

Report of the Task Force for Agricultural Development in Punjab

1. Introduction:

Punjab State has achieved extraordinary growth in agriculture. The States' contribution in making the country self reliant in food is well documented and appreciated. The State is now faced with serious crisis in agricultural economy and there is severe distress in the rural areas. The increase in food production per unit area is the outcome of higher cropping intensity and productivity. Before the introduction of new technology in late sixties the cropping intensity was about 126% and the productivity of both wheat and rice was about 1.2 tonne per hectares. Because of response of new technology to water and fertilizers, the farmers invested heavily in agricultural development and have raised the cropping intensity to about 200% and yield of wheat increased by about four times and that of paddy by about five times. The area under paddy increased from about 2.27 lac ha in 1960s to about 28.5 lac hectare during 2014. The total irrigated area increased from about 38% to 98% out of which 73% is irrigated by tubewells. Most of the paddy is grown in the tubewell irrigated areas. It has resulted in mining of ground water i.e. its withdrawal is more than the annual recharge. As a result, the water table receded alarmingly. In 1973, only about 0.4% area of the State was having depth to water table more than 20 meters below ground level which has now increased to more than 50%. The farmers had to spend huge amounts of money to pump water from deeper aquifers.

1.1 Clearly the situation arose on account of increase in area under paddy. Because of Government of India's policy of ensuring marketing and support price for paddy, the farmers continued not only to grow paddy but also to increase the area. Had Govt. of India adopted a similar policy for other crops, particularly maize, kharif pulses and oilseeds, the area under paddy could have been restricted to a level which would have maintained the water table i.e. the pumping would have been same as that of replenishment.

1.2 This situation must not be allowed to continue and **specific development funds should be provided to divert part of paddy area to other** low water requiring crops. If it is not done, the State will run out of water which could be economically pumped for crop production. In that case the productivity levels will fall back to 60s and consequences of such a situation are not difficult to imagine.

1.3 Majority of the farmers have no alternate option but to continue farming. Consequently shrinking holding size after every generation has become a cause of serious concern. About 34% of the cultivators operate upto 2 ha. of land. Such a holding does not provide enough surpluses to meet the normal family needs including those of education and health. Until they are given some skill training to find an off-farm employment, they will have to be assisted to grow high value crops with assured marketing.

1.4 This paper briefly outlines the reasons for emergence of present situation, programmes adopted to improve the small farm economy and strategy for future action. However, this will be possible only if the ground water resources are used in sustainable manner.

2. The Era of Change:

Among the Indian States, Punjab holds place of pride for its outstanding achievements in agricultural development because of a healthy mix of environmental, institutional and technological factors, evolving since independence and picking up pace after the state's reorganization in 1966. Imbedded in the scheme of things was the adoption of agriculture as the lead sector, as a response to the national demand for food. With political power in the state having been consistently rural based and drawn from a farming background, agriculture and rural development have remained a priority.

2.1 Beginning with consolidation of landholdings, followed by reclamation of new agricultural lands and synchronous extension of irrigation through canals, and propagation of new agricultural technology comprising high yielding variety seeds, chemical fertilizers and irrigation and agricultural

machinery viz. tractors, threshers and harvester-combines, Punjab agriculture continued making rapid strides over the years. The agrarian structure characterized by middle level peasantry, with landholdings of two to four hectares, and predominance of owner cultivators also contributed to the success of this process.

2.2 Most important to the whole process was the government's focus on agricultural development. The main components of the strategy included: extension of irrigation, rural electrification, rural link roads, rural focal points providing a variety of services, closely spaced agricultural market centers and, above all, an assured provision of credit and agricultural inputs. Widespread infrastructure, which could boost agriculture, was made available. As part of national policy, the minimum support price for wheat and rice, the state's two major crops, and their procurement played a significant role in sustaining agricultural development, and thereby raising rural incomes. Responsive farmers who adopted new varieties and other technologies were central in the process of agricultural transformation. With 1.53 per cent geographical area and around 4.5 per cent cultivated area of the country, the Punjab state became the largest food grain surplus state in India and the contribution of the state during the decade of 1970s and 1980s was about 70% in case of wheat and about 40% of rice which made the country self reliant in food and overcame serious food crisis faced by the country during 1950 and 1960s. During 1990s and 2000s the contribution was about 60% of wheat and about 33% of rice.

2.3 The State harvests highest wheat and rice yields in the country. In the year 2011-12, wheat productivity was 51 q/ha against the national average of only 31.8 q/ha and paddy productivity was 56 q/ha against the national average of only 35.5 q/ha. Due to expansion of tubewell irrigation through private capital investments, irrigated area in the state rose to more than 98 per cent of net sown area by 2011-12 from 59 per cent in 1965-66. The share of tubewells in irrigated area grew from 41 to 73 per cent and the fertilizer use increased from 38 kg to 243 kg per hectare of cropped area,

during this period. Mechanization became a necessity for timely sowing of wheat after rice to exploit the yield potential of the new high yielding varieties. The cropping intensity increased from 126% in 1960 to nearly 200% at present. Large number of farmers who owned small holdings did buy tractors and in the process got indebted due to overcapitalization.

3. Current status of farm incomes

Green revolution which started in 1967-68, led to phenomenal increase in agricultural productivity and production, which brought economic prosperity in farming. But over the years, agriculture became more input intensive, yield levels almost reached the initial potentials and further productivity growth slowed. Under the environment of input prices rising faster than output prices, economic profits squeezed. In addition, social expenditure increased as well as education and medical care became very expensive. Consequently, small holders are under severe economic stress. In rural areas, land is largely the major income generating asset and thus, family income is directly related to the size of land one cultivates or owns. At present, around 34 per cent of total 10 lakh operational holdings are of less than 2 ha, whose level of farm business income (excluding imputed rental values of land and grains kept for food, feed and seed) is very low. A perusal of Table-1 indicates that a marginal farmer (< 1ha) earns on average only Rs 66,000 and a small holder (1-<2ha) around Rs 1,47,000 annually out of which he has to meet the non-food consumption, social and other expenditure for his whole family. The most disquieting feature is that small holder earns even less than the salary of a Group-D employee working in a government office, which is around Rs 1,87,000 apart from his entitlement to medical and other allowances, and retirement benefits and better working conditions. The economic position of a marginal farmer is still worse. On the top of it, agriculture is prone to weather and market risks and entails hard work. It is evident that farming in case of less than 2 ha of land does not ensure a reasonable level of living and dignity to farmers.

Table-1: Farm business income of various categories of farmers

Net State Domestic Product (NSDP)	Marginal (<1 ha)	Small (1-<2 ha)	Semi-medium (2-<4 ha)	Medium (4-<10 ha)	Large (10 ha & above)
Per family (Rs) (5 member)	66044	147002	313179	611444	1575480
Per family/month (Rs)	5504	12250	26098	50954	131290
Per capita/month (Rs)	1101	2450	5220	10191	26258

Source: Calculated from Agriculture census-2011 figures.

3.1 Around 8 per cent of the rural population lives below the poverty line in the state (2011-12). Marginal and small farmers, and agricultural labour households though meet their energy requirements, but do not have access to good health facilities, quality education, good hygiene, etc. which are the major determinants for their future growth. An analysis of per capita monthly expenditure of different rural households in 2011-12 in Punjab state (Table-2) indicates that firstly per capita daily expenditure on food comes out to be only Rs 28.5 in landless rural households and Rs 45 only in small farmers and secondly the monthly expenditure on non-food items which include expenditure on health, education, electricity, social ceremonies etc. is only Rs 559 in case of landless and Rs 773 in case of small holders.

Table-2: Per capita monthly expenditure of rural households

Particular	Landless	< 2 ha holding	2-4 ha holding	>4 ha holding
Family size (No.)	4.97	4.90	5.70	4.87
Food expenditure (Rs)	4230	6596	7142	9016
Non-food exp. (Rs)	2778	3790	8812	8271
Per capita food exp. (Rs)	852	1346	1253	1853
Per capita non-food exp. (Rs)	559	773	1546	1700
Total per capita exp. (Rs)	1411	2119	2799	3552

Source: PAU Ludhiana project on "Tracking poverty in South-Asia: Village Level Study".

