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AGRICULTURE POLICY FOR PUNJAB



Submitted to Government of Punjab

By

Committee for Formulation of Agriculture Policy for Punjab State

March, 2013

AGRICULTURE POLICY FOR PUNJAB

Foreword
Constitution of Committee

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AGRICULTURE POLICY FOR PUNJAB

EXECUTIVE BRIEF

The thrust of the proposed policy 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. The production technology available for wheat and rice, supported by the appropriate policies and complemented with the required investments and institutional infrastructure, resulted in a spurt in their productivity and production in Punjab in a record time (green revolution). Consequently Punjab which was a food deficit State became the 'food basket' of the country. Because of low production risk and assured marketing of wheat and rice, about 80% of the arable area has come under these two crops. For a long period, this cropping system continued yielding a high growth in agricultural production and farm incomes. The production potential of the available technology of these crops has almost been fully exploited. There is now near stagnation in growth, decline in real farm incomes and over-exploitation of natural resources i.e. soil and water. The very sustainability of the wheat-rice production system is under threat. Climate change is posing a new challenge for future agricultural growth.

Like the earlier agricultural development, future growth will also depend upon technology development supported by the 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 price are assured. To achieve the objective, creation of Price Support Operation (Corpus) Fund is suggested.

The technology developments are essential to achieve enhanced production potential both in the crop and livestock sector, encouraging crops / varieties having low water requirements, high value crops i.e. fruits and vegetables and dairy farming. As soybean and pulses offer a long term potential source for diversification and sustainability, there is need to focus on a breakthrough in their productivity. It is recommended that the users of technology should bear a part of the cost of technology development.

The highlights of the suggested agriculture policy are (i) encouraging the optimal use of natural resources for long term sustainability of agriculture; (ii) enhancing the productivity of crops and live-stock through strengthening research, public and private investments and development programmes; (iii) improving the economy of farmers; (iv) encouraging the cultivation and addressing the problems of high value crops; (v) addressing the constraints through restructuring of the incentives, market orientation, credit delivery system and value addition to produce both at industrial scale and at the village level; and (vi) restructuring of various development departments for coordinated implementation of various activities.

I Introduction:

1.1 Introduction of high yielding varieties of wheat and rice during late 1960s, coupled with an appropriate policy environment and progressive farming community put the agricultural economy of the State on a high growth path during the green revolution era. Consolidation of holdings, development of irrigation, high capital investment, improved infrastructure and strong institutional reforms and net-work provided very conducive environment for success of green revolution technology in the state. This enabled the state to remain on high growth trajectory and also led to increase in real farm income. This technology led strategy resulted into the transformation of agriculture and rural economy in the state and converted Punjab into food bowl of the country. Agriculture continues to be an important sector of the State's economy in terms of employment and contributes about 22% of the Gross State Domestic Product (2010-11). The State has about 4.2 million hectares of cultivable area, which is 3% of the net area sown in the country. It produces about 19% of India's wheat and 11% of rice from 12.4% and 6.7% of the total area under wheat and rice, respectively. It has contributed 25-50% of rice and 38-75% of wheat to the central pool of food grains over the last four decades (**Annexure-I**). Punjab ranks 7th as gross producer of wheat in the world, it generates third largest marketable surplus after Canada and Australia which is about one tenth of the global trade in wheat. In the case of rice its marketable surplus is 2nd only to Thailand. These two crops which have low production risks and negligible marketing risks due to procurement at Minimum Support Prices are now occupying about 80% of the cropped area. Cotton is another important crop of the state which is grown over 5.2 lakh hectares (2011-12) which constitutes about 5% of the total cotton area, and 9% of the total cotton production in the country.

1.2 Of late, some disturbing trends have emerged in the agriculture sector of the state. The over dependence on wheat and rice and intensive use of farm land with more than 200% cropping intensity have led to a crisis in terms of over exploitation of natural resources viz. soil and ground water. Cultivation of paddy which increased from about 3.9 lakh hectares in 1970-71 to 28.2 lakh hectares in 2011-12 is causing over

exploitation of water resources, increased electricity consumption and also putting serious strain on State Exchequer to meet cost of free power supply to farm sector. The productivity level of wheat and rice has almost reached a plateau. Imbalances in soil fertility have developed; farmers have to use higher quantities of inputs to maintain productivity even at same level. This poses serious threat to long term sustainability of agriculture in the state. The rate of growth in output is decelerating, farmers' real income is declining and rural distress is rising.

1.3 Wheat and paddy would remain top priority of the country as staple food. With the anticipated growth in productivity and total production in other states where present levels of input use and productivity are low, the demand for these two foodgrains from Punjab will decrease. The State is likely to face problem of marketing for these crops. Obviously, a part of the area under these crops particularly paddy which is also a very high water consuming crop, has to be replaced.

