertain factors such as weather and market conditions. These factors make income from agriculture uncertain. Therefore, selection of suitable crops through allocation of land is one of the most important decisions for the farmers. One of the suggested approaches is to reduce risk through crop diversification. Under this strategy, a farmer is likely to grow a number of crops that differ in constraints arising out of biotic and aboitic stresses. During the course of our survey, we had asked farmers reasons for growing a particular alternative crop to paddy in kharif season in Haryana. The responses of sampled farmers for their attraction towords cultivation of bajra are presented in Table 6.1. It is evident that around 30 and 6 per cent sampled farmers opined that bajra is well adapted to climatic conditions such as rainfall, while their response for suitable soil was 26 and 29 per cent respectively. Around 30 per cent farmers stated that it fits well into crop pattern. However, 20 per cent opined that its residues can be used as fodder for livestock. We had also tried to seek the response of farmers about attractive prices and stimulation received from the policies of the government. The response of farmers on these matters was not found encouraging. Only 6 and 7 per cent stated that these are most important and important factors in decision making about area allocation. Thus, sampled farmers grew bajra primarily due to suitability of land and climatic conditions. The opinions of different categories of farmers varied significantly about reasons for growing bajra. The climatic conditions were rated as most important and important factor by 30 and 40 per cent medium and large farmers. A sizeable proportion in each group stated that these factors are least important. During our discussion, farmers informed that they do not have other options when land is rainfed and relatively inferior in quality. That is why they grow bajra on such lands.

Table 6.1
Reasons Expressed by Sampled Farmers for Attraction to Bajra Cultivation, 2012-13

(% multiple response)

Particulars	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Well adapted to the climate conditions (rainfall etc.)	23.1	7.7	30.8	30.4	6.5	28.3	40.0	0.0	10.0	30.4	5.8	26.1
Well adapted to soil type	23.1	23.1	30.8	26.1	26.1	28.3	30.0	50.0	20.0	26.1	29.0	27.5
Fatches an attractive price in the market	0.0	7.7	46.2	8.7	6.5	34.8	10.0	10.0	20.0	7.2	7.2	34.8
Government stimulates its growing	7.7	7.7	46.2	6.5	6.5	32.6	0.0	0.0	30.0	5.8	5.8	34.8
Fits well into overall cropping pattern	0.0	7.7	46.2	10.9	28.3	37.0	0.0	20.0	60.0	7.2	23.2	42.0
It allows for multiple picking	--	--	--	--	--	--	--	--	--	--	--	--
The residue can be used as fodder	7.7	7.7	30.8	19.6	4.3	32.6	10.0	0.0	20.0	15.9	4.3	30.4
Others	7.7	0.0	0.0	8.7	4.3	4.3	20.0	0.0	0.0	10.1	2.9	2.9

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source: Field Survey

Table 6.2
Reasons Expressed by Sampled Farmers for Attraction to Maize Cultivation, 2012-13

(% multiple response)

Particulars	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Well adapted to the climate conditions (rainfall etc.)	42.3	11.5	23.1	19.5	9.8	48.8	25.0	0.0	37.5	28.0	9.3	38.7
Well adapted to soil type	26.9	15.4	11.5	22.0	14.6	43.9	12.5	25.0	25.0	22.7	16.0	30.7
Fatches an attractive price in the market	23.1	23.1	30.8	41.5	14.6	19.5	62.5	0.0	25.0	37.3	16.0	24.0
Government stimulates its growing	11.5	3.8	26.9	9.8	12.2	26.8	0.0	12.5	37.5	9.3	9.3	28.0
Fits well into overall cropping pattern	3.8	26.9	42.3	19.5	19.5	43.9	12.5	62.5	12.5	13.3	26.7	40.0
It allows for multiple picking	--	--	--	--	--	--	--	--	--	--	--	--
The residue can be used as fodder	23.1	19.2	38.5	17.1	14.6	46.3	12.5	0.0	50.0	18.7	14.7	44.0
Others	0.0	0.0	3.8	4.9	4.9	4.9	12.5	0.0	0.0	4.0	2.7	4.0

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source: Ibid

We now analyze the probable responses of farmers in decision making to grow maize which is the second alternative crop to paddy in kharif season in Haryana. The possible reasons could be suitability of climate and soil, use of residues as fodder for livestock. Like bajra, we also looked into expected returns in terms of remunerative price and favorable incentive policies of the government. Table-6.2 elucidates this information. Around 66 per cent sampled farmers reported that climatic conditions are most important and important factors for their attraction to grow maize while 39 per cent stated that these are least important. Further, 39 per cent opined that suitability of soil is another reason for cultivating maize. On the other hand, 40 per cent were of the opinion that it fits well in the crop pattern. The responses of farmers about cultivation of maize also varied significantly about use of residues as fodder. As far as, returns and attractive price are concerned as motivating factors, 62 per cent farmers opined that these are most important and important factors in their decision making to allocate land for maize cultivation. Out of total farmers, 47 per cent stated that stimulation from government is also important in their decision making. Like bajra, response of farmers in different categories about the reasons for growing maize varied significantly. The included reasons received different ranking from small, medium and large categories of sampled farmers. However, suitability of soil and climatic conditions emerged as crucial factors in land allocation to maize by sampled farmers.

Next, we turn our analysis to reasons reported by the sampled farmers for growing cotton. This information is provided in Table-6.3. Like earlier analyzed crops, responses of farmers on previously enumerated reasons ranged between 2.4 to 27.4 per cent and 1.2 to 35.7 per cent respectively, when they stated the order in terms of ranking as most important and important. At least, 10 per cent farmers felt that these reasons are least important and do not play any role in land allocation to cotton. Around 57 per cent farmers stated that climatic conditions are important reason for their attraction towards cultivation of cotton. Further, almost similar percentage of farmers opined that suitability of soil is important. The response of farmers about other reasons was not encouraging. Among the farm size categories, response of small category for climatic conditions as an important factor was as high as 90 per cent. Similarly, the response of this category was 70 per cent as most important and important reason for suitability of soil to grow cotton. It is evident that response of medium and large category farmers could be observed relatively low on these two major concerns. The opinions of farmers also varied about other reasons for raising cotton.

Table 6.3
Reasons Expressed by Sampled Farmers for Attraction to Cotton Cultivation, 2012-13

(% multiple response)

Particulars	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Well adapted to the climate conditions (rainfall etc.)	50.0	40.0	10.0	24.5	26.5	36.7	24.0	28.0	12.0	27.4	28.6	26.2
Well adapted to soil type	50.0	20.0	0.0	22.4	28.6	10.2	20.0	48.0	12.0	25.0	33.3	9.5
Fatches an attractive price in the market	0.0	50.0	20.0	22.4	36.7	30.6	12.0	28.0	24.0	16.7	35.7	27.4
Government stimulates its growing	0.0	10.0	40.0	10.2	0.0	32.7	0.0	0.0	40.0	6.0	1.2	35.7
Fits well into overall cropping pattern	20.0	10.0	70.0	12.2	14.3	49.0	4.0	16.0	56.0	10.7	14.3	53.6
It allows for multiple picking	10.0	20.0	50.0	2.0	10.2	55.1	0.0	12.0	44.0	2.4	11.9	51.2
The residue can be used as fodder	--	--	--	--	--	--	--	--	--	--	--	--
Others	30.0	0.0	0.0	24.5	6.1	8.2	32.0	8.0	0.0	27.4	6.0	4.8

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source:Ibid

In a nutshell, the analysis of reasons for growing alternative crops i.e. bajra, maize and cotton to paddy in kharif season in Haryana indicated variations across crops and farm categories. However, suitability of climate and soil were rated as most important reasons for cultivating a particular crop in comparison to fitting well in crop pattern, possibility of multiple picking and use of residences as fodder for livestock. It is essential to mention that remunerative prices and stimulation from the government did not receive expected results since importance given by the sampled farmers to these factors in their decision making to cultivate these crops was not found crucial.

6.2 Problems in Cultivating Alternative Crops

It is a common knowledge that both biotic and aboitic factors affect crop production and threaten sustainability of crop production. Under these conditions, diverse agro- systems with different traits will be better able to perform. Around one fourth of the sampled farmers reported that diseases are the most important problem in raising alternative crops. In addition, 20 per cent of farmers ranked diseases as important problem. The problems of infestation of insect/pests were considered most important by 22 per cent sampled farmers. Also, around 23 per cent respondents stated as important. Around 14 and 15 per cent farmers felt that weeds are a problem in cultivating other crops in order to diversify crop pattern. Around 16 per cent of sampled farmers informed that environmental problems such as drought, water logging and high and low temperatures are most important problems in raising these crops. Further, 13 per cent considered these factors as important problems. In the array, non-availability of inputs such as seed, fertilizer, human labour and credit were considered most important problem by 9 per cent farmers. A higher proportion of farmers opined input availability as important problem, while 14 per cent reported that storage, prices, demand, access to information and transportation create problems in raising alternative crops. Another 13 per cent growers considered these facilities important for expanding area under alternative crops. The ranking given by different categories of the farmers to included factors varied significantly across farm size. The range of responses could be observed between 5.9 and 35 per cent respectively. In brief, diseases followed by infestation of insect/pests, environmental problems, marketing and input availability are likely to play an important role in decision making to allocate land to alternative crops by sampled farmers in Haryana.

Table 6.4
Main Problems faced by Sampled Farmers during Production of Alternative Crops, 2012-13

(% multiple response)

Particulars	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Diseases	23.4	19.1	14.9	23.3	20.2	13.2	35.3	20.6	11.8	25.2	20.0	13.3
Insects/pests	19.1	21.3	10.6	24.0	20.2	13.2	17.6	35.3	5.9	21.9	22.9	11.4
Weeds	19.1	17.0	21.3	14.0	16.3	20.2	5.9	5.9	32.4	13.8	14.8	22.4
Environmental problems (drought, Waterlogging, high temperature, etc.)	17.0	8.5	23.4	16.3	14.7	21.7	14.7	11.8	23.5	16.2	12.9	22.4
Non-availability of inputs (seeds, ferti -lizer, chemicals, labor, credit, etc.)	8.5	19.1	8.5	9.3	16.3	17.8	8.8	14.7	8.8	9.0	16.7	14.3
Marketing problems (storage, prices, Demand, information, transport, etc.)	12.8	14.9	21.3	13.2	12.4	14.0	17.6	11.8	17.6	13.8	12.9	16.2

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source: Ibid

Diseases:

Diseases take a heavy toll of rice crop. We have presented the details of diseases in rice cultivation in Table 6.5. Blast continues to be a major constraint in rice cultivation Around 28 per cent farmers rated it a moderate problem while 13 per cent opined that it is a severe constraint. The cultivators expressed that blast causes yield loss of almost 20 per cent. Further, root rot is rated by farmers as less severe problem which may cause yield loss of around 7 per cent and another disease, bacterial leaf spot also damages yield by around 7 per cent. Around 20 per cent farmers at the aggregate level have stated that it is a minor problem. In addition, anthracnose affects the productivity of rice. It results in considerable yield loss ranging between 9 to 15 per cent. Although, severity of the problem of diseases in rice cultivation stated by different categories of farmers differs considerably but all of them opined that these diseases create problems for the farmers in cultivation of rice in Haryana.