3.2 This meagre amount is not sufficient to meet energy and nutritional requirements of a person, who is engaged in hard physical labour even at odd hours. This is also insufficient to provide access to good education and health facilities to family of these households in the perspective of deteriorating health and education facilities in rural areas. Parents who are illiterate or semi literate are not able to provide inspiration/guidance to their children who in turn also remain semi-literate or illiterate. Off-farm employment to supplement farm income and rural education must be improved to improve the plight of small holders.

4. Problems and Challenges

After a tremendous performance for about three decades since the mid-1960s, the agriculture sector in Punjab is facing many challenges. Slow down in agricultural growth rate, escalation in costs of production, falling profitability in farming, reduction in employment elasticity of agriculture sector, increasing incidence of landlessness and indebtedness among the farmers and farmers' suicides are the major issues currently afflicting the Punjab agriculture. Fall in the ground water table, increasing soil fertility imbalance, appearance of new pests and weeds are posing major threats to the long-term sustainability of agriculture. Further, there are emerging uncertainties of weather, climate change and global warming. Though their impacts are yet to be quantified yet a rise in temperature will have a direct bearing on water availability, reducing the growth period, particularly in case of wheat. The weather aberrations have become more frequent affecting crop yields adversely and increasing cost of production in the State. For example, deficient monsoon in 2009 had increased farmers' expenditure on diesel alone by about Rs 400 crores. At the same time demand for water and energy from other sectors will also increase.

4.1 Shrinking holding size after every generation, dwindling ground water supplies and reduction in family incomes are major issues. Farmers invested heavily to develop land and ground water initially and again for deepening of the wells as the water table receded leading to indebtedness. It

has led to agrarian crisis and distress in rural sector particularly in case of small and marginal farmers. Such farmers constitute about 34% of the total cultivators but cultivate only 9% of the land. 7-8% economic growth in the country has not reached these farmers and they feel left out.

4.2 Mismatch in increase in cost of production and output prices has further exacerbated the situation. The increase in MSP of wheat and paddy has not been commensurate with the increase in labour wages and input prices. The State has high levels of inputs use to maintain high productivity levels. The price of diesel, DAP fertilizer, human labour and electric motors have increased by around 174 per cent, 170 per cent, 100 per cent and 290 per cent respectively (Table-3) while the MSP of wheat and paddy rose by 122 per cent and 137 per cent, respectively during 2000-01 to 2012-13.

Table-3: Price index of agricultural inputs and output

Year	Price index (base 2000-01)						
	Diesel	Electric Motor	Human Labour	DAP	MSP Crops		
					Wheat	Paddy	Cotton
2000-01	100	100	100	100	100	100	100
2012-13	274	390	200	270	222	237	222

Source: PAU

Consequently, the cost of production of wheat increased from Rs 25,000 per ha in 2000-01 to Rs 47,900 per ha in 2010-11 and that of paddy from Rs 26,000 per ha to Rs 56,600 per ha, respectively. This increase was by 92 per cent in wheat and 118 per cent in paddy. In real terms, the profits from the most important crops of the state have decreased during last 11 years due to higher increase in costs than the value of output. Fall in profits was around 10 per cent in wheat (from Rs.2872 to Rs.2594 per acre) and 18 per cent in paddy (from Rs.3292 to Rs.2696 per acre) during 2000-01 to 2010-11.

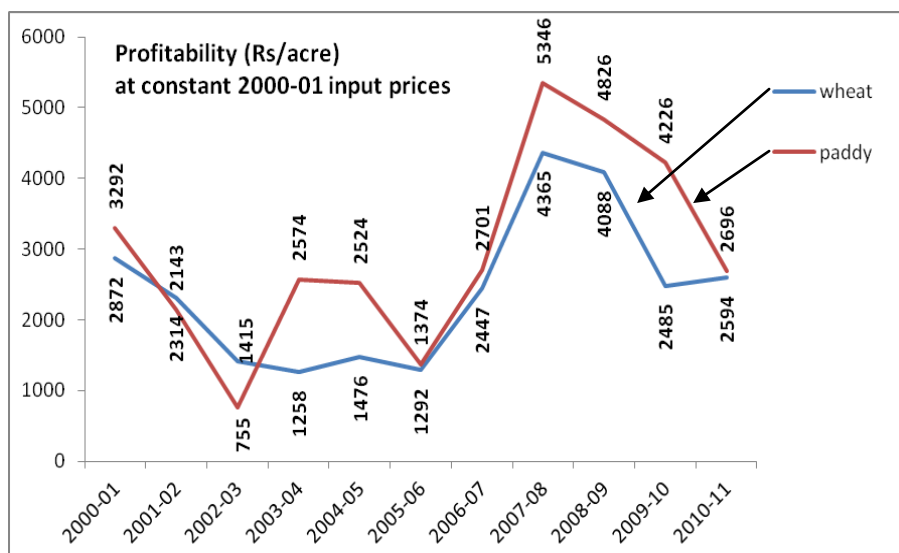


Fig.-1: Profitability of wheat and paddy at 2000-01 constant prices

4.3 Slowdown in growth of productivity of crops: Punjab state has achieved very high levels of per unit area productivity and is now facing a slowdown in the growth of productivity of crops. The realized productivity of wheat and paddy is almost equal to the genetic potential of these crops under our agro-climatic conditions. The average per ha productivity of wheat and paddy taken together over an area of 35 lac hectares of wheat and 28 lac hectares of paddy is about 11.5 tonnes per ha while the current genetic potential is around 14 tonnes per ha. Therefore, future growth in productivity is very limited (table-4). However, the economic implication of this scenario is that future growth in profits will largely be determined by favourable terms of trade and reduction in cost of production until new break-through in productivity is achieved. Historically, terms of trade have never been in favour of agriculture sector. Though, rise in prices of inputs and other consumption goods has been higher than output prices, yet the technological advancements earlier had helped sustaining profits and consequently the agriculture sector in the state. But, with no big technological change visible in near future, we have to find ways and means to improve living conditions of Punjab farmers through innovations in marketing, value addition, efficient input use management and

higher emphasis on cultivation of high value crops, dairy farming and fishery etc. Currently varieties of crops alternative to wheat and paddy are biologically more risk pron.

Table-4: Growth rates (% per annum) of paddy and wheat productivity

Crop	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2010-11
Paddy	5.3	1.3	0.02	1.4
Wheat	2.3	3.0	2.0	0.2

4.4 Lack of processing and value addition:

The agriculture sector in Punjab has reached a stage where its growth can only be sustained by increasing emphasis on high value crops (fruits, vegetables, cotton, canola, mentha, turmeric, etc.) and livestock sector and promoting their processing and value addition. Processing in both organized and un-organized sectors account for just 2.2 per cent of the production in Punjab. Heavy post-harvest losses at around 20 per cent for fruits and vegetables and lack of grading, standardization and scientific packaging in the post-harvest handling and management are important bottleneck in the cultivation of high value crops (HVCs).

Despite being one of the leading milk producing states in India with milk production of 9.6 million tonnes in 2011-12, the organized dairy sector handles only about 18 per cent, major chunk of which is either marketed as pasteurised milk or converted into ghee and milk powder. Only a small quantity is utilized for making high-end dairy products such as butter, paneer, cheese, baby food and ice cream etc. The product portfolio in dairy is very limited. A systematic planning and development of various segments like up-gradation of existing breeds, input delivery, procurement of livestock produce, processing, value addition, marketing and extension services in production and healthcare is lacking.