1.4 The state needs to think how it can benefit from demand buoyancy and consumer preferences to pay premium price for product attributes of their choice. Consumption bracket is also showing significant shift towards high value and processed foods. Besides, trade in agriculture is getting attractive and dynamic. India and Pakistan are contemplating liberalization of cross border trade. This will offer tremendous advantage to the state of Punjab to harness trade opportunities.

2. Performance of Agriculture Sector:

2.1 Agriculture which encompasses raising of crops and livestock is the main source of livelihood to the rural population which comprises about 2/3rd of total population of the State. Agriculture in Punjab has strong linkage with rural non-farm sector; it creates indirect employment for a large number of skilled and semi-skilled workers for repair and maintenance of farm machinery, and marketing of inputs and agricultural produce, etc.

2.2 Punjab's agriculture adopted technology led growth strategy that paid rich dividends to its peasantry, labour force and the State, revolved around the rice-wheat

cropping system. With the introduction of new technology in Punjab in mid-60s, initially for wheat cultivation and followed by rice cultivation, the rice-wheat cropping system rapidly came to dominate the State's agriculture. Fast increase in the productivity of both wheat and rice crops compared with assured procurement at minimum support prices, resulted in appreciable increase in the real farm income. This led to manifold increase in the area under wheat and rice cultivation.

2.3 The increase in productivity was the result of simultaneous actions in (a) production and distribution of seed of high yielding varieties (b) increased availability and use of fertilizers (c) large scale development of tubewell irrigation and (d) enhanced power and credit availability. Punjab developed its agriculture to the stage where it has the largest proportion of irrigated area (98%), highest cropping intensity (about 200%) and the most intensive use of chemical fertilizers (246 kg/ha) and other inputs during 2011-12 as compared to other states in the country. By the end of 1990's, the production potential of the available technology was almost fully exploited and the average yield of wheat and rice during 2011-12 reached 5150 and 3741 kg/ha.

2.4 Along with crops, livestock sector also played an important role in transformation of the rural economy of the State. The share of livestock sector in the NSDP from agriculture sector has increased from 25.7% in 1990-91 to 32.2% in 2009-10 indicating faster growth in livestock compared to crop sector. The farmers are intrinsically linked to dairy farming to produce milk and milk products for home consumption and for subsidiary income. Punjab is the fourth largest producer of milk in the country. It is pertinent to mention that with 2% of its milch animals, Punjab produces about 10 million tonnes of milk annually, which is about 9% of the national milk production with highest per capita availability of 932 grams/day during 2010-11. The agro-climatic conditions of the State provide ample scope for development of livestock sector but key gaps exist in organized production, processing and marketing of milk and milk products. Poultry has been taken up in the State as a commercial venture and the State has the highest per capita availability of 128 eggs per annum (2010-11).

The productivity of layers in the State is also highest *i.e.* 280 eggs per annum during 2010-11. The meat industry has good scope in the State.

2.5 Agricultural growth in Punjab slowed down from 4.6 per cent in 1980s to 2.5 per cent in 1990s and to 2.3 per cent in 2000s. Similarly, growth of crop sector decreased from 4.3 per cent in 1980s to less than 1.1 per cent in 1990s, with a little improvement to 1.5 per cent in 2000s. The overall agricultural growth in the State during 11th Five Year Plan (2007-12) has been estimated at 1.6 percent over a very high base against a national average of 3.4 percent. High rate of growth in agriculture resulted from double cropping and increase in productivity because of increase in irrigated area. By mid-nineties further growth in irrigation and cropping intensity was negligible. Thereafter, the growth is the result of increase in productivity only. The agricultural production/productivity level in Punjab is very high that limits further growth.

2.6 This policy paper aims at achieving two major objectives, firstly, a faster and sustainable agricultural growth and secondly an increase in the real incomes of farmers by increasing productivity, lowering cost of production and adoption of high value crops, agro-processing and dairy farming.

2.7 It hardly needs to be emphasized that the agricultural policy of Punjab or any other state gets shaped by the agricultural policies at the National level. Prices of agricultural commodities and assured marketing indirectly determine the cropping pattern.

3 The Challenge

3.1 The predominant rice-wheat system in Punjab, which provided good returns to the farmers till a few years back and contributed greatly towards food security of the country, has created a number of serious problems. The intensive land usage under these crops has resulted in rapid depletion of ground water mainly in Central Punjab. The area of the State having depth of water table more than 20 meters was only 0.4% in 1973 which increased to more than 50% during 2010

(Annexure-II). Because of this farmers have to make increased investment in agriculture through replacement of shallow tubewells fitted with centrifugal pumps by deep tubewells fitted with submersible pumps. The consumption of energy for pumping water from deeper layers for the same irrigated area is also increasing continuously; electricity being free, the financial burden on the state exchequer is also increasing.