Next, we have analyzed perceptions of farmers regarding diseases in bajra, an alternative kharif crop to paddy in Haryana. Table 6.6 indicates that 13 per cent of medium farmers rated powdery mildew as the first ranking problem while around 15 per cent small farmers ranked it as a slight problem but another 15 per cent rated it as a severe problem. Like small farmers, the response of medium farmers regarding degree of problem through this disease in bajra varies considerably. Among large farmers, 10 per cent opined that it is a slight problem. The yield loss in bajra due to its occurrence was 5 per cent. The disease of grain smut is important for bajra and around 23.9 per cent in medium group rated it slight and moderate problem. This stress causes again yield loss of around 5 per cent. We have also analyzed responses of farmers on ergot, late blight and pod rot. It is essential to mention that response of farmers varied in each category and there was no response in some cases. In a nutshell, powdery mildew, grain smut, ergot and pod rot are important diseases which negatively affect the productivity of bajra in Haryana.

After analyzing responses of farmers regarding occurrence of diseases and their impact on yield of paddy and bajra, we take up maize, a third alternative crop in kharif season in Haryana.

Table 6.5
Problems of Diseases faced by Sampled Farmers during Rice Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Blast	8.5	21.3	17.0	6.4	22.8	7.8	24.0	28.7	13.2	20.8	2.9	23.5	38.2	23.5	17.7	7.1	23.3	27.6	13.3	20.4
Foot rot	2.1	2.1	0.0	2.1	5.0	9.3	11.6	3.1	0.8	7.1	8.8	8.8	2.9	0.0	5.8	7.6	9.0	2.4	1.0	6.7
Bacterial leaf spot	8.5	34.0	2.1	2.1	7.1	16.3	15.5	7.8	3.1	6.8	11.8	14.7	2.9	0.0	10.8	13.8	19.5	5.7	2.4	7.2
Anthracnose	4.3	12.8	4.3	0.0	12.5	7.0	10.9	7.0	1.6	7.4	5.9	5.9	2.9	0.0	--	6.2	10.5	5.7	1.0	9.1
Sooth blight	0.0	2.1	0.0	0.0	--	0.0	0.0	1.6	0.0	11.0	2.9	0.0	2.9	0.0	--	0.5	0.5	1.4	0.0	11.0
Pod rot	4.3	14.9	12.8	2.1	14.8	4.7	4.7	9.3	3.9	15.4	0.0	2.9	0.0	0.0	--	3.8	6.7	8.6	2.9	15.1
Others	0.0	2.1	4.3	0.0	8.8	1.6	1.6	0.8	0.0	--	0.0	2.9	5.9	0.0	15.0	1.0	1.9	2.4	0.0	10.8

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.6
Problems of Diseases faced by Sampled Farmers during Bajra Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Powdery mildew	0.0	15.4	7.7	15.4	--	13.0	6.5	8.7	4.3	--	0.0	10.0	0.0	0.0	5.0	8.7	8.7	7.2	5.8	5.0
Grain smut	7.7	23.1	0.0	0.0	--	23.9	15.2	8.7	6.5	4.3	10.0	20.0	20.0	0.0	7.5	18.8	17.4	8.7	4.3	5.3
Ergot	7.7	7.7	7.7	0.0	--	17.4	6.5	4.3	2.2	20.0	10.0	10.0	10.0	0.0	--	14.5	7.2	5.8	1.4	20.0
Late blight	7.7	7.7	7.7	0.0	--	4.3	6.5	2.2	2.2	--	0.0	10.0	10.0	0.0	--	4.3	7.2	4.3	1.4	--
Pod rot	15.4	7.7	0.0	0.0	--	2.2	8.7	8.7	2.2	8.3	0.0	0.0	20.0	10.0	--	4.3	7.2	8.7	2.9	8.3
Others	7.7	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	--	0.0	0.0	10.0	0.0	--	1.4	0.0	1.4	0.0	20.0

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Maize is susceptible to powdery mildew, seed rot, leaf blight, late blight and pod rot (Table 6.7). All these diseases cause yield loss ranging between 6.5 and 20 per cent. The farmers opined that powdery mildew may impact yield negatively to the extent of 20 per cent. In particular, 12.5 per cent of large farmers rated it as a severe problem. The disease of seed rot is rated as a slight problem by around 25 per cent of medium and large farmers. The opinions of different category of farmers also differ regarding severity of leaf blight, late blight and pod rot. It is clear from responses of farmers that the occurrence of these diseases impacts productivity of maize in Haryana.

The responses of sampled farmers regarding problem of diseases in case of cotton are presented in Table 6.8, Wilt and leaf curl are important diseases which may cause yield loss of around 14 and 16 per cent. The farmers opined that root rot and angular leaf spot are relatively less dangerous and may impact the productivity of cotton by almost 6 per cent. The perceptions of farmers in different categories vary widely. For instance, 50 per cent of small farmers rated leaf curl as a slight problem. On the other hand, 22.4 per cent medium and 16 per cent large farmers feel that this is a severe problem in cotton cultivation. The opinions of farmers in different farm sizes also vary about damage in productivity due to occurrence of the other analyzed diseases. The range of yield loss varies between 4.5 per cent and 24 per cent. To sum up, the ranking of diseases causing loss in productivity of cotton is leaf curl, wilt, angular leaf spot and root rot respectively.

Insects and pests:

The damaging effects caused by insect/pests to the productivity of various crops are well evidenced in literature and measures of control are also provided by the agricultural scientists. It requires crop wise understanding of different insect/pests causing the harm. During our survey, we had asked some questions regarding qualitative assessment of sampled farmers. The responses of farmers regarding problems of insect/pests in paddy cultivation are presented in Table 6.9. Rice hispa, whitefly, stem borer, hairy caterpillar and leaf folder are the major insect/pests damaging the quantity and quality of produce in case of paddy. The farmers opined that each one causes yield loss but the degree of damage varies between 8.5 per cent and 14.9 per cent. In particular, rice hispa causes the maximum yield loss. The opinions of different category of farmers however, differ regarding the degree of yield loss.

Table 6.7
Problems of Diseases faced by Sampled Farmers during Maize Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Powdery mildew	3.8	3.8	0.0	0.0	--	4.9	0.0	2.4	0.0	--	0.0	0.0	12.5	0.0	20.0	4.0	1.3	2.7	0.0	20.0
Seed rot	3.8	30.8	7.7	3.8	8.4	9.8	24.4	12.2	0.0	10.0	12.5	25.0	12.5	0.0	10.0	8.0	26.7	10.7	1.3	9.1
Leaf blight	15.4	7.7	3.8	3.8	5.0	2.4	14.6	12.2	0.0	10.4	12.5	25.0	0.0	0.0	--	8.0	13.3	8.0	1.3	9.2
Late blight	7.7	23.1	7.7	0.0	6.4	0.0	12.2	9.8	0.0	6.6	12.5	12.5	0.0	0.0	--	4.0	16.0	8.0	0.0	6.5
Pod rot	3.8	3.8	3.8	0.0	--	4.9	7.3	4.9	4.9	15.0	0.0	0.0	0.0	0.0	--	4.0	5.3	4.0	2.7	15.0
Others	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.8
Problems of Diseases faced by Sampled Farmers during Cotton Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Wilt	0.0	10.0	10.0	0.0	15.0	2.0	18.4	10.2	2.0	9.9	4.0	16.0	8.0	8.0	24.0	2.4	16.7	9.5	3.6	14.1
Root rot	0.0	20.0	0.0	0.0	7.5	18.4	10.2	6.1	2.0	4.6	8.0	8.0	0.0	0.0	7.5	13.1	10.7	3.6	1.2	5.7
Leaf curl	10.0	50.0	10.0	0.0	17.8	6.1	26.5	20.4	22.4	13.7	8.0	12.0	44.0	16.0	19.0	7.1	25.0	26.2	17.9	16.0
Angular leaf spot	20.0	20.0	0.0	0.0	--	20.4	8.2	10.2	2.0	6.6	8.0	16.0	4.0	0.0	4.5	16.7	11.9	7.1	1.2	5.8
Others	0.0	10.0	10.0	0.0	5.0	0.0	4.1	2.0	0.0	5.0	4.0	0.0	4.0	0.0	--	1.2	3.6	3.6	0.0	5.0

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.9
Problems of Insects/Pests faced by Sampled Farmers during Rice Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Rice hispa	6.4	31.9	10.6	0.0	7.8	13.2	19.4	5.4	4.7	13.8	8.8	11.8	11.8	0.0	29.6	11.0	21.0	7.6	2.9	14.9
Whitefly	8.5	27.7	8.5	2.1	6.9	12.4	20.2	8.5	3.1	9.5	11.8	17.6	5.9	0.0	11.1	11.4	21.4	8.1	2.4	9.2
Stemborer	10.6	10.6	8.5	4.3	8.6	5.4	15.5	10.9	5.4	12.2	11.8	20.6	17.6	5.9	11.7	7.6	15.2	11.4	5.2	11.1
Hairy Caterpillar	12.8	2.1	0.0	0.0	--	7.0	5.4	3.9	0.0	10.4	5.9	5.9	2.9	0.0	5.0	8.1	4.8	2.9	0.0	9.5
Leaf folder	6.4	14.9	19.1	10.6	8.2	12.4	10.1	13.2	2.3	8.5	2.9	23.5	20.6	0.0	9.2	9.5	13.3	15.7	3.8	8.5
Others	0.0	2.1	2.1	0.0	12.5	0.0	2.3	0.8	0.0	5.0	0.0	2.9	0.0	0.0	--	0.0	2.4	1.0	0.0	8.8

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.10
Problems of Insects/Pests faced by Sampled Farmers during Bajra Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Root bug	7.7	7.7	0.0	7.7	--	6.5	8.7	0.0	2.2	5.0	10.0	0.0	0.0	0.0	--	7.2	7.2	0.0	2.9	5.0
Grass hopper	23.1	7.7	0.0	0.0	--	10.9	10.9	0.0	0.0	--	20.0	10.0	0.0	0.0	10.0	14.5	10.1	0.0	0.0	10.0
Maize borer	30.8	0.0	0.0	7.7	--	8.7	8.7	0.0	0.0	5.0	10.0	30.0	0.0	0.0	6.5	13.0	10.1	0.0	1.4	6.0
Hairy Caterpillar	15.4	7.7	0.0	0.0	--	10.9	4.3	0.0	2.2	5.0	10.0	20.0	0.0	0.0	3.0	11.6	7.2	0.0	1.4	4.0
Leaf folder	15.4	23.1	7.7	0.0	--	4.3	8.7	4.3	0.0	--	10.0	0.0	0.0	0.0	--	7.2	10.1	4.3	0.0	--
Others	7.7	7.7	0.0	0.0	--	2.2	0.0	0.0	0.0	--	0.0	10.0	0.0	0.0	--	2.9	2.9	0.0	0.0	--

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)

Y means Per cent yield loss.