4.5 **Low Productivity of milch animals:** Livestock, in addition to yielding regular income, also provides house hold nutritional security and additional employment to small and marginal rural households. Livestock farming has not moved out from part-time farm production to specialized farming. Appropriate incentives to encourage farmers to adopt livestock farming, especially dairying have not been provided at a desired scale.

4.6 **Overexploitation of natural resource base** is another major issue in State Agriculture. Under the National Policy to encourage staple food crops, the Govt. of India ensured their marketing at minimum support price (MSP). Farmers responded to this incentive and developed groundwater, almost doubled the cropping intensity and used copious amounts of fertilizers for higher yields. This resulted in over-exploitation of its natural resources especially groundwater and soil. Though, Punjab conventionally a non-rice producing area, the incentives provided to farmers encouraged them to grow paddy. The area under paddy increased from about 2.4 lac hectares in 1961 to about 28 lac hectares at present. Because of this water table receded and farmers had to make increased investment in agriculture through replacement of shallow tubewells by the submersible pumps. Till March, 2013 more than 50% of the total electric tubewells have been converted into deep tubewells. The requirement of energy for pumping water from deeper layers for the same irrigated area has also increased over time. Electricity being free of cost the financial burden on the state exchequer is also increasing. The groundwater resources are highly stressed in the state to meet irrigation water demand.

The water demand for the current cropping pattern is estimated at 4.5 million ha meter against the total available water supplies of about 3.0 million ha meter. This deficit is met by over-exploiting groundwater resources. There were 6 lakh tubewells in Punjab during 1980-81 and their number increased to 8 lakh in 1990-91, 10.73 lakh in 2000-01 and further increased to 13.83 lakh to-date. The rate of fall reached an all-time high at 91 cm per annum during early 2000s when rice area increased to 2.8 million ha and cropping intensity touched more than 190 per cent. Consequently, ground

water in 80 per cent of the 'Development Blocks' in the State is over-exploited. The problem is more serious in 96% of the blocks in central Punjab. The problem of overexploitation of ground water persists because the crops alternative to paddy are not provided similar facilities of assured price and marketing. Although MSP for maize and kharif oil seeds and pulses is announced annually but market support operations for these crops are lacking.

4.7 **Imbalance in Soil Fertility:** Highly productive (more than 11.0 tonnes per ha per year) and intensive rice-wheat cropping system (mean cropping intensity of about 190 %) in Punjab obviously needed larger quantities of nutrients which led to soil fertility imbalance and emergence of micro-nutrient deficiencies.

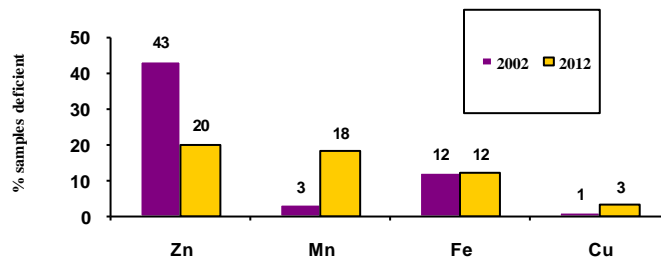


Fig.-2: Micro nutrient deficiency in Punjab Soils

The uptake of nutrients is very high because of high yields and it causes nutrient imbalances particularly of micro nutrients.

4.8 **Management of Crop Residues:** Punjab faces a serious problem of management of crop residues especially rice straw. While major part of the wheat straw is generally used as dry fodder for animals, rice straw is mostly burnt in the fields causing not only loss of nutrients and soil microorganisms but also serious environmental pollution. Punjab produces around 20 million tons of paddy straw, about 85 per cent of which is burnt.

4.9 **Agricultural Credit:** Timely availability of adequate credit is essential in agriculture which is highly 'time' responsive. Availability of cooperative credit has increased overtime for members of the cooperative societies. However, appreciable number of farmers are still dependent on non-institutional sources. Three major policy initiatives which have shaped the

institutional credit flow to agriculture sector are 2004-05 policy of doubling the institutional credit to agriculture in three years; Agriculture Debt Waiver and Debt Relief Scheme of 2008-09; and the Interest Subvention Scheme that sought to remedy the perceived negative impact of loan waiver on timely repayment. However, a study regarding 'Productivity of Agriculture Credit in India' by NABARD (2015) indicates that in pre-doubling phase fertilizers were statistically significantly responsive but in post doubling phase credit appears to have strong relationship with tractors". Tractorisation of agriculture particularly of small holder agriculture does not improve its economic viability and largely does not improve his debt serviceability. In real terms, the design of input intensive agriculture is such that the farmer has to raise loans to replicate it year-to-year.

Flow of institutional credit to livestock sector has not been in commensurate with its share in Agriculture GDP. Credit to animal husbandry has not been treated at par with crop loan even though animals generate a continuous stream of output. The facility of the Kisan Credit Cards has also not been extended to the livestock farmers.

Agricultural production process in the state has become cost intensive due to higher need and high use of inputs. Consequently, financial requirements of farming have gone up over time, which increased the dependence of farmers on outside funding. Small farmers largely depend on non-institutional sources. All the farmers are heavily indebted in the state. The level of debt in Punjab agriculture which was estimated as Rs 5,700 crore in 1997 has increased to Rs 31000 crore in 2009, when the average debt was about Rs.3 lakh per farm household. The situation may have further worsened. The outstanding loan however, includes funds needed for purposes other than agriculture like health, education and social obligations.

4.10 **Social Issues:** The rural society in the state is also facing serious social problems viz. reduced social cohesion, poor quality of education, and absence of good health care facilities. Unproductive expenditure on

ceremonial festivities etc. and over capitalization in agriculture, particularly by the small farmers, which is leading to the problem of debt, breaking of social fabric under economic stress and loss of productive manpower. Breakdown of traditional social structure has left rural communities without village level community-based support mechanisms. Traditional coping strategies have broken down, leaving the farmers with no fallback mechanism in the situations of distress. The largely traditional technology is a deterrent for rural youth taking-up farming profession as it does not match the ever-increasing aspirations triggered by exposure to enthralling urban lifestyles. Issues need to be taken head-on at all levels i.e. civil society, government and individual. Family support, community participation and religious institutions can play significant role in this regard. The multiplicity of factors has not only contributed to isolated cases of acute distress but rather to a completely distressed rural society. In nutshell, the farming sector at present faces many complexities on economic, environmental and social fronts, for which solutions are neither easy nor can be found within agriculture. A multipronged strategy focusing on both farm and non-farm sector of rural economy is necessary.

5. Steps taken by Punjab Government to mitigate the Crisis

Taking cognisance of the problems of farmers and farming, the State took some major initiatives to improve the sustainability of agriculture; farmers income; and environment. A renewed emphasis was laid on conservation of natural resources i.e. soil and water, promotion of protected cultivation, improvement in livestock farming and propagation of new technologies which are discussed briefly in the following paras.

5.1 Conservation of Irrigation Water

Water is the most precious input to modern intensive agriculture. Central Punjab is largely irrigated by tubewells where there has been alarming fall in ground water. The area of the central Punjab having depth of water table more than 20 meters was only 0.4% during 1973, which increased to

more than 50% during 2010. State has taken some steps to check the fall in water table and increasing water use efficiency.

5.1.1 Farmers had started planting paddy in the month of May which resulted in heavy loss of water through evapo-transpiration. The research results showed that to save water, paddy crop can be transplanted from 10th June onwards without any loss of productivity. For change in crop calendar, the State implemented "The Punjab Preservation of Sub Soil Water Act 2009" which ensured that the sowing of paddy nursery was not done before 10th May and the transplanting of paddy nursery was not started before 10th June. From kharif 2015, the dated of transplanting has been further postponed to 15th June. This has helped in arresting the rate of decline of water table.