3.2 The plateauing of yields of principal crops and increased cost of inputs such as fertilizers, pesticides etc. and higher labour wages have led to increase in the cost of production and thereby, a squeeze in farmer's income. Higher cropping intensity and monoculture of wheat and rice has led to depletion of both major and micro nutrients, emergence of new insect pests, diseases and weeds. Evidently, diversification from mono cropping of wheat and rice to other crop rotations for conservation of both soil and water is essential.

3.3 One third of the farmers in the State cultivate about 8% land and operate on land holdings of less than 5 acres. Such holdings are economically unviable due to high fixed capital investment such as machinery and high price of market supplied inputs. The income from such holdings is very low and these farmers are unable to meet their essential demands, education, health and other needs of the family. With every new generation pressure on land increases and holdings are further fragmented. At the same time there are very few openings for such farmers to take up off-farm employment.

3.4 Since food security would continue to be the top agenda for the country and in view of the impending Food Security Bill, the annual requirement of grains for Central Pool is likely to increase. However, with the increase in food production in food deficit states of the country, the marketing of food grains produced in Punjab is likely to face serious challenge.

3.5 Currently large area grown under rice, with the prevalent production practice which is very intensive, is the main cause of depletion of ground water and causing problems of sustainability. For maintenance of water balance, the quantity of underground water pumped should be equal to the average annual recharge. According

to estimates of Punjab Agricultural University, about 1.6 million hectares can be safely put under paddy as against the current area of about 2.8 million hectares. Evidently, 1.2 million hectares area under paddy needs to be diversified to other crops requiring less water. Several approaches have been pursued in the past to reduce area under paddy cultivation, but they met with little success. The issues blocking diversification have been economic returns from alternative crops; assured marketing and pricing; a reliable and proven technology for alternative crops; and adequate mechanisms to transfer the same to field. A significant investment is required in Research and Development (R&D) as well as marketing infrastructure, which at present is lacking for alternate crops.

3.6 In view of increasing per capita income, the demand for food items like fruits, vegetables, milk and meat products is increasing at a higher rate than the demand for cereals and is likely to grow at a faster rate. Thus, to improve the economy of farmers, it is necessary to help improve their capacity/ability to adopt cultivation of high value crops like vegetables and fruits. Value addition in these crops is necessary to raise farm income and promote their cultivation. The diversification to high-paying commercial dairy farming is necessary. The farmers are switching over but at a slower pace. However, majority of farmers and landless villagers are likely to continue to have 1-3 milch animals; the incomes of such farmers will improve only if the yield potential of such animals is increased. To achieve these objectives R&D is a pre-requisite.

3.7 There are emerging uncertainties of weather, climate change and global warming. Though the impacts are yet to be quantified, rise in temperature will have a direct bearing on water availability and crop yields, thereby impacting the agricultural sector. The population growth will require higher production of food grains. At the same time demand for water and energy from other sectors will also increase. This is a very alarming scenario.

3.8 The State has adapted well to mechanized farming except for transplanting of paddy, cotton picking, sugarcane harvesting, etc. With the national economy growing at a rate of 6-7% and emerging opportunities for employment in their

own States with the implementation of MNREGA, the migration of labour for farm work from other parts of the country to the State is likely to decline. Thus, there is a need to help the farmers for mechanization of all the labour intensive farm operations.

3.9 Rural indebtedness has emerged as a serious problem in the State. The magnitude of rural indebtedness due to borrowing to meet gap between farm income and family expenses and heavy capital investment necessitated by deepening of tube-wells has increased to a level where it has become a serious concern both for the Government and the farmers. For combating or reducing rural indebtedness some policy decisions are needed on regulation of informal lending and its financial institutional infrastructure, more efficient use of public resources and increase in public investment that would cut down the fixed costs of the farmers.

3.10 Un-employment and under-employment in rural areas is a matter of serious concern. Industrial sector in the state has failed to create sizeable employment for wards of farmers and rural labour. There is an urgent need to increase the avenues of employment in rural areas through agro-based rural industrialization, secondary agriculture and diversification of crop system towards high value crops and on farm post-harvest value addition. The policy of empowerment of the rural poor through skill development, better health and education services, vocational training and a conducive industrial policy is urgently required which will encourage establishment of industry in rural areas and ensure employment for local people.