Source: Ibid

For instance, around 31.9 per cent of small farmers rated it as a slight problem. On the other hand, 11.8 per cent large farmers feel that it is a severe problem. The responses of different category farmers also vary about the severity of the problem caused by various insect/pests and their impact on the productivity of paddy but there is a general agreement about the yield loss due to infestation of insect/pests in case of paddy in Haryana.

The results of responses of farmers regarding occurrence of insect/pests in case of bajra are presented in Table 6.10. Clearly, root bug, grass hopper, maize borer, hairy caterpillar and leaf folder affect the productivity of bajra in the range of 4 to 10 per cent. The farmers opined that grass hopper causes yield loss of 10 per cent. The responses of farmers also differ in the severity of problem. Around 23 per cent of small farmers opined that grass hopper is not a problem while around 8 per cent stated that it is a slight problem. Similarly, 30.8 per cent small farmers pointed out that maize borer is not a problem where as 30 per cent large farmers opined it as a slight problem. The different opinions were expressed by the farmers in different categories about the severity of insect/pests in cultivation of bajra in Haryana.

The crop of maize is negatively impacted by insect/pests such as maize shoot fly, thrips, maize borer, hairy caterpillar and leaf folder. The responses of farmers about the severity of these insect/pests in Haryana are presented in Table 6.11. The farmers opined that the highest damage of 16.7 per cent in yield is caused by thrips. On the other hand, maize shoot fly reduces yield by 4.4 per cent. According to 46.2 per cent small farmers, maize shoot fly is a slight problem while 45.14 per cent farmers in the same category stated that it is a moderate problem. About 50 per cent and 26.9 per cent small farmers stated maize borer as a slight and moderate problem. The responses of farmers in different categories about the damage to productivity due to other insect/pests also vary considerably but around 63 per cent sampled farmers rated maize borer as a problem which causes yield loss of 8.7 per cent in their perception.

Having analyzed the perceptions of farmers about incidence of insect/pests in case of food grain crops of paddy, bajra and maize, we take up cotton. The responses of sampled farmers are presented in Table 6.12.

Table 6.11
Problems of Insects/Pests faced by Sampled Farmers during Maize Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Maize shoot fly	3.8	46.2	15.4	0.0	4.2	7.3	12.2	4.9	0.0	5.0	0.0	0.0	0.0	0.0	--	5.3	22.7	8.0	0.0	4.4
Thrips	0.0	0.0	3.8	0.0	--	9.8	9.8	2.4	0.0	16.7	0.0	12.5	12.5	0.0	--	5.3	6.7	4.0	0.0	16.7
Maize borer	3.8	50.0	26.9	0.0	6.6	7.3	36.6	22.0	2.4	8.2	12.5	37.5	0.0	0.0	20.0	6.7	41.3	21.3	1.3	8.7
Hairy Caterpillar	11.5	11.5	3.8	0.0	5.0	9.8	12.2	7.3	0.0	12.5	0.0	25.0	0.0	0.0	--	9.3	13.3	5.3	0.0	8.8
Leaf folder	34.6	19.2	3.8	0.0	5.5	7.3	22.0	2.4	0.0	7.5	12.5	0.0	12.5	12.5	--	17.3	18.7	4.0	1.3	6.5
Others	0.0	0.0	0.0	0.0	--	0.0	0.0	4.9	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	2.7	0.0	--

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.12
Problems of Insects/Pests faced by Sampled Farmers during Cotton Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Termites	30.0	40.0	10.0	0.0	2.0	28.6	12.2	4.1	0.0	4.2	16.0	20.0	0.0	0.0	4.0	25.0	17.9	3.6	0.0	3.9
Leaf Hopper	10.0	10.0	30.0	0.0	5.0	14.3	24.5	8.2	0.0	6.2	4.0	28.0	4.0	0.0	9.6	10.7	23.8	9.5	0.0	7.1
Cotton White fly	40.0	20.0	20.0	0.0	7.5	10.2	22.4	26.5	8.2	9.9	8.0	24.0	28.0	4.0	5.8	13.1	22.6	26.2	6.0	8.4
Spotted bollworm	10.0	0.0	0.0	0.0	1.0	4.1	12.2	8.2	0.0	10.0	0.0	12.0	4.0	4.0	15.0	3.6	10.7	6.0	1.2	11.8
Pink bollworm	0.0	0.0	0.0	0.0	--	12.2	8.2	2.0	0.0	5.0	4.0	0.0	8.0	4.0	20.0	8.3	4.8	3.6	1.2	12.5
American bollworm	10.0	10.0	0.0	0.0	--	4.1	2.0	2.0	0.0	5.0	4.0	4.0	4.0	0.0	--	4.8	3.6	2.4	0.0	5.0
Cotton semi looper	0.0	20.0	30.0	0.0	5.0	12.2	16.3	16.3	4.1	10.5	8.0	24.0	16.0	0.0	9.7	9.5	19.0	17.9	2.4	9.9
Aphid	20.0	20.0	20.0	0.0	2.0	10.2	20.4	12.2	0.0	6.6	4.0	12.0	12.0	0.0	12.2	9.5	17.9	13.1	0.0	7.8
Red cotton bug	0.0	0.0	10.0	0.0	5.0	0.0	0.0	0.0	0.0	--	0.0	4.0	0.0	0.0	12.0	0.0	1.2	1.2	0.0	8.5
Durky cotton bug	0.0	0.0	10.0	0.0	5.0	0.0	0.0	0.0	0.0	--	0.0	4.0	0.0	0.0	13.0	0.0	1.2	1.2	0.0	9.0
Mealy bug	0.0	0.0	10.0	0.0	5.0	0.0	0.0	0.0	0.0	--	0.0	4.0	4.0	0.0	8.0	0.0	1.2	2.4	0.0	6.5
Others	0.0	20.0	10.0	0.0	5.0	0.0	16.3	8.2	2.0	7.3	0.0	24.0	4.0	4.0	7.6	0.0	19.0	7.1	2.4	7.2

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Cotton is affected and damaged by a large number of insect/pests. We have sought responses of the farmers about severity and damage to the productivity by termites, leaf hopper, cotton whitefly, cotton semi looper, aphid, red cotton bug, durky cotton bug and mealy bug. The sampled farmers opined that all these inset/pests impact productivity of the cotton. The minimum loss by termites is 3.9 per cent. It appeared that pink bollworm and spotted bollworm affect the productivity of the cotton to the extent of 12.5 and 11.8 per cent respectively. Cotton semi looper is harmful to the extent of 10 per cent while durky cotton bug may cause a loss of 9 per cent in yield of cotton. The responses of small, medium and large category farmers regarding severity of problem caused due to insect/pests vary considerably. The response ranges between 2 per cent to 40 per cent. But, they agreed about losses in productivity of cotton due to infestation of insect/pests at the aggregate level.

Weeds:

Weeds affect crops by reducing productivity. Normally, crops are exposed to severe competition from self grown weeds which grow without human efforts and not wanted. They compete with the major crop for water, soil, nutrients and sun light. Therefore, proper control of weeds is a pre-requisite for obtaining higher input efficiency. They also harbour insect/pests, diseases and other micro organisms. In addition, weeds reduce the quality of produce and make harvesting difficult. The stage, at which, there is a maximum impact of weeds on crop growth is termed as critical period of weeds. Competition which usually varies between 15 to 60 days after sowing depends upon the crop, crop duration, soil and climatic conditions. Often, weed management is done through mechanical, cultural and chemical methods. The utilization of herbicides is an important method.

Table 6.13 presents responses of sampled farmers about growth of weeds in cultivation of rice. Clearly, rice is exposed to weeds such as itsit, mathana, bhakhra, motha, grass and sonfa. These weeds compete for expensive inputs. The absence of control measures reduces the productivity. The sampled farmers rated itsit followed by mathana as comparatively damaging weeds. These affect the productivity of rice by around 8 and 6 per cent respectively. The mathana, sonfa and grass impact the yield rates negatively by 5.6, 5.5 and 5.3 per cent respectively. The responses of farmers across various farm sizes on the severity of these weeds vary considerably.

Table 6.13
Problems of Weeds faced by Sampled Farmers during Rice Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Itsit	14.9	23.4	12.8	0.0	6.1	13.2	17.1	16.3	1.6	8.1	11.8	14.7	20.6	0.0	8.6	13.3	18.1	16.2	1.0	7.9
Mathana	12.8	14.9	4.3	2.1	5.8	3.1	8.5	3.1	0.0	5.0	5.9	11.8	0.0	0.0	5.8	5.7	10.5	2.9	0.5	5.6
Bhakhra	12.8	0.0	0.0	0.0	3.0	7.0	2.3	2.3	0.8	5.0	17.6	5.9	0.0	0.0	7.5	10.0	2.4	1.4	0.5	4.3
Motha	12.8	31.9	8.5	6.4	8.6	16.3	27.1	20.9	3.9	5.5	20.6	29.4	8.8	0.0	6.7	16.2	28.6	16.2	3.8	6.3
Grass	17.0	25.5	12.8	6.4	4.0	16.3	25.6	10.9	4.7	5.5	17.6	17.6	0.0	8.8	6.7	16.7	24.3	9.5	5.7	5.3
Sonfa	10.6	17.0	8.5	0.0	6.8	8.5	7.8	4.7	0.8	4.9	5.9	2.9	2.9	0.0	--	8.6	9.0	5.2	0.5	5.5
Others	2.1	0.0	0.0	0.0	--	0.8	4.7	5.4	0.8	13.0	2.9	8.8	5.9	2.9	2.7	1.4	4.3	4.3	1.0	7.8

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.14
Problems of Weeds faced by Sampled Farmers during Bajra Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Itsit	23.1	0.0	0.0	0.0	--	4.3	17.4	4.3	2.2	10.0	20.0	0.0	10.0	0.0	--	10.1	11.6	4.3	1.4	10.0
Mathana	15.4	7.7	0.0	0.0	--	2.2	10.9	2.2	0.0	--	0.0	20.0	0.0	0.0	--	4.3	11.6	1.4	0.0	--
Bhakhra	23.1	0.0	0.0	0.0	--	10.9	2.2	6.5	0.0	5.0	0.0	10.0	10.0	0.0	--	11.6	2.9	5.8	0.0	5.0
Motha	7.7	30.8	7.7	7.7	--	13.0	32.6	15.2	6.5	7.5	20.0	10.0	40.0	0.0	5.0	13.0	29.0	17.4	5.8	7.0
Grass	23.1	23.1	7.7	7.7	--	10.9	19.6	13.0	6.5	10.0	0.0	50.0	10.0	10.0	5.0	11.6	24.6	11.6	7.2	8.8
Sonfa	0.0	0.0	7.7	0.0	--	2.2	8.7	2.2	0.0	10.0	0.0	0.0	10.0	0.0	--	1.4	5.8	4.3	0.0	10.0
Others	0.0	0.0	0.0	0.0	--	2.2	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--	1.4	0.0	0.0	0.0	--

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

For instance, 31.9 per cent small farmers opined that mathana is a slight problem but in the same category, around 9 and 6 per cent feel that it is a moderate and severe problem. The same figures for medium farmers could be observed around 27, 21 and 4 per cent respectively. On the other hand, 29 and 9 per cent large farmers rated mathana as moderate and severe problem. These variations could be also noticed for other varieties of weeds. At the aggregate level, 24, 10 and 6 per cent of farmers stated that grass is slight, moderate and severe problem. In a nut shell, although responses of sampled farmers varied about the problems and severity of the weeds, they agreed that weeds cause loss in productivity of rice in Haryana.