5.1.2 The uneven agriculture land adversely affects the yield of crops and water use efficiency. To save the irrigation water, enhance water use efficiency and increase crop production, the State introduced precision land leveling of fields by laser land levelers. During 2007-08, 25% capital assistance was provided to 30 Primary Agricultural Cooperative Societies (PACS). Encouraged by the usefulness of laser land levelers and response of farmers, the State up-scaled the programme and provided capital assistance of Rs. 1.00 lakh per laser leveler, which was about 33% of the cost of the equipment. To-date capital assistance has been provided for about 1800 laser levelers. Impressed by its performance, large number of individual farmers have also purchased this equipment on-their-own and started operating these on custom-hiring. The State has about 5,500 laser land levelers (of which about 1500 are with the Primary Agricultural Cooperative Societies for providing custom-hiring service to the farmers of the State and about 1 million ha area has been precision leveled.

5.1.3 Trench planters/ ridgers are used for sowing sugarcane. These help in saving 20-25% of water and increase yield appreciably. This equipment was introduced and demonstrated during 2009 crop season. Encouraged by the response of the farmers, the State has started a programme to provide

40% capital assistance on this equipment so that large area of sugarcane is sown with this technique.

5.1.4 Under Ground Pipeline System (UGPS) involving mainly laying of RCC/PVC/HDPE pipes to convey irrigation water is a technology that has proved to be highly useful in on-farm conservation of irrigation water as it saves 15-25% of water by reducing conveyance losses, 15-20% of power required for pumping and the same amount of labour. Replacing the earthen field channels in the field with underground pipe line also saves about 1% of land which can be brought under cultivation. During the last 25 years, more than 2 lakh tubewells, out of 12 lakhs tubewells, have been covered by laying underground pipeline covering approximately 4 lakh hectares area. Since 2007-08, the State Govt. has initiated an innovative programme of providing assistance on Community UGPS projects for conveying life-saving canal irrigation water to the tail-end and far-off fields. An area of 73,962 hectares has been benefited by laying about 5175 km UGPS in the State.

5.1.5 As a result of these interventions, the rate of decline of ground water level has reduced to 55 cm/year (Table-5).

Table-5: Rate of decline of groundwater (cms per year)

Year	1980 to 1990	1990 to 2000	2000 to 2005	2005 to 2009	2009 to 2013
Rate of decline in groundwater table (cms/year)	17	25	91	78	55

5.2 Improvement in Small Farm Economy

5.2.1 About 65% farmers of the state, cultivate less than 4 hectare of land each. This farm size does not generate enough income to meet the financial requirements of the family including health, education and social obligations. To improve the economy of such farmers, it is necessary to build their capacity to enable them to adopt high return alternatives, high cost new

technologies and high value crops e.g. vegetables, and poultry, dairy, fishery etc., demand for which is rising and would continue to increase in future also.

5.2.2 Cultivation of vegetables under the low cost net houses increases not only the yield but also the quality of the produce with minimum use of pesticides. The crop is available in off season also when prices are generally higher. The technology is however, capital and knowledge intensive. To enable the farmers to adopt this technology, capital assistance and on the spot guidance was necessary and provided. A net house covering 500 square yards (one kanal) costs about Rs.2.3 lac and a set of two such net houses covering one-fourth of an acre assures a net income of one lac rupees per annum. The technology can be extended to at least one lakh such farmers during the next 4-5 years. However, assured marketing infrastructure is essential. Cool-chains with facilities of waxing, grading, and quick freezing need to be created.

5.2.3 **Dairy farming:** In the year 2005 the State took an initiative to motivate farmers to adopt commercial dairy farming by rearing at least 10 high yielding cross bred cows. As a pilot project, the Dairy Development Department, Punjab was asked to set up 250 such dairy farms in the milk shed area of a private milk plant at Nabha. The banks were persuaded to provide loan for setting commercial dairy farms at 3% lower rate of interest than prime lending rate including 1% rebate for regular repayment of the loan. The insurance companies were persuaded to cut down the insurance premium to 50%. The State provided financial assistance to the Department to subsidize full cost (Rs.250/-) of the microchip and 50% cost of the insurance premium per milch animal for the first year. Insertion of Microchip in the rumen of animals at the time of insurance helped in proper and foolproof identification of the animals and ensured early settlement of insurance claims. Encouraged by the success of the pilot project, the department set a target of setting-up about 800 commercial dairy farms annually and 5000 such farms have been successfully established and are operational.

Proper housing for animal especially cross bred cows is essential to exploit their inherent potential. The State took the initiative to standardize

the design of cattle shed for cross bred cows so that farmers could replicate the same. The idea was to design a model cattle shed which shall provide sufficient space for animals to feed, move freely and rest at will and also to protect them from direct rain showers and sun; and provide proper flow of light and air. A shed sufficient for 10 cows and their off-springs can be constructed on a small plot of 70' x 60' of which 42' x 60' is covered with roof. About 24' wide un-bricked (katcha) area is kept for resting of animals. The State also established four Dairy Training and Extension Centers and such sheds were constructed at these Centers for demonstration purposes. The cost of each shed was around five lacs rupees and a capital subsidy of Rs.1.5 lac was provided. To-date 2016 such model cattle sheds have been constructed in the State and the programme is still continuing. Most of the farmers who started with 10 milch animals, have expanded to 30-40 crossbred cows.

For successful dairy farming, production of milk at low cost is a very important since variable cost items (Feed and fodder, labour, veterinary expenses etc) constitutes about 87 of the total cost of milk production. Silage making to feed the high milk yielding cows results into lesser use of expensive cattle feed supplement thus reducing cost of production. It is important that for feeding sufficient quantities of silage to the animals throughout the year, the farmers preserve green fodder, especially maize to make silage at least thrice in a year. However, silage making is time and labour intensive exercise. Most of the small farmers therefore, avoid this practice. Although the use of hi-tech machinery like fodder harvester and loader makes silage making less labour and time intensive, but the machinery involved in silage making is very expensive and a small dairy farmers, rearing 20-30 cows cannot afford to purchase and maintain the same. To promote silage making amongst small dairy farmers, the State started a programme to set up 10 Dairy Machinery service Centres. Each such centre was proposed to have machinery like multi cut fodder harvester, front loader, tractors and trollies and a shed to park the machinery. Cost of each such centre was estimated at Rs.50 lakh and the State Government provided capital subsidy to the tune of Rs.20 lakh per centre to

the society/milk Producers Company or group of dairy farmers who set up such centres. Ten centres have been set up and there is demand for more.

5.2.4 Improvement in Productivity of Milch Animals: The commercial dairy programme is running satisfactorily but its scope is limited as it cannot be taken up by all the farmers. Therefore the focus is now on improving the milk production of milch animals of other farmers and landless people in the villages. They generally rear 2-3 buffaloes and/ or cows for milk for domestic use and sale. There are 32 lac adult buffaloes and 10 lac cows in the state. Currently, the average milk production is around 1500 liters per lactation. Incomes of farmers can be substantially enhanced by improving milk productivity of buffaloes by upgrading the breed through artificial insemination using high quality semen of bulls with milk production potential of 4000 liters per lactation.

To meet this objective, the State took-up a programme of buffalo development in the year 2010 to establish 200 Integrated Buffalo Development Centres (IBDC) to provide services of Artificial Insemination (AI) at the door steps of the farmers. Milkfed, Punjab was designated as End Implementing Agency (EIA) which engaged two NGOs namely BAIF and JK Trust for executing the programme. NGOs were required to provide AI services to farmers at their door steps in identified villages around the IBDCs using semen of 4000 liters potential for buffaloes and 7000 liters for cows to deliver 1000 calves per centre, out of which at least 800 buffalo calves, during project period of 5 years.

The NGOs set up 200 IBDCs by December 2010 covering 1600 villages and the project has been completed. There has been an improvement in productivity of buffalos by 2.4 kg/day, thus giving the farmers owning two animals an additional income of about Rs 150 per day without any additional cost. The results are very encouraging and the programme needs to be up-scaled to cover the entire state.