4. Policy Objectives

4.1 The State Agriculture Policy aims to address various interlinked concerns of sustainability of the current cropping pattern and stagnating farm incomes through a simultaneous and multi-pronged action with an emphasis on improvement in production technology and infrastructure, pushing up capital formation, re-structuring the incentives and streamlining the institutions. At present the agriculture has reached high level of productivity and the current growth rate for the last five years has been 1.6%. Against this base, this policy paper proposes to attain a long term growth rate of 3%

per annum in the agricultural sector including dairy with technologically feasible, economically viable and environmentally sustainable initiatives. This growth should be inclusive and demand driven so as to cater to the needs of domestic and international market while remaining alert to the emerging trade environment which is offering many new opportunities as well as posing new challenges.

4.2 To ensure a faster and sustainable agricultural development, it is essential to maintain ground water balance, increase area under high value crops requiring low water, promote value addition, ensure better marketing environment, create employment and thereby secure better livelihood and living conditions for farmers, particularly the small and marginal, and also the agricultural labourers. Along with raising the productivity, emphasis should be laid on reducing the cost of production. It is necessary to mechanize as many agricultural operations as possible and make available the agriculture machinery on custom hiring basis. Finally, the State incentives viz. capital assistance, subsidies and assured pricing and marketing for alternate crops, especially maize, sugarcane and cotton are required. Investment is also required for creation of post-harvest handling and marketing infrastructure for fruits and vegetables. Currently, proven technology is available for these crops which are economically competitive with rice. But research needs to be strengthened to provide such technology for pulses and oilseeds as well, where India faces large deficit, so that these also become economically competitive with rice. It looks like a mere coincidence that in last one year India exported about 10 million tonnes of rice and at the same time imported 10 million tonne of edible oil. However, it signals strong message to go for import substitution strategy by shifting area under paddy to oilseed crops. This is possible through focused support for oilseed crops like soybean that makes its profitability at par with paddy. The state should develop area specific niches in high value crops and enterprises.

5. Policy Measures and Strategy

5.1 The strategy for further agriculture development has to address the sustainability concerns while achieving the overall growth objectives. The State can play a major role in meeting the vegetables, fruits and milk requirements of northern region of the country. Development of small scale market oriented family farms for protected cultivation of vegetables offers a great potential. Commercial dairy farming and improving the milk yield potential of milch animals can be a significant contributor to agriculture growth. Therefore, appropriate interventions and infrastructural investments need to be made to best utilize these opportunities and undermine the threats.

5.2 Agriculture in the State is entering the next stage of development which involves high productivity and high value product. This requires a new set of policies, institutions and infrastructure. The State has excellent network of rural roads and connectivity. The State is quite rich in terms of natural endowments and physical infrastructure. These advantages now need to be harnessed to promote high tech and high value agriculture. At present Punjab farmers are sticking to wheat and rice rotation because of assured Minimum Support Price and marketing. As consumption patterns are diversifying away from cereals and other states are harnessing cereal technology, future of Punjab agriculture is in progressively increasing area under high value alternatives. These alternatives require linking farmers with processors, industry and retail. This change requires bold decisions and strong mind-set to harness immense potential of natural and manmade capital in the state. The State needs to rope in private sector in a very big way, liberalize production and marketing, forge industry-farmer linkage, adopt innovative alternatives for high-tech agriculture and development of value chain in the State. The State must embrace measures like contract farming, establishment of cold chains, supportive taxation regime for private investments in agricultural production, value chain and marketing.

5.3 Given the alarming rate of decline in water table in the State there is a need to address the situation with some urgency. This should be based on holistic view of water and farm sector. Experts often blame free power supply to farm sector in the state for over-exploitation of water resources. To ensure the efficient use of water and power, the supply should be metered and the farmers should be charged beyond a certain level of free supply. The subsidy amount so saved should be used for Agricultural Research & Development and skill development for rural unemployed.

5.4 About 18 million tonnes of paddy straw is being burnt, which causes environmental pollution. A legislation should be enacted to check this menace. Other measures like sowing of wheat in standing stubbles of paddy, shredding paddy stubbles in soil and baling of straw for use in production of bio-energy, ethanol etc. should be taken.

6. The Crops Sector

6.1 Prior to large scale adoption of high yielding varieties of paddy, the major crops during the kharif season were maize (5.6 lakh ha), groundnut (1.7 lakh ha) and bajra (2.1 lakh ha); most of these areas now stand replaced by paddy. Other major kharif crop was cotton (5 lakh ha). Some area under bajra has also been replaced by cotton. During rabi, there was large area under gram (8.7 lakh ha) and rapeseed mustard (1.1 lakh ha), which has been mostly replaced by wheat. The predominance of paddy-wheat rotation has some far-reaching implications for the State in the form of disturbance of its water balance, deterioration in soil health, emergence of new pests and diseases, intensive use of commercial energy and deterioration in the overall agro-ecosystem of the State.