Next, we analyze problems of weeds and farmers perceptions regarding weeds on productivity of bajra in Haryana. It is clear from Table 6.14 that bajra is exposed to weeds such as itsit, mathana, bhakhra, motha, grass, sonfa and other weeds. Around 30.8 per cent small farmers, 32.6 per cent medium farmers and 10 per cent of large farmers opined that motha is a slight problem in cultivation of bajra. On the other hand, 7.7 per cent small, 15.2 per cent medium and 40 per cent large farmers stated that it is a moderate problem. Some of the small and medium farmers expressed it as a severe problem. The yield loss caused by this weed was 7 per cent as per reporting of the farmers. This yield loss is lower than itsit, sonfa and grass which is pointed out between 8.8 and 10 per cent. The opinions of farmers about severity of the weeds across farm sizes varied significantly but all of them felt that weeds cause yield loss and therefore, it becomes urgent to control the weeds by integrating manual and chemical methods.

Like paddy and bajra, problem of weeds occurs in case of maize also. The sampled farmers stated that itsit, mathana, bhakhra, motha, grass and sonfa are the major weeds which grow in the fields of maize in Haryana. Table 6.15 shows that the impact of weeds on productivity of maize varied between 4 and 10 per cent respectively. The opinions of sampled farmers about severity of weeds across farm sizes differ significantly. Around 12 per cent small farmers pointed out that motha, grass and sonfa create severe problems in cultivation of maize. However, this per cent was 12 per cent in case of motha and grass for medium group while the same was round 19, 12 and 8 per cent respectively for large farm size group. Results show that opinions of different categories of farmers varied about the severity of problems of weeds.

Table 6.15
Problems of Weeds faced by Sampled Farmers during Maize Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Itsit	7.7	23.1	0.0	0.0	4.0	4.9	12.2	2.4	0.0	4.0	0.0	0.0	12.5	0.0	--	5.3	14.7	2.7	0.0	4.0
Mathana	0.0	38.5	3.8	0.0	--	2.4	14.6	7.3	0.0	--	0.0	0.0	12.5	0.0	--	1.3	21.3	6.7	0.0	--
Bhakhra	7.7	11.5	0.0	0.0	--	4.9	2.4	0.0	2.4	--	0.0	12.5	0.0	0.0	--	5.3	6.7	0.0	1.3	--
Motha	26.9	23.1	11.5	0.0	5.7	26.8	12.2	24.4	4.9	4.8	25.0	25.0	12.5	25.0	--	26.7	17.3	18.7	5.3	5.1
Grass	34.6	26.9	11.5	3.8	7.5	14.6	34.1	12.2	2.4	6.0	12.5	12.5	12.5	25.0	--	21.3	29.3	12.0	5.3	7.0
Sonfa	15.4	15.4	11.5	0.0	5.7	7.3	19.5	7.3	0.0	5.8	0.0	0.0	0.0	12.5	--	9.3	16.0	8.0	1.3	5.8
Others	0.0	0.0	0.0	0.0	--	0.0	0.0	2.4	0.0	10.0	0.0	0.0	0.0	0.0	--	0.0	0.0	1.3	0.0	10.0

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.

Source: Ibid

Table 6.16
Problems of Weeds faced by Sampled Farmers during Cotton Production, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Mundi	0.0	0.0	0.0	0.0	--	0.0	2.0	2.0	0.0	6.0	4.0	0.0	0.0	0.0	--	1.2	1.2	1.2	0.0	6.0
Sati	10.0	20.0	10.0	0.0	5.0	12.2	4.1	2.0	0.0	4.0	16.0	4.0	20.0	0.0	8.3	13.1	6.0	8.3	0.0	6.3
Motha	20.0	10.0	40.0	0.0	5.0	30.6	12.2	10.2	0.0	4.6	24.0	20.0	8.0	0.0	7.0	27.4	14.3	13.1	0.0	5.1
Somwa	0.0	10.0	10.0	0.0	5.0	0.0	10.2	12.2	2.0	10.1	0.0	0.0	24.0	4.0	8.3	0.0	7.1	15.5	2.4	9.3
Jhangi, germs	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	4.0	0.0	10.0	0.0	0.0	1.2	0.0	10.0
Dalchati	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	4.0	0.0	0.0	--	0.0	1.2	0.0	0.0	--
Bail (casauta)	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	2.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	1.2	--
Grass	0.0	10.0	0.0	0.0	--	6.1	0.0	4.1	0.0	7.5	0.0	0.0	0.0	0.0	--	3.6	1.2	2.4	0.0	7.5
Doob	30.0	0.0	10.0	0.0	--	6.1	6.1	0.0	0.0	4.0	16.0	8.0	0.0	0.0	4.0	11.9	6.0	1.2	0.0	4.0
Santa	0.0	0.0	0.0	0.0	--	2.0	4.1	2.0	0.0	5.0	0.0	4.0	12.0	0.0	3.7	1.2	3.6	4.8	0.0	4.0
Dilla	0.0	0.0	0.0	0.0	--	2.0	4.1	0.0	0.0	7.5	8.0	0.0	0.0	0.0	--	3.6	2.4	0.0	0.0	7.5
Makda	0.0	10.0	0.0	0.0	2.0	0.0	2.0	0.0	0.0	--	8.0	0.0	4.0	0.0	8.0	2.4	2.4	1.2	0.0	5.0
Samak	20.0	0.0	0.0	0.0	--	14.3	8.2	0.0	0.0	4.3	16.0	0.0	4.0	0.0	7.5	15.5	4.8	1.2	0.0	4.9
Kundra	10.0	0.0	0.0	0.0	--	0.0	2.0	0.0	0.0	5.0	4.0	4.0	0.0	0.0	7.5	2.4	2.4	0.0	0.0	6.3
Mathana	0.0	0.0	0.0	0.0	--	2.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	--	1.2	0.0	0.0	0.0	3.0

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Y means Per cent yield loss.
Source: Ibid

Table 6.17
Problems of Environmental Stress faced by Sampled Farmers during Cultivation of Alternative Crops, 2012-13

(% multiple response)

Particulars	Small					Medium					Large					Overall				
	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y	1	2	3	4	Y
Drought at																				
Pre-sowing stage	17.0	6.4	12.8	4.3	40.0	17.8	13.2	8.5	2.3	28.0	5.9	14.7	2.9	0.0	5.0	15.7	11.9	8.6	2.4	30.8
Flowering stage	12.8	2.1	2.1	0.0	5.0	6.2	11.6	0.8	0.0	4.4	8.8	8.8	8.8	0.0	6.4	8.1	9.0	2.4	0.0	5.2
Pod development stage	4.3	25.5	6.4	0.0	3.0	10.1	11.6	3.9	0.0	11.3	0.0	26.5	8.8	2.9	7.9	7.1	17.1	5.2	0.5	9.3
Early seeding stage	2.1	4.3	0.0	0.0	--	7.8	6.2	3.1	0.0	4.3	0.0	8.8	2.9	2.9	6.9	5.2	6.2	2.4	0.5	5.6
Maturity stage	8.5	2.1	4.3	0.0	--	7.0	10.9	1.6	0.0	3.4	0.0	8.8	8.8	2.9	8.5	6.2	8.6	3.3	0.5	5.3
Rain at																				
Pre-sowing stage	8.5	12.8	6.4	0.0	12.5	8.5	13.2	10.1	2.3	12.8	8.8	14.7	5.9	0.0	15.0	8.6	13.3	8.6	1.4	13.3
Flowering stage	8.5	17.0	4.3	2.1	5.0	10.1	6.2	3.1	0.8	11.7	8.8	8.8	5.9	2.9	8.5	9.5	9.0	3.8	1.4	8.4
Pod development stage	0.0	14.9	6.4	0.0	27.5	11.6	4.7	3.1	1.6	5.0	5.9	11.8	5.9	0.0	6.7	8.1	8.1	4.3	1.0	12.1
Early seeding stage	2.1	6.4	2.1	0.0	5.0	6.2	5.4	3.1	0.0	--	2.9	14.7	5.9	0.0	13.1	4.8	7.1	3.3	0.0	11.5
Maturity stage	2.1	10.6	19.1	6.4	10.0	3.1	16.3	6.2	0.0	5.0	0.0	14.7	8.8	2.9	14.2	2.4	14.8	9.5	1.9	8.1
High temperature at																				
Pre-sowing stage	6.4	12.8	2.1	2.1	--	3.9	9.3	1.6	0.0	--	0.0	14.7	5.9	0.0	--	3.8	11.0	2.4	0.5	--
Flowering stage	6.4	12.8	2.1	0.0	5.0	3.9	10.9	3.1	0.0	5.0	14.7	11.8	2.9	0.0	10.2	6.2	11.4	2.9	0.0	7.2
Pod development stage	4.3	12.8	4.3	0.0	--	4.7	10.1	3.9	0.0	7.5	8.8	17.6	0.0	0.0	3.5	5.2	11.9	3.3	0.0	5.5
Early seeding stage	2.1	14.9	4.3	2.1	6.0	1.6	8.5	3.1	0.8	3.0	2.9	8.8	2.9	0.0	11.3	1.9	10.0	3.3	1.0	7.3
Maturity stage	4.3	12.8	12.8	0.0	10.0	3.1	7.8	3.1	3.1	22.5	2.9	14.7	5.9	0.0	11.3	3.3	10.0	5.7	1.9	17.5
Low temperature at																				
Pre-sowing stage	2.1	2.1	4.3	0.0	--	2.3	3.1	0.8	0.0	--	8.8	0.0	0.0	2.9	--	3.3	2.4	1.4	0.5	--
Flowering stage	4.3	8.5	0.0	0.0	--	3.9	3.1	0.8	0.0	4.2	2.9	2.9	5.9	2.9	--	3.8	4.3	1.4	0.5	4.2
Pod development stage	2.1	2.1	2.1	0.0	--	4.7	7.0	1.6	0.8	1.3	2.9	5.9	5.9	2.9	12.5	3.8	5.7	2.4	1.0	6.9
Early seeding stage	4.3	4.3	2.1	0.0	--	2.3	5.4	1.6	0.0	5.0	5.9	0.0	2.9	0.0	9.0	3.3	4.3	1.9	0.0	7.7
Maturity stage	10.6	14.9	6.4	0.0	3.0	4.7	9.3	4.7	0.0	4.7	2.9	14.7	2.9	5.9	7.7	5.7	11.4	4.8	1.0	5.4

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Source: Ibid

But, they felt that removal of weeds need to be paid urgent attention for harvesting good yield of maize. The farmers should integrate best possible methods to arrest and eliminate their growth.