5.2.5 **Establishment of Agro Service Centres:** Small farmers have low capacity to invest, low risk bearing ability and are discriminated by various institutional services. The capital investment by the small farmers in heavy machinery and equipment increases their fixed costs and thus reduce the net returns. Some of the modern technologies need expensive equipments such as laser levelers, ridgers, bed planters etc. which are necessary for improving water-use efficiency and income through increase in yield. Happy seeders have been introduced which help in sowing wheat in standing stubbles of paddy and help in its recycling. These equipments are very costly and need to be used only for limited number of days during the year. These remain out of the reach of the small farmers. In order to make these equipments available to small farmers on custom hiring basis, the State has financially assisted PACS and private entrepreneurs to set up agriculture machinery service centres. This will help in reducing the burden of heavy capital expenditure, thus cutting down the farmers' fixed costs and adoption of latest technology. The cost of such a centre was estimated at Rs.10 lakhs and a capital assistance of 33%, subject to a maximum of Rs.3.30 lakh has been provided. To-date 1544 such service centres (out of which, 1282 are with PACS) have been set-up and are functioning satisfactorily and provide the custom hiring services to the needy farmers on reasonable rates. It is necessary to set-up such centers all over the State so that the small farmers can avail this facility and avoid over-capitalization which has already resulted in their indebtedness. Use of latest machinery also leads to saving ground water and increases productivity.

5.2.6 **Promotion of Fish Farming:** Fisheries sector was recognized as an income and employment generator to the farming community. At present there are over 8500 fish farmers in the state. The area under fish culture in Punjab is about 14,673 ha with an average productivity of about 5.27 tonnes/ha. However, the productivity of small and marginal farmers is about 2 tonnes/ha, which is required to be increased by introducing appropriate technologies and practices.

In order to increase the yield of fish farms of small and marginal farmers, the State decided to establish model Fish Farms of one hectare each in 11 districts by providing assistance for de-silting of fish ponds, aerator, nylon threads for protection against predators and organizing training of farmers at GADVASU, Ludhiana. Timely supply of seed and other inputs and guidance provided by extension staff, the yield of fish at the selected farms increased by 25 to 40%. A modern fish farming demonstration unit of one acre was established at GADVASU, Ludhiana for training of farmers.

About 1.25 lakh ha of land in south west districts of Punjab comprising Mukatsar, Ferozepur, Fazilka, Faridkot, Bathinda and Mansa is water-logged. As these salt affected lands are unfit for any profitable agricultural practices and water, although saline, is abundantly available, aquaculture is a best option to utilize these lands for fish production without exerting any undesirable pressure on already depleting fresh water resources in the State. In order to study the possibility of rearing fish in water-logged saline soils, GADVASU, conducted aquaculture trials in salt affected waterlogged waste lands in village Sajrana, District Fazilka (erstwhile district Ferozepur) in the years 2007 to 2010. Freshwater carps (catla, rohu, mrigal, common carp and grass carp) were reared successfully in inland saline water (salinity up 5-8 ppt) with an average productivity of 2.5/ha/yr. Now, fish farming is being promoted in these areas on a large scale.

5.2.7 Crop Residue Management: About 80% of the paddy straw produced in the state is burnt in the fields. It causes high environmental pollution and also burns the organic matter-nitrogenous fertilizers worth Rs.250 crores annually. For accomplishing such a large operation, a number of steps need to be taken viz. (a) direct seeding of wheat in residues; (b) chopping to incorporate it in the soil; and (c) its collection for production of bio-energy. The State has developed/ identified the necessary equipment for this purpose. 'Happy seeder' which helps to sow wheat in the standing stubbles of paddy has been introduced and about 700 have been provided to the farmers. Choppers and rotavators are used to shred and incorporate the straw in soil and balers

have also been introduced for collection of straw. These machines have been working satisfactorily and there is need to expand their coverage on a large scale to handle the straw and stop its burning in 3-4 years. It requires a huge financial investment.

6. Strategy and Recommendations for Future Development:

The strategy for further agriculture development has to address the sustainability concerns while achieving the overall growth objectives. We have attempted to identify the areas requiring immediate attention which include the interventions aimed at shift in cropping pattern, promotion and development of horticulture, promotion of agro forestry, water conservation and management, promotion of agri-processing and agri-business, development of livestock sector and improvement in agriculture marketing infrastructure in the State. Greater attention is also required towards agricultural research with a special focus on conservation of natural resources and production technologies for alternate crops. Similarly, a renewed emphasis has to be laid on improving the productivity of livestock sector for generating additional income to the farmers. This will require a huge investment both public and private in the agriculture sector especially for providing incentives for propagation and adoption of new technology and creation of necessary infrastructure. Accordingly, the major recommendations of the State Task Force for rejuvenating State Agriculture are as follows.

6.1 Diversification of Agriculture:

6.1.1 Sustainability and security of livelihoods are important parameter to decide development directions. State's future agricultural economy must be protected. These become all the more critical in distress situations where farmers are more vulnerable and under-empowered. The primary initiative in Punjab Agriculture to achieve this objective comprises of Diversification of Agriculture to make it sustainable over long time and take up programmes which help improve small farm economy.

6.1.2 Shifting area from rice to other crops is extremely important to sustain natural resources in the state. The crop choices in the State before the rice revolution were highly diverse. Maize, cotton, sugarcane, pulses and oilseeds were the important kharif crops of the state till 1970-71. The area under these crops can be increased in their traditional belts if their productivity is enhanced, prices become remunerative, market is assured, yield variability is reduced and value addition is taken-up. However, this will vary depending upon the availability of technology, markets and price. Agro-forestry is an alternate option and is proposed to be taken-up along with intercropping of maize and wheat for initial 2-3 years particularly in case of poplar plantations.

The increase in area under maize in place of paddy holds a great promise as high yielding hybrids of maize are now available, but for this purpose a remunerative price and markets have to be assured. The maize can be easily processed for production of corn oil as well as ethanol which will not only reduce the burden on ground water and electric power but will also reduce pollution due to burning of paddy straw.

6.1.3 Since the returns from the alternate crops are generally lower than that of paddy, the farmers will have to be incentivized to shift to these crops through a better and remunerative MSP. For alternate crops, different types of agricultural machinery for sowing, spraying, harvesting etc. will be required and to encourage the farmers, to purchase such machines, capital assistance needs to be provided.

6.1.4 To encourage cultivation of horticulture crops i.e. fruits and vegetables, specific marketing facilities are necessary. However, the cultivation of vegetables is best suited due to better returns and low gestation period as compared to fruits which start giving economic returns after 4-5 years. Establishment of aggregation centres having washing, grading and pre-cooling facilities will have to be encouraged through Self Help Groups, Farmer Producers Organizations, Cooperative Societies or in PPP mode. If this is ensured, this programme is the answer for improving economy of small and marginal farmers.

In case of **horticultural produce** which is perishable in nature, price crash due to glut like situation because of increase in area is a big concern and multi-purpose fruit and vegetables processing plants along with cool-chain infrastructure needs to be established in the natural growing area of the crop. The State Government has established five citrus estates with the objectives to improve quality and productivity of citrus at minimal costs in its "Natural Growing Areas". Such estates need to be set up for other fruits like Litchi, Pear etc.

6.1.5 **Strengthening supply of Quality Seeds and Planting Material**

Quality seed and planting material are basic for higher productivity. The seed policy for major crops should aim at achieving coverage of the entire State with the new seeds at an interval of 3-5 years. However, the seeds of hybrids need to be replaced every season. The existing institutions need to be strengthened to produce the needed quantities of seeds of various crops including fodder at regular intervals. Production and availability of disease-free planting material through conventional and tissue culture techniques, especially of vegetatively propagated crops, need special attention and infrastructure for this purpose should be created.

6.1.6 There is heavy demand for planting material for fruits. Modernizing the current nursery production by establishing containerized Nurseries with screen house, shade net and drip/fertigation system for each polybag along with media sterilization for each plant produced may be taken-up. To improve the shelf life of produce, farmers be assisted to construct on farm cold rooms.