6.2 Paddy is a high water requiring crop. For long term sustainability, it is necessary to divert sizeable area under this crop to other low water requiring crops, and develop high yielding varieties/hybrids of paddy which are of shorter duration and coincide their cultivation with monsoon season. The yield of basmati (which requires less water than non-basmati varieties) should also be

improved and area under its cultivation increased. Paddy cultivation practices like aerobic cultivation, System of Rice Intensification (SRI) and direct seeding which require comparatively less water should be fine tuned/researched and encouraged. Concerted efforts need to be made to achieve progressive decrease in the area under paddy cultivation in the next 5-7 years by 40 percent.

6.3 The Punjab Agricultural University estimated that paddy can be grown over an area of 1.6 million hectares without adversely affecting the ground water levels. The current area (2011-12) under paddy is about 2.8 million hectares. Thus an area of 1.2 million hectares has to be replaced. The currently available choices to replace paddy are maize, cotton, sugarcane, soybean, pulses, groundnut etc. (**Annexure III**). However, this will require assured price and marketing particularly for maize as for paddy and wheat. Since maize hybrids yielding 6-7 tonnes per hectares are available, area under maize can be increased to 5.5 lakh hectares. However research efforts are needed to develop high yielding maize hybrids which are tolerant to pest attack. Apart from requirement of maize for cattle feed, poultry and starch production, this can be utilized for producing ethanol for mixing with petrol. Demand for export of maize from India has also arisen. The country is short of edible oils and pulses and this shortage is likely to persist for long time. Farmers will face no problem in their marketing. The kharif pulses and oil seed crops can also substitute paddy but currently available varieties of these crops are not economically competitive with rice. Likewise, some improvement in the incentives for cotton need to be provided to keep it continuously more attractive than paddy. Vegetables and fruits are other options for replacing some area under paddy and also for increasing income of farmers.

6.4 Improvement in Crop Productivity

6.4.1 Green revolution was the result of technology based on high yielding crop varieties which was supported strongly by appropriate policies and investments in infrastructure. The second push to agriculture will also be possible with the development of new technology. This time the revolution has to be knowledge intensive rather than input intensive. Productivity levels in rice and wheat crops have almost reached a plateau. Stagnation in yields due to narrow genetic base poses a serious challenge to most of the breeding programmes. There is a need to lay emphasis on introgression of desirable genes from wild species for germ plasm enhancement under pre-breeding programme. In view of these considerations, crop breeding programmes in the conventional mode may not be able to meet the future needs. Climate change is now a serious threat to productivity and demands an urgent reorientation of crop breeding programmes in terms of genetic and genomics as well as trait profile and screening strategy of germplasm.

6.4.2 The main thrust should be on breeding of crop varieties with better quality, tolerance to biotic and abiotic stresses, high nutritional value and suitability for processing. The use of biotechnology should be the hallmark of future breeding. It is proposed that both public (PAU) and private sector should be encouraged to take up research on transgenics. Genetically modified crops hold the future of agricultural growth. A clear cut policy decision should be taken in this regard at the government level. To meet the bio-safety standards, proper bio-safety trials should be conducted so that necessary data is generated for taking evidence based judicious decisions about the cultivation of GM crops. The germplasm base in major crops such as wheat, rice, cotton, maize, sugarcane, pulses, brassicas, vegetables and fruits should be strengthened.

6.4.3 The knowledge gap between the research scientists and the farmers should be reduced. This will need strong extension efforts. Special efforts need to be made in reducing the gap between potential yield and the actual yield obtained at

present at the farmers' field, reducing intra-regional and inter-regional yield variations. Efforts should also be made to cover more area under hybrids where ever possible.

6.5 Adaptation to the Climate Change

6.5.1 Climate change is now accepted as a reality. Its major manifestations are erratic precipitation and rise in temperature. Changes in climate in the long run can adversely affect productivity of crops. Increase in temperature can reduce crop duration, enhance evapo-transpiration, affect the survival and distribution of pest and pathogen populations, and decrease fertilizer use efficiency. The variations in rainfall may offset the adequacy and timely availability of irrigation water. Thus, it is important to focus on development/adaptation of technologies to mitigate the adverse effects of climate change on crop production.

6.5.2 Special efforts need to be made to develop suitable methodology/models for prediction of extreme weather events such as excessive rainfall in a short period, frost, hailstorms etc. and identify crop genotypes showing tolerance to such extremes. Efforts should be made to provide area specific and crop specific weather advisory services to the farmers to mitigate the adverse effects of sudden changes in weather. Wheat genotypes should be tested under heat stress conditions for developing varieties having terminal heat tolerance. Multiple-cropping systems like potato - spring maize - rice, summer mungbean - rice - wheat, agro-forestry etc. need to be promoted as adaptive measure to changing climate. Use of remote sensing technology for assessment of crop losses due to biotic and abiotic stresses need to be taken up. Efforts should also be made to harness the traditional knowledge and practices for sustainable agricultural growth.