Finally, we analyze perceptions of sampled farmers about the severity of unwanted weeds and their impact on productivity of cotton. Cotton gets weeds such as mundi, sati, motha, somwa, jhangi germs, dalchoti casauta, grass, doob, santa, dilla, makda, samak, kundra and mathana. The expected loss in productivity caused by occurrence of these weeds could be between 3 to 10 per cent. The higher negative impact is due to jhangi germs followed by somwa. It is evident from Table 6.16 that other weeds also cause considerable loss in yield. The sampled farmers opined that severity of weeds was observed different by small, medium and large group of farmers. Around 10 and 40 per cent small farmers stated that somwa, motha, jhangi germs and doob are moderate problem in cultivation of cotton. On the other hand, response ranged between 4 and 24 per cent in case of large farmers. The same figures at the aggregate level varied between 1.2 and 15.5 per cent. During the survey, farmers stated that problem of weeds is common in cultivation of cotton in Haryana and they take remedial action by combining various methods to control and eliminate weeds.

We have noted earlier that environmental problems put a serious constraint in raising alternative crops on sampled farms. The drought, rain and shifting temperature i.e. high and low may affect different stages of plant growth. With greater variability in environmental factors, we expect a range of responses that will affect agricultural production process. Further, these changes are expected to increase abiotic stresses forcing crop production to function under greater levels of perturbation in the future. In view of variability in above mentioned indicators in production of crops, we have sought perceptions of sampled farmers about the severity of problem at pre-sowing, flowering, pod development, early seeding and maturity stage of plant growth. This information is presented in Table 6.17. It may be observed that more than half of respondents feel that drought is an environmental problem affecting crops at pre-sowing stage. The problem was lesser felt at the flowering stage, early seeding and maturity stages. Nonetheless, it is crucial at pod development stage. The second environmental factor, variability in rainfall affects plant growth at all the above mentioned stages but impact seems higher at pre-sowing and maturity stages. Further, variability in temperature affects crops at four crucial stages in varying degrees but around 10 per cent of farmers rated it slight problem, although it was felt as a moderate and serious problem by less than 5 per cent of respondents. We had also sought perceptions of farmers in different

categories about the problems created by drought, variability in rainfall and temperature at different stages of plant growth. The responses varied significantly because some of the categories opined these problems as severe while a small proportion of producers across categories stated that these problems are not important. This result is contrary to expectations. The range of responses varied between 1 per cent and 25 per cent. The respondents during discussions reported that unfavorable environmental factors create tension, reduce productivity and in turn profitability from cultivation of crops. Crop losses due to environmental problems are disaster for the agricultural economy of the regions. Thus, development of resilient agricultural systems is a great challenge and scientists should evolve technology with least effect of these factors to make farming profitable and attractive.

Input Availability:

We have further sought perceptions of sampled farmers about problems of input availability for alternative crops in kharif season in Haryana. Table 6.18 presents these details. An examination of results points out that lack of irrigation facility is a slight problem for around 22 per cent cultivators while the same constraint was moderate and severe problem for other 22 and 16 per cent producers. Further, paucity of land as a problem in cultivation of these crops was cited by around 25 per cent respondents. It is well evidenced in literature that easy availability of quality seed, fertilizer and pesticides motivate farmers to adopt optional crops and improved technology. However, procuring these inputs was a severe problem for a small proportion of respondents while it was a moderate problem for 15 to 18 per cent sampled farmers. Since, maintaining time line of field operations is completely dependent on farmers, it was narrated as a problem by less than 10 per cent respondents. The response of the farmers is almost similar for availability of machinery. The problem of suitability of land for producing these crops was not considered a priority by the respondents. Haryana is known for shortage of human labour and therefore, more than 40 per cent sampled farmers experienced this problem. During discussions, farmers informed that they opt to use machines over human labour whenever there is a scope.

Table 6.18
Problems of Inputs faced during Production of Alternative Crops by Sampled Farmers, 2012-13

(% multiple response)

Reasons	Small				Medium				Large				Overall			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Lack of Irrigation facility	23.4	21.3	19.1	0.0	22.5	24.0	12.4	3.1	23.5	17.6	23.5	2.9	22.9	22.4	15.7	2.4
Shortage of land	21.3	34.0	6.4	0.0	30.2	17.8	4.7	0.0	29.4	8.8	2.9	0.0	28.1	20.0	4.8	0.0
Non-availability of quality seeds	34.0	12.8	4.3	2.1	23.3	16.3	7.0	0.8	26.5	14.7	8.8	0.0	26.2	15.2	6.7	1.0
Non-availability of fertilizer	21.3	14.9	2.1	6.4	20.9	17.8	4.7	0.8	20.6	23.5	5.9	2.9	21.0	18.1	4.3	2.4
Non-availability of chemicals/pesticides	21.3	23.4	0.0	0.0	18.6	12.4	4.7	0.8	11.8	14.7	8.8	0.0	18.1	15.2	4.3	0.5
Shortage of labour	27.7	21.3	8.5	2.1	21.7	17.1	21.7	4.7	14.7	32.4	32.4	0.0	21.9	20.5	20.5	3.3
Timeliness of field operations	19.1	14.9	0.0	0.0	7.8	3.1	0.0	0.8	8.8	2.9	0.0	0.0	10.5	5.7	0.0	0.5
Availability of machinery	12.8	12.8	0.0	0.0	12.4	3.1	1.6	0.0	11.8	0.0	0.0	0.0	12.4	4.8	1.0	0.0
Lack of credit	12.8	19.1	4.3	0.0	20.2	17.1	8.5	0.8	20.6	29.4	5.9	0.0	18.6	19.5	7.1	0.5
Non-suitable land	12.8	4.3	2.1	2.1	5.4	6.2	1.6	2.3	5.9	8.8	2.9	0.0	7.1	6.2	1.9	1.9
Low yield	4.3	10.6	0.0	0.0	2.3	5.4	0.8	2.3	0.0	5.9	0.0	0.0	2.4	6.7	0.5	1.4
Non-availability of disease resistant varieties	2.1	2.1	0.0	0.0	0.8	2.3	0.0	1.6	0.0	0.0	0.0	2.9	1.0	1.9	0.0	1.4

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Source: Ibid

But, there are certain agricultural operations which producers prefer to be done manually despite availability of machines. The transplantation and harvesting of paddy and picking cotton are such operations. Further, availability of finance is a constraint for small farmers, although medium farmers also face this problem. Around 30 per cent sampled farmers reported arrangement of credit as a problem. The problems of low yield rates and in turn low prices and profitability are the seriously felt constraints by the growers and therefore, around 40 per cent respondents reported these constraints as a problem in varying degrees. It seems that producers do not face serious problem of availability of disease resistant seeds of alternative crops in Haryana and therefore, they have not expressed it as a high ranking problem. The ranking of problems related to inputs by different categories of farmers varied considerably. A mixed pattern could be observed. However, shortage of human labour was experienced by around two third large farmers who manage cultivation of crops through hired human labour due to limited availability of family labour.

Marketing of Produce:

Although, crop diversification has advantage of mitigating price and production risks, the advantage depends on availability of land and economic factors. When farmers opt for crop diversification as survival strategy, they face severe constraints due to difficulty in access to information on price, variability in price, losses due to storage, shortage of human labour for sorting, packaging, transportation and lack of nearby markets. We tried to probe opinions of sampled farmers about the severity of these problems. Table 6.19 presents this information. It may be noted that variability in price as a problem was rated by highest percentage of respondents. Almost 60 per cent sampled farmers experienced this problem. A sizeable proportion of farmers experienced difficulty in accessing price information. The problem of crop losses in storage was reported by less than 10 per cent respondents. Around 20 per cent sampled farmers faced problems in arranging human labour for various agricultural operations. The demand for the produce is one of the major determinants of price. Around 25 per cent respondents reported this as a problem. The problem of nearby markets was felt by relatively small proportion of respondents.

Table 6.19
Problems faced by Sampled Farmers during Marketing of Produce, 2012-13

(% multiple response)

Reason	Small				Medium				Large				Overall			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Difficult to access information on price	29.8	14.9	17.0	4.3	31.8	15.5	9.3	2.3	32.4	26.5	5.9	2.9	31.4	17.1	10.5	2.9
Variability of price	14.9	31.9	23.4	2.1	17.8	38.8	19.4	1.6	2.9	44.1	26.5	2.9	14.8	38.1	21.4	1.9
Losses during storage	23.4	2.1	4.3	0.0	10.1	3.9	3.1	1.6	8.8	8.8	0.0	2.9	12.9	4.3	2.9	1.4
High labour needs for sorting/packaging	14.9	12.8	0.0	0.0	17.8	17.8	3.9	1.6	11.8	20.6	5.9	2.9	16.2	17.1	3.3	1.4
Transport to market	17.0	2.1	2.1	4.3	14.0	9.3	3.1	1.6	5.9	5.9	5.9	0.0	13.3	7.1	3.3	1.9
Low market demand	17.0	14.9	4.3	0.0	17.8	20.9	2.3	1.6	20.6	11.8	5.9	2.9	18.1	18.1	3.3	1.4
No nearby markets	14.9	10.6	0.0	0.0	11.6	3.1	2.3	0.8	14.7	5.9	5.9	0.0	12.9	5.2	2.4	0.5
Others1	6.4	10.6	0.0	0.0	1.6	6.2	1.6	2.3	0.0	2.9	0.0	2.9	2.4	6.7	1.0	1.9
Others2	2.1	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.0

Note: Ranks are in order of importance from 1 (No problem), 2 (slight problem), 3 (moderate problem) to 4 (severe problem)
Source: Ibid

Table 6.20
Suggestions of Sampled Farmers to Increase Yield of Alternative Crops, 2012-13

(% multiple response)

Suggestion	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Increase in plant population	14.9	8.5	46.8	3.9	14.7	58.1	8.8	20.6	50.0	7.1	14.3	54.3
Use more fertilizer	12.8	8.5	40.4	3.1	8.5	48.1	0.0	8.8	38.2	4.8	8.6	44.8
Use more chemicals	2.1	6.4	38.3	3.1	8.5	42.6	0.0	5.9	35.3	2.4	7.6	40.5
Timely planting	59.6	19.1	6.4	81.4	8.5	7.0	64.7	23.5	2.9	73.8	13.3	6.2
Timely weeding	46.8	14.9	14.9	51.9	22.5	8.5	38.2	32.4	5.9	48.6	22.4	9.5
Provide irrigation at right time	44.7	14.9	12.8	55.0	10.9	12.4	50.0	11.8	26.5	51.9	11.9	14.8
Use of proper plant protection	44.7	10.6	14.9	42.6	20.2	19.4	32.4	26.5	17.6	41.4	19.0	18.1

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source: Ibid

Table 6.21
Suggestions to Researchers by Sampled Farmers to Increase Yield of Alternative Crops, 2012-13

(% multiple response)

Suggestion	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Increase the seed size	4.3	17.0	40.4	3.9	18.6	34.9	5.9	8.8	29.4	4.3	16.7	35.2
Increase number of pods per plant	8.5	14.9	46.8	8.5	20.2	54.3	8.8	29.4	44.1	8.6	20.5	51.0
Develop fertilizer responsive varieties	14.9	12.8	40.4	10.9	17.1	42.6	8.8	26.5	26.5	11.4	17.6	39.5
Develop short duration varieties	19.1	27.7	27.7	29.5	27.9	22.5	41.2	17.6	20.6	29.0	26.2	23.3
Develop drought tolerant varieties	44.7	2.1	14.9	31.8	16.3	14.7	35.3	14.7	14.7	35.2	12.9	14.8
Develop disease resistant varieties	57.4	14.9	10.6	61.2	19.4	13.2	44.1	26.5	11.8	57.6	19.5	12.4
Develop excess moisture tolerant varieties	21.3	12.8	19.1	25.6	17.8	17.8	17.6	32.4	2.9	23.3	19.0	15.7

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source:Ibid

During the course of discussions with farmers, it was felt that intensity of these problems is higher for small farmers who are starved of capital. The perceptions of small, medium and large categories of farmers on cited problems varied significantly. It is suggested that complete chain of crop diversification i.e., production, marketing, processing, packaging, retailing may be created through direct link among all stake holders involved in production of these crops.