6.1.7 **Agro forestry** is a traditional land-use adaptation which has come of age as an integrative science and practice with immense social, economic and environmental benefits such as reducing pressure on forests for fuel-wood and timber; carbon sequestration; and increasing biodiversity. Agro-forestry is another option for agriculture diversification and the Poplar

based agro-forestry system has the potential to yield economic returns higher than paddy-wheat rotation. For this purpose, wood markets equipped with latest infrastructure are proposed to be established; high tech wood industries (laminated wood from Poplar and Eucalyptus) need to be promoted in the State; and nurseries for production of poplar saplings shall have to be strengthened.

The assessments by Indian Plywood Industries Research and Training Institute, Bangalore (IPIRITI) reveals that there is a large gap in demand and supply of wood in the State. So, over eight years period additional 2 lakh hectare area (4% of total geographical area) should be brought under agro forestry. This will require strengthening infrastructure for mass production of quality planting material (clonal seedlings) along with provision of loan in consultation with financial institutions in future for providing sustenance to the farmers during the lock in period of 7 years of plantation and strengthening of extension services and Research and Development in Agro-forestry. Some mechanism needs to be established to ensure certainty of price at the time of planting. The trees are generally sold after 6-8 years and price fluctuations during this period can be very high and source of uncertainty to the farmers which suppresses their will to shift to agro-forestry.

6.2 Development of Livestock Sector

Livestock contributes about one-third of the GSDP from agriculture sector. It plays a very vital role to up-lift of rural economy by promoting various types of livestock rearing activities like dairy, Goat, Pig, poultry farming etc. Most of this contribution is made by the farmers who rear 2-3 milch animals for producing milk for domestic consumption and to sell small quantity to meet their day to day financial needs. To achieve a better growth in this sector, it will require addressing the challenge of low milk yield, high reproductive disorder, occurrence of some deadly diseases and shortage of quality feed and fodder.

Livestock farmers at present are not treated at par with the crop sector in terms of other facilities viz. income tax exemption, low interest rate, cheap working capital, exemption of custom and excise duty on dairy equipment for farm-gate processing. This deficiency needs to be rectified.

Breed improvement is necessary to increase the productivity. To handle the increased milk production and to provide a remunerative price to the producers, the milk processing facilities will have to be strengthened and modernized. The rearing of small ruminants viz. goats, pigs etc. by resource poor small and marginal farmers will also have to be encouraged and processing facilities will have to be created to provide front end linkages with the market. The fresh water aquaculture and fisheries in saline and waterlogged areas have great potential and also needs to be promoted. Livestock sector in addition to yielding regular income provides household nutritional security and better employment opportunities.

6.2.1 **Dairy farming** in Punjab has been an inseparable part of most of rural households. To encourage its adoption, farmers need capital assistance for induction of high yielding milch animals, erection of suitable housing, and to mechanize the milking operations for small dairy farmers opting for 2-10 animals.

6.2.2 For promotion of Commercial Dairy units with 20+ high yielding milch animals (cows as well as buffaloes), in addition to animal housing and milking machines, financial assistance for providing machinery for fodder cultivation and silage making viz. self propelled forage harvester, single Row Fodder Harvester, silage Loader/Pusher, feed mixing & dispensing unit, milking parlor etc. will also be required. Such units will also be encouraged to set-up bio-gas plants for captive power generation.

6.2.3 To improve the productivity of milch animals availability of Superior Quality Germ Plasm and Elite Bulls is necessary. High genetic potential semen and sexed semen of H.F./Jersey bulls for cows as well as goat and swine semen shall be imported and supplied to the farmers at subsidized

cost. For conservation of local breeds of Nili Ravi Buffalo Bulls and Sahiwal cow bulls shall be kept for semen production at Govt. Semen Banks. Artificial Insemination coverage of buffalo will be enhanced to about 70%. For meeting the increased demand of high quality semen, a Mega Semen Station needs to be set-up in the State with a capacity of more than 75 lac semen straws annually.

6.2.4 There is a need for strengthening of health management programme and improving bio-security measures. Health related services with emphasis on prevention of diseases through mandatory vaccination programmes and round-the-clock availability of clinical facilities including AI facilities is the basic need of livestock farmers which must be strengthened.

6.2.5 A programme for nutritional management for enhanced animal productivity should be initiated. Though feed and fodder is one the most important and critical input to improve productivity, its development has not received required focus. Emphasis needs to be laid on developing new high-yielding fodder varieties, which are also more nutritious. A thrust should be given on production of better seeds for fodder crops and popularizing the techniques of silage and hay making. Quality and BIS specified feed and mineral mixture should be available to the farmers. The newer feed technologies like bypass fat protein etc. should also be propagated.

6.2.6 Strengthening of Small ruminants as well as non-ruminants viz. Goat, Sheep, Pig and Poultry are the major sources of meat out of which Goat and Poultry meats have higher preferences. A new modern pig breeding farm needs to be established along with strengthening of existing farms to make the good quality piglets available to the entrepreneurs. Further, contract farming in rearing of poultry, which requires small capital investment, may be encouraged in view of the growing demand of poultry products.

6.2.7 **Fish farming** has emerged as an important tool for diversification of farming in the State. The main objective of the program is to

increase the fish production by incentivizing construction of new ponds, establishment of medium sized fish feed mills, establishment of new carp fish seed farms and hatcheries for production of seed of new species like tilapia and fresh water prawn. Production and capacity building of the farmers through training, demonstrations and extension will constitute an important component of the fisheries development programme. The capital assistance needs to be provided for construction of ponds and providing the seedlings.

6.3 Strengthening of Agricultural Infrastructure:

6.3.1 **Up-gradation of grain handling and storage system** in the State is its dire need. The State on an average procures about 20 million tons of wheat and rice annually. Currently, out of total storage capacity in the State, 37% is open (CAP storage) and only 1% comprises storage in silos. Majority of the food-grains in the State are still stored in gunny bags that too in open which leads to increased losses in storage. For efficient and effective handling of grains in the markets, bulk handling should be started and storage infrastructure in terms of an integrated Silo Grid requires to be created to eliminate storage in gunny bags completely and to minimize wastage during storage. 50 Local storage silos of 50000 MT capacity at Mandi level and 20 rail head silos of 2,00,000 MT capacity for long term efficient handling/storage of grains need to be constructed. Similarly, the storage should be decentralized by creating on-farm silo storage facilities and the farmers should be paid a remunerative monthly storage charges per tonne of grain stored to minimize the losses during handling and storage.

6.3.2 **Horticulture Produce:** Horticulture produce being perishable, needs immediate storage or disposal. Generally 25-30% losses are occurring in the post harvest stage and marketing. The existing fruit and vegetables markets in the State need to be modernized and strengthened in term of infrastructure for efficient handling, varieties/hybrids of vegetables in different maturity groups with high yield and better quality are require to promote their cultivation; and high-tech nurseries to provide good quality planting material of fruits need to be strengthened. Two existing multi-fruit juicing plants in the

State should be modernized and upgraded for processing of fruits viz. kinnow, guava, pear, amla and vegetables like tomato etc. For aggregation and consolidation of vegetables and fruits and for primary value addition, trading, warehousing, credit facilitation and provision of input services and technical inputs, it is proposed to set-up Agri-marts and pack houses. It is proposed to provide financial assistance to the farmers who intend to market their produce to distant domestic markets by providing freight subsidy for transportation of produce and cold storage space at subsidized rates in major markets of eastern and southern India.

6.3.3 Similarly, vegetable production clusters may be developed around Amritsar and SAS Nagar where State has International Airports. The perishable cargo centers can be set-up at these airports and vegetables can be exported to the middle east and erstwhile CIS countries by starting dedicated cargo flights from these airports. In general, there is a need to set-up efficient supply chains including cool and cold storage to encourage the large scale cultivation of vegetables and fruits.