6.6 Improving Irrigation Water Management

6.6.1 The canal irrigated area in the State has declined from 16.6 lakh hectares in 1990-91 to 11.13 lakh hectares in 2010-11. This has been mainly due to decrease in surface water availability and poor maintenance of the canal system. There is an over exploitation of ground water resources in the central region as indicated by alarming

decline in ground water levels. In addition, the South-Western region of the state has poor quality ground water that is causing problems of soil salinity. Some areas are also having problem of drainage leading to water logging. It is imperative to reduce ground water use in the central region by developing and refining water saving technologies in crop production.

6.6.2 Major thrust should be given to rational utilization and conservation of water resources. For this purpose, "Water Resources Regulatory Authority" should be set up to promote and regulate the optimum use of surface and ground water. Special attention needs to be paid to the declining water tables in the central parts of the State. Appropriate risk management mechanisms in terms of either price support or effective insurance coverage for potentially viable alternate cropping systems need to be put in place to motivate the farmers for switch over. The storage capacity of natural water bodies at Harike and Hussaniwala should be restored. The additional water thus available should be utilized for recharging ground water in the critical regions by making the Bist Doab and the Sidhwan bet canals as recharge-cum-irrigation canals; their sides only should be lined and during the period when irrigation water is not to be supplied, these should still be kept filled up through monitored/small flow of water for recharging. Efficient on-farm water management should be promoted to conserve water at field level by lining field channels and promoting cost-effective water-saving technologies such as laser leveling, underground pipe line conveyance system, drip irrigation systems, sprinklers, mulching, etc. A programme for in-situ rain water conservation through construction of water harvesting structures particularly in Kandi area and ground water replenishment through recharge structures should be prepared and implemented. For sustainable development, the management of land and water resources on watershed basis should receive special attention.

6.6.3 In South-Western parts of the State, poor quality water and problem of water logging should be managed through combination of interventions such as bio-drainage and growing salt tolerant crop varieties and conjunctive use of poor quality

water with canal water. Large scale reuse and recycling of waste water for irrigation should be encouraged.

6.6.4 Given the alarming rate of decline in water table in the state, there is a need to assess the future requirements to promote the inter generational equity in access to water. An Act based on Model Bill prepared by Government of India for The Conservation, Protection and Regulation of Groundwater 2011 should be enacted for this purpose. It is imperative to create awareness amongst the farmers about the need for conservation and efficient use of water and its quality management. Conservation of ground water needs serious and immediate attention, 73% of the irrigated area is dependent on tubewells. At present, the ground water is over-exploited which is largely due to free electricity supply. Water and power should be used efficiently. The canal regulation system including head works should be modernized. The power supply should be metered and farmers should be charged beyond a certain level of free supply. The subsidy amount so saved should be used for agricultural R & D and skill development for rural unemployed.

6.7 Soil Health Management

6.7.1 Soil is the basic resource and should be managed to optimize its multiple functions especially, related to crop production and environmental protection on a sustainable basis. Its production potential must be maintained. Intensive cropping and higher productivity have caused mining of soil nutrient reserves leading to depletion of soil fertility and emergence of multi nutrient deficiencies of macro and micro nutrients. Non-judicious use of fertilizers and dumping of municipal and industrial wastes containing heavy metals in soils is posing a serious challenge to soil health and water quality. In order to address these challenges, there is a need for concerted efforts to improve nutrient use efficiency and improve soil health through a combination of measures.

6.7.2 Integrated nutrient management systems need to be refined and promoted under different cropping systems to improve nutrient use efficiency and maintaining good soil health. At the present level of productivity and cropping intensity

available organic manures in the State cannot meet the full nutrient requirements of the crops. The balanced and conjunctive use of biomass, organic and in-organic fertilizers, bio-inoculants and bio-fertilizers, farm yard manure, vermi-compost, and green manuring should be promoted. The invigorated emphasis should be laid on soil testing and the soil health cards should be prepared for every farmer in the State in a time bound manner indicating the status of macro and micro nutrients as well as chemical properties of the soils to help guide the farmers in application of organic, inorganic and bio-fertilizers in a judicious and balanced manner. The reclamation of degraded and fallow lands along the rivers should be taken up to optimize their productive use. A legume crop should be incorporated in rice-wheat and maize-wheat system to improve the soil health. Berseem, a legume should be rotated with a view to cover new plots every year. Use of equipment for in-situ management viz. happy seeders, rotavators, straw-choppers etc. should be encouraged to re-cycle paddy straw to enhance soil fertility. Likewise paddy straw should be baled and used for power generation. A legislation for Management of Crop Residues should be enacted to check their burning to save the environment and improve soil fertility.