6.3 Suggestions:

We had also sought opinions of respondents and asked for suggestions to increase yield of the alternative crops. Table 6.20 gives this information. We have included factors such as increase in plant population, fertilizer use, in time planting and weeding, timely application of irrigation and plant protection chemicals. The ranking of the respondents for these parameters was significantly different. Timely sowing was rated as most important. Only 6 per cent respondents felt that it is a least problem. Further, provision of irrigation at right time was stated as a problem by 64 per cent respondents. It could be due to uncertainty in canal water and limited availability of power for tubewells. Almost 60 per cent sampled farmers expressed requirement of proper plant protection for raising yield levels of alternative crops. It is essential to high light that increase in plant population and application of fertilizer were pointed out as least problems affecting the yield rates. As expected, opinions and rankings given by farmers about the above cited factors, in raising yield level varied significantly across farm sizes. But, all of them agreed during field survey that these are crucial factors which may be looked into carefully for enhancing productivity of alternative crops to paddy in kharif season in Haryana.

The research and development and its effective diffusion at grass root level is important for implementation of crop diversification away from paddy to alternative crops. We have already analyzed experience of sampled farmers on various problems related to adoption of crop diversification. In addition, we asked producers to offer suggestions for researchers in order to further strengthen research to promote these crops. We had enquired about increase in seed size, number of pods, development of short duration, disease, drought and moisture tolerant varieties. The considerable proportion of sampled farmers reported that these are most important and important problems. In case of increase in seed size and number of pods as well

as responsiveness of fertilizer, a sizeable proportion of farmers stated that these are least important problems. The highest percentage of sampled farmers (78 per cent) felt that disease resistant varieties are a problem which should be solved out on priority basis by the researchers and scientists. The ranking of analyzed factors across farm size differed substantially. Around 72 per cent small category farmers stated that development of disease resistant varieties is a problem while 47 per cent of them urged that researchers should also take into consideration development of drought tolerant varieties of alternative crops. These numbers and ranking also varied in medium and large size category of farmers. The message for researchers and scientists is very clear from the opinions of respondents that they are required to undertake intensive research on varietal aspect with due considerations of duration, drought, disease and moisture.

Marketing is often cited as a serious problem for agricultural commodities except for wheat and rice which are largely procured by the government agencies at the designated minimum support price. Table 6.22 provides information about the suggestions offered by sampled farmers to ease the problem of marketing of alternative crops. It is essential to mention that percentage of farmers asking for procurement of alternative crops was as high as 82 per cent. It is essential to point out that this suggestion was offered irrespective of farm category. The access to price information was second point emphasized by the farmers and they want reforms on priority basis. Other factors such as reducing losses in storage and creating grading facilities were also cited as problems by 34 and 42 per cent respondents. As expected, responses of farmers belonging to different categories varied considerably but one point emerges clearly that farmers are serious about the marketing problems of alternative crops and these should be sorted out by pragmatic policy reforms without losing time in order to improve the welfare of the farming community in general and weaker section like small farmers in particular. During the survey, respondents highlighted the need to improve extension services for successful implementation of the crop diversification. They had serious problem with number of trainings organized by the extension department.

Table 6.22
Suggestions of Sampled Farmers to Improve Marketing of Alternative Crops, 2012-13

(% multiple response)

Suggestion	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Increase the access to information on price	51.1	23.4	17.0	37.2	31.0	24.8	17.6	52.9	23.5	37.1	32.9	22.9
Decrease losses during storage	21.3	8.5	27.7	18.6	20.2	18.6	11.8	11.8	20.6	18.1	16.2	21.0
Improve the grading facilities	27.7	2.1	25.5	27.1	19.4	20.9	32.4	11.8	8.8	28.1	14.3	20.0
Effective procurement by Govt. agencies	59.6	21.3	8.5	65.1	15.5	14.7	76.5	11.8	5.9	65.7	16.2	11.9
Others	6.4	10.6	12.8	5.4	10.1	10.1	8.8	20.6	5.9	6.2	11.9	10.0

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source: Ibid

Table 6.23
Suggestions to Extension Workers by Sampled Farmers, 2012-13

(% multiple response)

Suggestion	Small			Medium			Large			Overall		
	1	2	3	1	2	3	1	2	3	1	2	3
Increase the number of training programmes	63.8	12.8	19.1	65.1	19.4	15.5	73.5	11.8	8.8	66.2	16.7	15.2
Information regarding HYVs	51.1	29.8	12.8	51.2	31.8	12.4	41.2	29.4	8.8	49.5	31.0	11.9
Others	6.4	17.0	38.3	5.4	10.9	28.7	8.8	29.4	20.6	6.2	15.2	29.5
Training at Field level	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.0	2.9	0.5	0.0	1.9
Timely availability	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
Timely quality	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Proper supervision	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.5	0.0
Crop insurance facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.5	0.0
Farmer field	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.5

Note: Ranks are in order of importance from 1 (most important), 2 (important) to 3 (least important)
Source:Ibid

They opined that number and duration of trainings are insufficient for a switch over from existing crop pattern to alternative pattern. Around 83 per cent respondents offered their suggestions to increase number of trainings. The role of information about high yielding/improved varieties of suggested crops in quest to diversify is extremely important. Among respondents, around 80 per cent, a large majority reported that obtaining this information is a problem despite its overwhelming importance in switch over. Nonetheless, less than 15 per cent of sampled farmers stated that it is a least important problem. The remaining aspects of training such as place, quality, supervision and availability of extension personnel were not cited as problems in adoption of crop diversification. It may be noted that a large proportion of sampled farmers did not respond about crop insurance despite this being a crucial factor in ensuring returns from crop cultivation in agriculture in Haryana.

To sum up, we have analyzed perceptions of sampled farmers about severity of problems emerging in alternative crop cultivation due to biotic and aboitic stresses including environmental factors (drought, rainfall and variability in temperature), diseases, insect/pests, weeds and their impact on productivity of paddy and alternative kharif crops. The opinions of different categories of farmers on these concerns varied significantly, however they agreed that biotic and aboitic stresses impact crop production due to damaging effects and reduce crop productivity in turn influencing the quality of produce and profitability. This holds true for paddy and its alternative kharif crops, i. e. bajra, maize and cotton in Haryana. The impact of these menaces can be reduced /eliminated by control measures.

A variety of integrated approaches based on physical, chemical, biological and cultural methods have been recommended and were found effective in controlling insect pests, diseases and weeds. Therefore, farmers should rely on a judicious combination of different practices suitable in a particular location. It is advised that farmers may consult extension workers before purchasing the chemicals considering the limitations of cash, environment and safety. At the end, there is an urgent need to develop resilient agricultural systems. The scientists should evolve technology with least effect of these factors to make farming profitable and attractive.

Chapter-7

Major Findings and Policy Implication to Promote Alternative Crops

This chapter aims to present main findings of the study and to draw policy implications in order to encourage farmers to adopt crop diversification in Haryana. Most of the past studies on crop diversification are based on secondary data and do not provide farm size information. Literature based on in depth village studies at the micro level is limited to some states and therefore, there is an urgent need to conduct in-depth micro level studies. Such studies provide an important insight that cannot be derived from secondary data based studies due to availability of limited information. The present study is a departure from earlier literature in terms of its focus on issues related to crop diversification at the macro as well as micro levels and therefore, will be useful to frame future policy initiatives.

7.1 Objectives of the Study:

Food security, nutritional security, sustainability and profitability are the main focus of present and future agricultural development. The crop rotation of rice-wheat largely adopted in irrigated areas of Haryana has posed a serious challenge in future for sustainability of agriculture in the state. Crop diversification through adopting alternative crops and cropping systems could improve productivity and also the agro-eco-systems of the region. Further, irrigation requirements of the area could be reduced through adoption of alternate cropping systems, thereby reducing pressure on depleting water table. In addition, alternate cropping systems based on cash crops/high value crops will help in reducing production risk in mono-cropping and will raise income of the farmers. This study aims to analyze issues related to crop diversification from paddy to alternative crops in kharif season in Haryana.

The specific objectives of the study are as under:

v) to examine the production and procurement pattern of paddy in Haryana.
vi) to workout the relative economics of paddy vis-à-vis alternative crops.
vii) to bring out the constraints in adoption of alternative crops.
viii) to suggest policy measures to overcome the constraints in adoption of alternative crops to paddy in Haryana .

7.2 Research Methodology:

This study is conducted in the state of Haryana. It is based on published and un-published sources of secondary and primary data. The relevant information about the state and districts was obtained from various issues of the Statistical Abstract of Haryana, Government of Haryana, Panchkula. Further, the time series data on area, production and yield of paddy and alternative crops for selected districts and state were also culled out from this source. The required preliminary information regarding the selection of blocks and villages was obtained from the district officials. The meetings with the Deputy Directors of Agriculture of selected districts were useful and informative. The crops for the study were decided as per the study design provided by the coordinator.

The scope of the study is confined to kharif crops i.e. paddy and alternative crops such as bajra, maize and cotton grown by the farmers in Haryana. Six districts namely, Panchkula, Sonepat, Faridabad, Palwal, Jind and Fatehabad with diversification of crops in kharif season were selected for in-depth study. The selection of respondents is based on multistage sampling design. At the first and second stage, paddy and alternative crops producing districts and blocks in these districts were selected. At the third stage, villages were selected on the same criterion. A questionnaire was canvassed to the farmers growing these crops. All farm size categories i.e. small, medium and large were covered in the sample. The number of farm households in each category was decided according to their proportion at the district level. The primary data pertaining to the year 2012-13 were collected from 210 farmers.

The methodology followed for each aspect is different. For measuring the state and district level growth rates of area, production and yield of paddy and alternative crops for the period 1970-71 to latest available period, semi-log equation was used. The entire time period for computation of compound growth rates of area, production and yield of various crops is divided into three sub periods i.e. 1970-71 to 1984-85; 1985-86 to 1999-2000 and 2000-01 to 2011-12. Finally, growth rates were computed for the entire period from 1970-71 to 2011-12.