6.3.4 **Wood Markets:** The country and the State is deficit in timber, paper, newsprint and wood based products at present and meets its demand by imports. The marketing infrastructure for wood produce in the State is inadequate. Four Wood Markets established one each at Hoshiarpur, Dasuya, Balachaur and Ludhiana need to be equipped with modern saw mills, seasoning plant and other related infrastructure to facilitate marketing of wood.

6.3.5 **Marketing Infrastructure for alternate crops:** The assured marketing facilities as available for wheat and paddy are absolutely essential for maize, cotton, pulses, oilseeds etc. to motivate farmers to adopt these crops. Although, MSP is fixed for maize, pulses and oilseeds, yet this has never been implemented. Most of the farmers who cultivated these crops have to sell these crops at prices much lower than the MSP. This discourages the farmer to take the cultivation of these crops, which not only would have met substantial part of edible oil and pulse imports, besides using much less water

than paddy. Market infrastructure will have to be upgraded to handle properly the increased production of these crops.

The Maize crop is facing a serious marketing problem due to high moisture content at the time of harvest which varies from 20% to 28% against an optimal of 14% for proper storage and processing. As a result, the farmers get a market price lower than Minimum Support Price. To ensure better prices to the farmers, it is proposed to equip 20 maize market yards with maize drying facilities. Similarly five modern markets for sale of basmati rice need to be established.

6.3.6 Milk Marketing Infrastructure: To ensure a remunerative price to the producers, the milk processing plants in public sector need to be modernized/ replaced by the state of art equipment to improve the milk processing/product manufacturing facility and to cut down the processing costs. A new Mega Dairy Plant of 15 LLPD capacity may be set-up and the existing milk plants and the milk collection structure at the society/farmer level may be modernized. Further, pre-cooling facility needs to be created at the door steps of milk producer. Use of milk vending machines by the milk producers should be incentivized.

6.3.7 Markets for Livestock Products: The commercial piggery farmers need to be incentivized for setting up on-farm slaughtering and processing units by providing capital subsidy. Such facilities will facilitate the manufacturing of different types of pork products like sausages, nuggets, ham, bacon, pickle etc.

6.3.8 Similarly, due to urbanization, increase in literacy rate, non-veg strata of the society likes well dressed, hygienic meat, for which setting-up of Modern Slaughter Houses in Municipal Cities should be facilitated.

6.3.9 To encourage fish farming in the State, a self sustainable marketing system, supported by a well connected network of the modern fish whole sale/retail markets, is required to be promoted.

6.3.10 **Price Stabilization Fund**

The diversification of agriculture is of utmost importance for conservation of water. The State needs an agriculture development that meets the needs of the present without compromising the ability of future generations to meet their needs. However, the crops alternate to paddy i.e. maize, oilseeds and pulses do not yield the same returns to the farmers as that of paddy in the absence of procurement at MSP. To achieve a shift in area away from paddy, the loss to the farmers will have to be compensated. For this purpose, a market stabilization fund of Rs. 500 crore needs to be created to reimburse the loss of income to the farmers.

6.4 Agriculture Machinery:

6.4.1 To reduce the capital cost, particularly of small and medium farmers the **Agricultural Machinery Service Centres** need to be set up . These centres particularly farm machinery and implements such as laser levelers, happy seeders, rotavators, balers, seed bed preparation equipments etc. to the farmers on custom-hiring basis are recommended. The cost of setting-up of such a centre is about Rs.20.00 lacs. It is recommended to incentivize the establishment of such centres by providing financial assistance to all the Primary Agricultural Cooperative Societies in the State.

6.4.2 Similarly, dairy farming machinery especially for fodder harvesting and silage making is quite costly. Therefore, on the pattern of Agriculture Service Centers, Dairy Machinery Service Centers are also proposed to be set-up by providing each centre a Fodder Harvester, Hydraulic Trolleys (Two), Pneumatic Maize Planter, Tractor (80HP), Fodder Compactor and Pusher, Silage Cutter cum Loader and Paddy/ wheat Straw Raker & Bailer for providing to the dairy farmers on custom hiring basis. Estimated cost establishment of one such center is about Rs.60.00 lacs.

6.4.3 **Strengthening of Animal Health Care infrastructure** is a must for development of a vibrant livestock sector. In addition to the well-knit net work of 2852 veterinary institutions to the livestock population of the State,

it is proposed to construct 220 new civil veterinary dispensaries to provide more efficient services. Further, at least one veterinary hospital in each of the 142 blocks should be developed as a model hospital where all the facilities like Mobile Vans, Disease Diagnostic Lab., minor surgical facilities would be available for livestock farmers.

6.5 Conservation of Natural Resources:

6.5.1 Site specific **soil fertility management** through balanced nutrient use and application of soil amendments based on soil testing should be propagated. Application of gypsum, being a major source of sulphur can greatly help in improving their productivity. The south-western districts are facing a severe problem of land degradation due to use of brackish ground water. The application of gypsum will help not only in minimizing the affect of use of poor quality ground water but will also improve soil physical properties thus rendering it fit for cultivation of other crops as well. The supply of gypsum for reclamation of soils particularly those irrigated with high RSC underground water should be subsidized to encourage its use.

6.5.2 Collection and disposal of crop residues remains a practical problem. About 5–7 tons/ha of rice straw is left unused in the field by self propelled and tractor-mounted harvester combines. Management of crop residues has emerged as a major area of concern. The main options available for management of crop residue are in situ management by incorporation or mulching and collection of crop residues by bailing. To overcome this problem of residue especially paddy straw it is proposed to promote the available technologies like happy seeders, balers and rakes and chopper and shredders in the State. This will lead to proper management of straw an also directly and indirectly benefit the soil health as well as lessen environmental pollution due to burning of straw.

6.5.3 Promotion of Efficient Irrigation Water Use:

Punjab has more than 10 lakh tubewells that irrigate about 3 Million hectares mainly through flood irrigation with water application

efficiency of about 50 to 55%. Conveyance of irrigation water through Under Ground Pipeline System (UGPS) has proved to be highly useful in improving the on-farm water use efficiency and saving of 15-25% of water. It is proposed to provide technical and financial assistance to the farmers for laying of RCC/ PVC UGPS in their fields.

The adoption of modern irrigation systems viz. Drip and Sprinkler system requires application of water to the plants daily basis and therefore, continuous supply of water is required. For this purpose, on-farm water storage tanks for storage of water from the canal network and Solar Photovoltaic (SPV) pumps coupled with the micro irrigation systems for its application may be promoted. The major barrier to the large-scale adoption of solar PV water pumps is the high capital cost as compared to conventional pumps.

6.6 Post-harvest Handling and Value Addition

6.6.1 Agro processing is considered necessary for (a) development of industry to provide employment to the unemployed/ under employed rural youth (b) sustainability by replacing a part of rice area to maize by ensuring its proper marketing and processing into corn oil or ethanol and (c) processing of fruits and vegetables to ensure marketing as well as maintaining price level.

6.6.2 Emphasis needs to be laid on setting up of multi-commodity small agro-processing centres in rural areas for primary processing and value addition. The farmers should be organized into producer groups/producer companies to produce products conforming to uniform standards. Suitable incentives should be provided to facilitate the setting up of such centres and marketing of their products. One such centre should be set up in each development block in the next 5 years. The State tax structure should be reviewed to make the processing units more competitive for processing the state produce for value addition.

6.7 Agricultural Credit:

6.7.1 Modern agriculture including dairy farming is highly capital intensive and access to institutional credit at affordable rate of interest is central for adequate input use and productivity growth on small farms. Though, overall institutional credit supply has increased, yet availability of credit to small and marginal farmers is proportionately low. The institutional lending being inadequate and cumbersome the farmers resort to borrowing from private non-institutional source of finance at very high rate of interest. Thrust should be laid to streamline the working of cooperative credit infrastructure to improve their outreach and to ensure cost effective, adequate and timely flow of agricultural credit to the farmers. Credit facilities at affordable interest should be provided for capital investment in crop and livestock sector and full refinance should be provided by NABARD to cooperative credit institutions to improve their viability.