6.7.3 Organic farming should be encouraged to the extent of availability of organic manure. Production technologies should be developed for meeting the organic standards. Necessary certification facilities need to be provided by the government. Awareness among the farmers and consumers about benefits of organic products should be created.

6.8 Integrated Pest Management

6.8.1 Insects and diseases cause heavy losses to field crops. Intensive agricultural practices and monoculture have led to an aggravation of insect-pest problems. New and less known insect-pest species and diseases have emerged. Besides, changing climate and sowing of non-descript varieties/hybrids have led to new pests and diseases. For effective management of emerging insect and disease problems, there is a need to generate basic and applied information for developing sustainable pest management programmes.

6.8.2 Insect and disease surveillance should be streamlined and strengthened for timely action to reduce/avoid losses to crops. Integrated pest management modules should be promoted for all the major crops for need-based and judicious application of pesticides. There is a need to ensure quality of pesticides. Bio-diversity among insect species and micro-organisms should be studied to find out beneficial insects and microbes for use as bio-control agents in different crops and propagated.

6.8.3 To reduce the pesticide use, it is necessary to identify the high pesticide using areas by analyzing farm gate samples of vegetables, basmati rice, fruits and other crops for pesticide residues. To minimize the build-up of pesticide residues and to keep the same within scientifically acceptable limits appropriate strategies should be developed and monitored. The judicious use of chemicals and bio-pesticides needs to be propagated. The pre-harvest intervals / waiting periods for commonly used and new pesticides should be worked out and the safety limits determined. The farmers should be accordingly educated to follow such recommendations for the produce to be within the pesticide safety limits. A state-of-the-art laboratory should be established in the State for residue analysis of pesticides and heavy metals in the crop produce.

6.9 Environmental Pollution

6.9.1 Burning of residues of paddy and other crops is causing serious environmental problems. A legislation for Management of Crop Residues should be enacted to check their burning. About 18 million tons of paddy straw is estimated to be burnt every year. A number of steps needs to be taken simultaneously viz. sowing of wheat in standing stubbles with the use of Happy Seeders, incorporating straw in the soil with the help of Rotavators and Shredders etc., baling of straw for use in production of bio-energy, ethanol, methane for power generation etc. For this purpose, specific guidelines be prepared for funding and their adoption by individuals and cooperatives.

6.9.2 Indiscriminate use of pesticides is also a cause of concern particularly when these are sprayed on fresh consumable crops. Besides, residues are serious health hazards. These should be checked through Insect Pest Management.

6.10 Farm Mechanization

6.10.1 Due to intensive agriculture and short window of time available between harvesting of one crop and sowing of the next, and shortage of labour, farm machinery is crucial for timeliness and precision in farm operations. Increase in cropping intensity, change in cropping pattern, use of high yielding varieties, good cultivation practices, etc. demand mechanization of field operations at affordable cost. Water saving, cost-effective and yield promoting farm machinery has already been introduced and made available to the farmers on custom hiring basis through cooperatives (**Annexure-IV**). Entire state should be covered by establishing such Agro Service Centres; one each for a cluster of 4-5 villages.

6.10.2 Suitable machinery is not available in Punjab for rice transplanting, sugarcane harvesting, cotton picking and cultivation of vegetable and horticultural crops. Labour shortage is increasing and farmers are facing problems for timely operations. Such machinery should be introduced/developed and promoted. Burning of residues of paddy and other crops is causing serious environmental problems. Available machinery where necessary should be improved to suit the local conditions and promoted for management of crop residues. Retention of crop residues in the field will improve soil organic matter, reduce micro-nutrient deficiency and also increase the water retention capacity of the soil.

6.10.3 Mechanization of dairy operations should be accorded high priority to improve the rural economy. Dairy Machinery Service Centres should be set up for providing costly machinery for fodder sowing, harvesting and silage/hay making to the dairy farmers on custom-hiring basis.

6.10.4 For economical repair and maintenance, the quality up-gradation and standardization of available equipments should be ensured. For this purpose, the State should lay down the specifications of various implements and ensure their production as per specifications.

6.11 Horticultural Development

6.11.1 Horticulture should get high priority to improve farm economy and promote crop diversification. Protected cultivation of vegetables under low cost net houses has been introduced. **(Annexure-V)**. Protected cultivation ensures better quality of vegetables with pesticides residue within the prescribed limits, higher prices and higher yield through advancing the maturity and increasing the fruiting and marketing span. The net-house technology needs to be further improved and extended on a large scale. The objective should be to cover as large a population of small farmers as possible.