In Haryana, paddy is the dominant crop during the kharif season. The alternative crops could be bajra, maize and cotton. Although, yield rates of bajra and cotton in the state are second highest in the country, farmers prefer to grow paddy due to higher yield, assured market and net returns. They often use inputs especially irrigation, fertilizer and pesticides indiscriminately in cultivation of paddy due to lack of knowledge about optimal use. The over use of these resources is resulting in depleting water table and environmental problems in addition to escalated cost of cultivation. In order to save precious resources and environment, it is imperative to analyze the resource use efficiency of paddy and alternative crops grown by the sampled farmers in Haryana.

We have used Cobb-Douglas type of yield function to assess resource use efficiency. This function is widely used in agricultural research and is convenient for the comparisons of elasticity coefficients. In order to determine resource use efficiency of major inputs, a double log regression model with yield as dependent variable and human labour, machine labour, seed, fertilizer and irrigation as independent variables was formulated. The estimated coefficients of the considered independent variables were used to compute the Marginal Value Productivity (MVP) and Marginal Factor Cost (MFC). Resource use efficiency was measured by comparing the MVP of each resource with corresponding Marginal Factor Cost (MFC)

7.3 Main Findings:

Now, we present main findings of the study

i) Status of Kharif Crops in Haryana and Selected Districts:

State Level Scenario:

In Haryana, net area sown (NAS) occupies a dominant proportion in the reported area. Around 84 per cent of NAS was sown more than once. It could be possible due to impressive development of irrigation in the state.

The agro-climatic variations in Haryana are large and therefore, a variety of crops can be grown in the state. At present, crop pattern in Haryana is highly skewed

towards foodgrain crops with an area allocation of 70.60 per cent of GCA. In addition, mustard and cotton are grown on 8.25 and 9.27 per cent of GCA. The crop pattern has experienced a perceptible change over the past decades with expansion in area under wheat, rice, mustard and cotton. Pulses recorded greatest loss in acreage between 1980-81 and 2011-12.

An examination of area, production and yield of kharif crops in Haryana at TE 1970-71, 1985-86, 2000-01 and 2011-12 indicates that acreage under kharif cereals in total kharif area has declined from 84.23 per cent to 67.18 per cent between 1970-71 and 2011-12 despite a huge expansion in acreage under paddy which has jumped from 14.20 per cent to 49.65 per cent of total kharif are between TE 1970-71 and 2011-12. Cotton and vegetables are the significant gainers while kharif pulses emerged as the greatest losers despite their nutritional value and nitrogen fixing capacity. The production also followed the same trend. The productivity gains appeared to be impressive for paddy, bajra, maize and cotton. The yield of bajra and maize increased at the rate of 3.45 and 3.33 per cent per annum during 1970-71 and 2011-12.

District level Scenario:

An analysis of area, production and yield of major kharif crops in selected six districts (Panchkula, Sonepat, Faridabad, Palwal, Jind and Fatehabad) has exhibited mixed pattern of increase and decrease. In general, acreage under jowar, bajra, maize has declined during the reference period while it has increased under rice and cotton Sonepat is an exception with decline in area and production of cotton. However production of maize has recorded an increase of 2 per cent per annum in Panchkula due to moderate growth of yield (2.25 per cent) despite decline in area. In Sonepat, production of rice increased at an impressive rate of 8.41 per cent per year due to appreciable growth in area (6.55 per cent per annum) and moderate growth in productivity. The similar trends in area, production and yield of rice could be noticed in Faridabad and Palwal. The district of Jind has exhibited commendable growth in production of rice and cotton during the study period. Among the selected districts, Fatehabad emerged as the pioneer in growth of rice production at the rate of 11.64 per cent per annum due to commendable area expansion (9.32 per cent per year) and yield growth (2.13 per cent per year) between 1970-71 and 2011-12. Fatehabad

also appeared to be a front runner in the growth of cotton production during the same period.

ii) Socio-Economic Characteristics of Sampled Districts and Households

For a deeper probe in crop diversification, we have looked into main indicators related to population and workers, agricultural development and infrastructural development at the district level.

Sampled Districts:

(i) The total population of Panchkula, Sonepat, Faridabad, Palwal, Jind and Fatehabad districts was 5.61, 14.50, 18.10, 10.43 and 9.42 lakh respectively during 2011. Surprisingly, 88.89 per cent of population in Fatehabad is rural based. Education, although a catalytic factor in development has exhibited poor performance in Palwal and Fatehabad districts. The share of agricultural workers in total workers in selected districts was between 9.84 and 63.52 per cent. The share of non-agricultural workers in Faridabad and Panchkula was more than 80 per cent. It appeared that growing work opportunities in these districts benefited rural population due to relatively better development of non agricultural sector. The composition of workers in farm and non-farm sectors was markedly different across the selected districts for field survey. Faridabad has shown around 90 per cent workers engaged in the non-farm sector. On the contrary, Jind has exhibited.36 per cent of the work force involved in this sector. Thus, Faridabad is much ahead of other selected districts in rural non-farm employment.

(ii) A comparison of important indicators of agricultural development reveals wide disparities across the selected districts. The agricultural economy of all these districts is food grains based with an area allocation of more than 65 per cent of GCA under these crops. The cotton is grown on more than 10 per cent of GCA in Jind and Fatehabad districts. The irrigation status, yield rates of important crops, input use were analyzed to gauge the disparities. Out of the selected districts, Fatehabad appeared to be much ahead in productivity of paddy and cotton in comparison to other selected districts.

(iii) The infrastructural development of selected districts was distinctively different. Although, Faridabad is the most important industrial and commercial centre near the capital city of Delhi, it is not found rich in infrastructure such as roads.

Sampled Farmers:

For better understanding of crop diversification, we have looked into main indicators related to population, educational status of the head of households, farm size, nature of land ownership, cropping pattern, sources of irrigation and farm assets. The efficiency and success of farming is influenced to a significant degree by the socio-economic background of the households. In addition, these characteristics influence adoption of improved technology and marketing behavior.

Demographic Characteristics:

The average size of the family of selected farm households was 7.08 persons at the aggregate level. A positive correlation emerged between farm size and average size of family. The large farmers in selected districts indicated an average size of family around 9 persons against 6 persons by small households. It could be due to prevalence of joint family system. The literacy rate of the head of households was not found to be impressive however, head of large farm households indicated higher level of literacy. Around half of the head of households were between the age group of 32 to 50 years. Only 8 per cent were in the age group of below 30 years. The main occupation of head of households was agriculture. A small fraction of them also had subsidiary occupation. The number of permanent farm labour employed by selected households was 57 adults and most of them were males. These were largely employed by large farmers followed by medium farmers. In addition, 10 children were also employed by large farm households. The average wage per month was Rs. 6192, 4774 and 2430 for male, female and children.

Ownership of Farm Inventory:

Land and other resources influence the level and pattern of farm management in farm households. The sampled farm households on an average possessed assets worth Rs. 4,03,138 at the overall level. The farm size disparities were wide. The

small category of farm households owned farm assets worth Rs. 99,855 against Rs. 7,64,807 by the large farm category. It may be highlighted that the present value of farm assets increased with increasing size of holding and indicated a positive relationship. As expected, households in small category indicated lowest value of farm assets while the large category of farm households owned the highest by indicating present value of Rs.7,64,807 per household. Each category of farm households possesses various inventories. Tractors followed by submersible pumps exhibited higher present value in comparison to other assets.

Land Resources:

The nature of land ownership influences crop pattern, adoption of technology and innovation. At the aggregate level, average land owned by selected farmers was 3.85 hectares. The practice of leasing-in land was prevalent but a minuscule share of land was leased out. The net operated area per household was 5.26 hectares. A positive relationship emerged between land operated and farm size. Thus, large farmers operated 13.40 hectares against 1.26 by small farmers. Tubewells are the major source of irrigation. Some farmers combined tubewells and canal for watering their fields. The sources such as tanks are non-existent.

Crop Pattern:

The crop pattern on the sampled farms was found different in kharif and rabi seasons Wheat is the dominant crop in rabi season occupying 80.63 per cent of NAS. In addition, fodder and vegetables were also grown on 5.33 and 2.23 per cent of NAS. Paddy is the main crop grown by the farmers in kharif season occupying 43.31 per cent of NAS. The commercial crop of cotton was allotted 20.42 per cent of NAS. The most important coarse cereal crop of bajra received 8.20 per cent of NAS and maize was grown on 6.04 per cent of NAS. The farm size variations were common in allocation of area to different crops grown by the farmers.

Production and Disposal:

An analysis of production, retention and disposal of paddy and alternative kharif crops grown by the farm households during the reference year revealed that production of paddy was around 101 qtls per farm during 2012-13. Farm size variations were found wide. The sampled households retained a part of production

i.e. 2.58 qtls for domestic consumption and seed requirements. In retention, self consumption dominated whereas other requirements were found marginal. The quantity of paddy sold was around 17162 qtls of basmati and 3634 qtls of non-basmati during the reference year. Since medium farm category produced higher quantity than other categories, they also dominated in sales. The price of paddy realized by the medium farmers was Rs. 3730/qtl for basmati and Rs.1372 for non-basmati. The produce of paddy was sold primarily to local traders followed by government agencies and private companies.

The output of bajra was 5.22 qtls per farm at the overall level during the reference year. The retention of bajra was less than 1 qtl per household at the aggregate level and it was around the same for all categories of farm households. The marketed surplus of bajra was sold to local traders irrespective of farm size.

Results of field survey indicate that production of maize was 8.67 qtls per farm at the aggregate level during 2012-13. A small quantity of 0.59 qtl per farm was retained for domestic consumption and other purposes. Like bajra, maize was also sold to local traders by all categories of farmers.

The selected farmers also produced 22.34 qtls. of cotton per farm during 2012-13. Further, large variations in production of cotton could be observed across farm size. The entire quantity of cotton produced by farm households was sold to local traders and they realized an average price of Rs. 4957/qtl during the reference year.

Iii) Economics of Paddy vis-à-vis Alternative Crops Cultivation:

We have analyzed input use pattern, cost of cultivation and economics of production of paddy vis-a-vis alternative crops (bajra, maize and cotton) grown by the sampled farmers during kharif season in Haryana.

Input Use:

Paddy is the most important crop of kharif season. Results state that paddy growers used around 59 mandays of human labour, 79 hours of machine labour, 11.4 kg seed, 232 kg urea and 43 hours for irrigation per hectare during 2012-13. Further, plant protection was also resorted by the farmers. The usages of these inputs varied significantly across farm size.

Farmers in Haryana treat bajra as a low value crop and therefore, they apply minimum doses of expensive inputs. The cultivators used around 21 mandays of human labour, 21 hours of machine labour, 3.9 kg seed, 102 kg urea and merely 2 hours of irrigation per hectare for cultivation of bajra during 2012-13. Evidently, input use for cultivation of bajra was much lower in comparison to paddy.

Maize is not a popular coarse cereal grown by the farmers in Haryana despite its multiple uses. The producers used around 33 mandays of human labour, 16 hours of machine labour, 14 kg seed, 177 kg urea and 3 hours irrigation per hectare during 2012-13.