6.7.2 As profit margins from dairy farming in initial 2-3 years are low, farmers find it difficult to re-pay the loan installment during this period. It is therefore, proposed that the repayment schedule for recovery for long term loans for dairy farming should be 10 years with a moratorium of payment for first year and payment of interest only during the next two years.

6.7.3 The private money lenders should be registered and necessary legal support created, if necessary through legislative measures. Legislation for debt determination and settlement needs to be enacted for settlement of outstanding debts of the farmers.

6.8 Strengthening of Agricultural Research and Extension

6.8.1 The green, white and blue revolutions were the result of development and application of new technology which led to higher productivity. Appreciable increase in production in future will also come from development of new technologies. For this purpose, allocation of funds for research, both in crop and livestock sector has to be increased. Future research would be highly fundamental and time consuming. As such, adequate

allocation of funds to agriculture research institutions i.e. Punjab Agricultural University (PAU) and Guru Angad Dev Veterinary and Animal Sciences University (GADVASU) is necessary for strengthening and restructuring their research programmes, to meet the urgent and anticipated future needs. There is a dire need for capacity building of research scientists through regular training at the national and international institutes of repute.

6.8.2 The major thrust areas for research in crop sector shall be improvement in the productivity and quality of crops especially pulses and oilseeds, horticulture crops and agro-forestry; conservation of natural resources; mechanization and value addition; and technology for mitigation and adaptation to climate changes etc. etc. Similarly, intensive research is required in livestock sector for breed improvement; to improve productivity of milch animals; development of new molecular systems for disease diagnosis and farmer friendly technologies for farm-gate value addition of animal products; and new aquaculture technology for promotion of fisheries in water-logged and salt affected areas etc. etc.

6.8.3 The **delivery of technology** package generated by the Agricultural Research Institutes to the farmers is basic to improve the rate of adoption of technology and productivity of agriculture. Demonstrations should be arranged at farmers' fields to convince them about the useful-needs of new technology so that they may adopt the same. For this purpose, a well planned programme needs to be prepared and necessary funds provided. The endeavour should be made to build a well organized efficient and result oriented extension service system through an annual induction of extension officers against the resultant vacancies and creation of new posts particularly in livestock sector.

Public-Private-Partnership (PPP) in the delivery of services should be promoted for convergence and sharing of resources. Agriculture and Animal Husbandry are becoming highly specialized activities. To cope with the emerging needs, the mid-career training of middle level and senior level extension functionaries at MANAGE or at a National Academy and abroad should be arranged. The information technology system should also be used

progressively for improving the knowledge of extension functionaries as well as delivery to the farmers effectively.

6.9 Review of format of Central Schemes:

6.9.1 Concerned by the slow growth in the Agriculture and allied sectors, a special Additional Central Assistance Scheme (Rastriya Krishi Vikas Yojana (RKVY)) was launched to reorient the strategy to rejuvenate agriculture to meet the needs of the farmers. The major objective of the scheme was to incentivize the states so as to increase public investment in Agriculture and allied sectors and to provide flexibility and autonomy to states in the process of planning and executing Agriculture and allied sector schemes. 100% allocation was made by Govt. of India out of which at least 50% was to be spent on development of infrastructure. However, the format has been changed now to 50:50 after more devolution of funds to the States as per recommendations of the 14th Finance Commission. Firstly, the most of the States are facing financial constraints and secondly the State budgets are more sensitive to the local requirements. As such, the change in format will certainly affect the public investment in agriculture and more so in creation of infrastructure. Similarly the performance under NFSM, NHM and other Missions shall also be affected.

6.9.2 Further, cash transfer of incentives is also being advocated but in agriculture it may not be possible to achieve desired objective of creation of assets or use of input. The cash transfer may not lead to purchase desired quantity of fertilizers or piece of machinery as the poor financial condition of beneficiary may necessitate the use of cash to meet other immediate needs.

6.9.3 The shift to nutrient based subsidy (NBS) has further distorted the ratio of use of various fertilizers instead of achieving the balanced fertilization. Since the introduction of NBS, the use of phosphorus has declined in different parts of the country and in Punjab it has been lower by about 15% as compared to 2009. The affects of low use shall be visible after 4-5 years as there has been slight build-up of phosphorus in Punjab soils due to extensive

use earlier. On the other hand, the use of urea is increasing. So the amount of subsidy for various nutrients needs to be reviewed to promote balanced use of fertilizers.

6.9.4 There is multiplicity of agencies looking after the development programmes of almost every sub-sector of agriculture economy. For example, irrigation which is the basic input to modern agriculture is being looked after by Ministry of Water Resources in Union Government along with Ministry of Agriculture (for command area development), Ministry of Rural Development (for integrated watershed management programme) and Central Ground Water Board (for artificial recharge), etc. The States find it extremely cumbersome and time consuming to run one agency to other for holistic coverage of irrigation system from capture of water to its on-farm use. A serious and concerted effort to re-work the jurisdiction of departments needs to be made.

6.9.5 To achieve a better growth in agriculture sector, the investment in agriculture needs to be improved. The allocation to the agriculture sector (agriculture + irrigation) in the Union budget was about 31% in the first five year plan (FYP) has come down to about 17% in 12th FYP. Development of a resilient and resurgent agricultural production system requires a holistic integrated approach as well as a higher public and private investment in agriculture infrastructure in areas of water sources management, post harvest handling, small holder farm mechanization and the off-farm rural industrial and service sector. It is probably the right time to take a relook at various missions with a focus on individual crops or sectors and conceive a holistic National Mission for Viable Farming which will be inter-disciplinary in scope.

6.10 Skill Development for Off-farm Employment: The major agrarian issue is “how to improve small farm economy” i.e. the economic viability of farming families operating less than 2 hectares. Their crop yields are at par, production and income per ha is the same as those of medium and large farmers but the total size is so small that they hardly earn just enough to sustain themselves. They have no economic / social security for any eventuality, nor do they have any economic empowerment for future growth

and development. As a short term measure to improve their earnings, the investment in rural infrastructure particularly rural industrialization should be increased so as to promote diversified livelihood opportunities in rural areas to provide rural poor and landless an adequate scope for upward mobility through participation in off-farm and non-farm sources of employment and income. In the medium to long run, the rural youth need to be empowered with proper access to quality education and skills acquisition in collaboration with the industry so as to be able to take-up gainful employment both within and outside agriculture including service sector. Simultaneously, the new industrial units in the rural areas should be encouraged and mandated to recruit persons from the surrounding rural areas.

7. To conclude, the thrust of the proposed recommendations is to suggest future course of growth and development for agriculture sector and ways and means to improve sustainability of agriculture production and increase real farm incomes. Like the earlier agricultural development, future growth will also depend upon technology development supported by appropriate public policies, relevant institutional changes and facilitating increased investment from the private sector as well. For improving farm income, sustainable intensification, diversification of agriculture and value addition of produce are essential. Maize, kharif pulses and soybean are important kharif crops proposed to replace part area of paddy, which is possible only if their marketing and remunerative prices are assured. The technology developments are essential to achieve enhanced production potential both in the crop and livestock sector for which the investments in research as well as development of agriculture should be increased.

Government of Punjab would certainly endeavour to prepare programmes and implement them along with creation of a conducive enabling policy regime, though some of the policy prescriptions would need to be fixed by the Central Government. Given the thrust on National Food Security, the country needs to increase its food-grain production, offering a basket of options to the consumers, which can perhaps be achieved, as done earlier in

late 60s' and early 70s' through specific policy interventions by the Central Government. It is felt that one major policy prescription on Minimum Support Price (MSP) for crops other than wheat and paddy by the Central Government, can largely help to achieve the objective of agriculture diversification in the State. Punjab needs a different treatment under the plan development programmes/ schemes of the Central Government to take agriculture to a higher growth trajectory.