Cotton is a major commercial crop which has been generating employment in Haryana in spite of technological advancement. The growers used around 63 mandays of human labour, 29 hours of machine labour, 238 kg urea, 117 kg DAP and 8.5 hours of irrigation. In particular, farmers used several variants of chemical fertilizer for this crop.

Cost of Cultivation:

The sample farmers incurred cost on above mentioned items used by them in cultivation of paddy and alternative crops in kharif season. The per hectare cost of cultivating paddy was Rs. 35, 581 on sampled farms and the maximum proportion of cost was incurred on human labour followed by machine labour and chemical fertilizer. Findings show that per hectare cost of cultivating bajra on sampled farms was Rs. 11039 during 2012-13. The human labour, machine labour and fertilizer were found the major components of cost. The second alternative crop of maize was grown by incurring a cost of Rs. 22,613 per hectare. The human labour, seed, fertilizer and machine labour were the major components of cost. Among the included crops, cost of cotton production was found higher than other crops. The producers incurred a cost of Rs. 38,999 per hectare during 2012-13. Like, paddy, bajra and maize, human labour, machine labour, fertilizer, seed and plant protection were the major items in cost composition.

To sum up, cost of cultivation varies from one crop to another. Farm size variations are common. Among the included crops, cost of cultivation was found

higher in production of cotton and paddy due to expenditure on pesticides and irrigation.

Returns from Cultivation of Paddy vis-à-vis Alternative Crops:

The per hectare yield of paddy on sampled farms was 44.4 qtls. Farm size and productivity were found negatively related. After deducting the cost from gross returns, producers earned a profitability of Rs. 1,09,258 per hectare during 2012-13. The net returns per hectare from bajra, maize and cotton were Rs. 11,964, Rs. 11,950 and Rs. 64,052 respectively during 2012-13. Thus, profitability from cultivation of paddy and cotton was found higher than other kharif crops grown by the farmers.

iv) Resource Use Efficiency:

We had formulated Cobb-Douglas type of regression model to measure resource use efficiency of human labour, machine labour, seed, fertilizer and irrigation in cultivation of paddy, bajra, maize and cotton. The yield of crops is used as dependent variable and above mentioned factors as independent variables. In order to examine resources use efficiency, we have further computed Marginal Value Productivity (MVP) and Marginal Factor Cost (MFC) of included resources.

The regression results of paddy reveal that coefficients of human labour, machine labour, fertilizer and seed turned out positive and statistically significant. This implies that increase in these resources would influence yield positively. The model explained 88 per cent variation in yield. Further, ∑bi indicated constant returns to scale at the overall level. The regression results of the model carried out for small, medium and large farms pointed out mix pattern in terms of significance of included variables. However, coefficient of irrigation for large farms turned out negative. It implies that large farmers are overusing this resources and any addition would lead to fall in productivity of paddy. The estimated MVPs and MFCs and their ratio indicated that none of the resource is optimally used and therefore, farmers need to make adjustment in their usage to attain resource use efficiency.

In case of bajra, coefficient of human labour was positive, high and statistically significant. Seed was another variable which turned out statistically significant. The returns to scale measured by adding coefficients were found

constant at the aggregate level. The MVPs of human labour and seed are considerably above their MFCs. This implies that marginal productivity of these factors exceeds the cost and therefore, resources are underutilized while machine labour is being overused. Hence, farmers need to adjust the usage of resources in order to attain resource use efficiency.

In case of maize, coefficients of human labour, seed and fertilizer are positive and statistically significant. This is indicative of positive influence of these variables on yield. ∑bi was slightly above one and therefore, indicates increasing returns to scale. The MVPs and MFCs of included resources have shown mixed pattern. It is reiterated that none of the included resources was used optimally by sampled growers and therefore, adjustment is needed in the usage in order to obtain optimal resource use.

In cotton cultivation, the coefficient of human labour turned out positive, high and statistically significant at the overall level. Seed was another variable which came out as positive and significant. The model explained 90 per cent variation in the yield of cotton. Further, ∑bi exceeded one and implied increasing returns to scale. Like paddy, bajra and maize, none of the included resources was used at optimal level by cotton growers and therefore, they need to make adjustments in their usage in order to attain resource use efficiency.

V) Constraints in Cultivation of Alternative Crops:

The long term sustainability of rice-wheat rotation in Haryana has posed a serious challenge for policy makers due to over exploitation of natural resources (soil and water), lowering of water table and emergence of new weeds and pests. There is an urgent need to reduce acreage under paddy in kharif season by encouraging farmers to grow alternative crops in order to conserve environment and natural resources. This requires an understanding of constraints responsible for non-adoption of alternative crops. We have analysed constraints in cultivation of paddy and alternative crops i.e. bajra, maize and cotton in terms of biotic and aboitic stresses through qualitative responses. Generally, crops are affected negatively by aboitic and biotic stresses. Aboitic stresses occur in many forms such as drought, variability in temperature and rainfall, flood, etc. On the other hand, biotic stresses

occur as a result of harm done to crops by living organisms such as diseases, insect/pests and weeds.

Agriculture is a risky business because it deals with uncertain factors such as weather and market conditions. These factors make income from agriculture uncertain. Therefore, selection of suitable crops through land allocation is one of the most important decisions for the farmers. During the survey, we had asked farmers reasons for growing a particular crop. The analyses of paddy, bajra, maize and cotton revealed that climatic conditions, suitability of soil, input availability, environmental problems and marketing play an important role in decision making to allocate land.

Diseases:

Diseases take a heavy toll of paddy, bajra, maize and cotton. In case of rice, blast, foot rot, bacterial leaf spot and anthracnose etc affect the productivity of paddy. The powdery mildew, grain, smut, ergot, late blight and pod rot create problems in bajra cultivation. Further, maize is susceptible to powdery mildew, seed rot, leaf blight and pod rot while cotton gets diseases such as wilt, leaf curl, root rot, angular leaf spot, etc. These diseases may result in yield loss upto 15 per cent. The severity of the problems stated by different categories of farmers differs considerably but all of them agreed about loss in yield of these crops due to occurrence of diseases.

Insect/pests:

The infestation of insect/pests in crops damages the quality of the produce in addition to reduction in productivity. Rice hispa, whitefly, stem borer, hairy caterpillar and leaf folder are the major insect/pests which affect rice crop while bajra is susceptible to root bug, grass hopper, maize borer, hairy caterpillar and leaf folder. The major insect/pests impacting maize are maize shoot fly, thrips, maize borer, hairy caterpillar and leaf folder. Cotton gets insect/pests such as termites, leaf hopper, cotton semi looper, aphid, red cotton bug, durky cotton bug and mealy bug. The sampled farmers opined that these insect/pests negatively affect the crops by impacting productivity and quality of the produce.

Weeds:

Weeds affect crops by reducing productivity. These are self grown and compete with the major crop for water, soil nutrients and sun light. Rice is exposed to weeds such as itsit, mathana, bhakhra, motha and sonfa. The almost same type of weeds grow in bajra and maize. The common weeds in case of cotton are mundi, sati, motha, somwa, jhangi germs, dalchoti, casauta etc. Farmers stated that removal of weeds is essential for harvesting good yield.

Other Constraints:

The environmental factors such as drought, rain and shifting temperature affect different stages of plant growth. The farmers expressed that these problems create severe constraints and may reduce yield upto 25 per cent. The crop diversification has advantage of mitigating price and production risks. The advantage depends on availability of land and economic factors. Farmers stated that they face severe constraints in access to information on price, variability in price, losses due to storage, shortage of human labour and lack of nearby markets. We had also sought responses of sampled farmers on research and development for the alternative crops. Most of the farmers reported that drought and disease resistant varieties of the alternative crops is a serious problem which should be solved on priority basis by the researchers and scientists. The farmers also emphasized the urgency of efficient extension services.

We have analysed perceptions of sampled farmers about severity of problems emerging in crop production due to biotic and aboitic stresses including environmental factors (drought, rainfall and variability in temperature), diseases, insect/pests and weeds and their impact on productivity of paddy and alternative kharif crops. The opinions of different categories of farmers on these concerns varied significantly, however they agreed that biotic and aboitic stresses impact crop production negatively due to damaging effects and reduce crop productivity in turn influencing the quality of produce and profitability. This holds true for paddy and its alternative kharif crops, i. e. bajra, maize and cotton in Haryana. The impact of these menaces can be reduced or eliminated by control measures.

A variety of integrated approaches based on physical, chemical, biological and cultural methods have been recommended and were found effective in controlling insect/pests, diseases and weeds. Therefore, farmers should rely on a judicious combination of different practices suitable in a particular location. It is advisable that farmers may consult extension workers before purchasing the chemicals considering the limitations of cash, environment and safety. At the end, there is an urgent need to develop resilient agricultural systems. The scientists should evolve technology with least effect of these factors to make farming profitable and attractive.

7.4 Policy Implications:

It has been widely recognized that diversification of existing crop systems is the viable solution to cope with the drawbacks of monoculture of wheat and paddy in irrigated conditions in Haryana. In this context, switching over from paddy to alternative crops in kharif season assumes special significance since paddy is a water guzzling crop responsible for depleting water table and environmental problems. The shift away from paddy is not easy because of higher returns from cultivation of paddy vis-à-vis alternative crops. Therefore, ensuring profitability of alternative crops on sustainable basis through suitable policy reforms appears to be a pre-requisite for successful crop diversification in Haryana. We recommend following policy measures for this purpose.

Results of our study show that paddy is the most profitable crop in kharif season on the sampled farms. This is due to higher yields, favorable price policy, availability of inputs at affordable prices and efficient extension services. In order to reduce area under paddy, there is an urgent need to ensure parallel facilities for alternative crops including research and development to augment yield levels and its effective dissemination at the grass root level.

The degree of production and price risks in alternative crops is higher than paddy. Climate change is further aggravating the yield risk. The first risk can be reduced by development of suitable technology and second, by favorable price policy, credit and insurance facilities, investment in creating nearby markets and rural infrastructure. This is possible through wholehearted support of the government and participation of the private sector.

At the end, crop diversification away from paddy towards alternative crops in the kharif season in Haryana requires a favorable price regime, technology for raising the existing levels of productivity, financial support, rural infrastructure and above all, multi-pronged government support. Without firm policy reforms in favour of alternative crops, crop diversification will remain an elusive goal in Haryana and will persist as an issue which will be debated on different fora without any concrete outcome.

APPENDIX-1:

Distribution of Sample Farm Households for the Field Survey

Crop	Small	Medium	Large	All
Rice	47	129	34	210
Maize	26	41	8	75
Bajra	13	47	10	70
Cotton	10	49	25	84

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Action taken on comments of the Coordinator

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Table on category and crop wise selected farmers is provided in appendix.

(i)…….in corporated…….

(ii)…….in corporated…….

(iii)…….in corporated……

(iv) Separate tables cannot be generated since questions addressed in the questionnaire were not crop specific. However, Chapter-6 contains crop specific tables on constraints.

(v) In the regression model, all variants of fertilizer were clubbed together due to large variations in number of farmers using a particular variant across the included crops and for better results.