6.11.2 Peri-urban cultivation of vegetables needs to be promoted. Necessary support infrastructure and incentives for promoting mechanization, processing and export of vegetables such as chilli, onion, potato, garlic, muskmelon, etc. should be provided. There must be a supportive appropriate national trade policy in agriculture for export led diversification.

6.11.3 More emphasis needs to be given to develop and introduce varieties of vegetables and fruits suitable for processing e.g. seedless Kinnow for better juice quality. Daisy Tangerine, a newly recommended tangerine cultivar, needs to be promoted for getting early harvest and varietal diversification in citrus.

6.11.4 Kandi area is more suitable for horticulture crops. Special efforts should be made to develop this area as a horticulture belt for fruits like Amla, Guava and Kinnow. Kandi area also needs to be developed for organic farming of horticultural and other crops.

6.11.5 For better fertilizer response, irrigation and fertigation schedules technology with drip irrigation needs to be standardized and promoted for horticultural crops both for protected and open field cultivation.

6.11.6 Work on root stocks of different fruits need to be strengthened for tolerance to biotic and abiotic stresses. It is also recommended that floriculture be

developed around the cities where there is demand for flowers. More flower varieties need to be developed for cultivation during summer season.

6.11.7 For ensuring marketing of vegetables and fruits, establishment of collection Centres for horticultural produce with facilities like washing, grading, packaging and cooling should be encouraged through public-private participation. A mechanism for expeditious glut clearance of fruits and vegetables either due to additional area under the crop and/or nature's bounties should be put in place. Efforts should be made to ensure faster movement of such commodities to various parts of the country through express trains with cold storage facilities. Agro-processing needs a high priority and an enabling environment for creation of infrastructure and attracting investment is necessary.

6.12 Supply of Quality Seeds and Planting Material

6.12.1 Quality seed and planting material is essential 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. Accordingly the total availability of breeder seed, foundation seed and certified seed needs to be determined and produced. Creation of adequate infrastructure and institutions for supply of enough quality seeds by strengthening the Punjab State Seeds Corporation (PUNSEED) and Seed Certification Authority for effective delivery of quality seed at farm gate should receive top priority. Seed testing laboratories in the State should be strengthened and equipped with modern equipments for testing of Genetically Modified (GM) crops and fingerprinting of Deoxyribose Nucleic Acid (DNA) for checking quality of seeds. The role of the private sector in strengthening seed production of the high yielding varieties/hybrids developed by it and PAU need to be expanded in Public Private Partnership (PPP) mode.

6.12.2 Production and availability of disease-free planting material through conventional and tissue culture techniques, especially of vegetatively propagated crops,

need to be emphasized and infrastructure for this purpose should be created. Since Phytophthora foot rot is causing heavy losses to citrus plantation, research to identify resistant root stock should be strengthened.

6.12.3 The fodder seed production should be accorded a high priority in view of importance of green fodder in improving the milk productivity and reducing cost of milk production. The Department of Agriculture should be entrusted with the work of fodder seed production as part of crop rotation at seed farms. A proper seed multiplication system for fodder crops should also be put in place.

6.13 Farm Forestry

6.13.1 At present the country and the State is deficit in timber, paper, newsprint and wood based products and meets its demand by imports. This shortage may persist in future also. Agro forestry in Punjab can be taken up successfully and economically, particularly in the foot hills (Kandi area) and 'bet' areas of the State, to meet this demand and also achieve long term sustainability and diversification of agriculture. The State has comparative advantage in timber and biomass production. High yielding disease resistant clones of Eucalyptus and Poplars are now available. However, planned and integrated development of farm forestry and wood based industries and positive policy framework for large scale investments are pre-requisites for exploiting the potential. The potential and needs are large.

6.13.2 Tissue culture technology and cloning techniques have successfully shortened maturity of some tree species and thus increased their profitability. Coordinated efforts should be made to produce quality planting material, planting technologies and development of wood industry. It should be possible to plant 0.4 lakh ha annually with harvest cycle of 5-6 years so as to cover about 2-2.5 lakh ha. A fairly high-yielding wheat crop in rabi can be inter-cropped successfully in poplar plantations. The regulation of local timber marketing is also necessary for the growth of agro forestry. The State should develop 4-5 modern timber markets in the State with latest infrastructure for drying, seasoning and saw mills which the farmers or their groups could use and make their value-added products.

6.14 Post-harvest Handling and Value Addition

6.14.1 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.

6.14.2 The existing system of fruit and vegetables marketing has failed to provide remunerative price to the producers and a fair price to consumers as it is dominated by a long chain of middle men. To ensure remunerative prices of vegetables to the farmers, a marketing chain starting from pre-cooling at the farm level and refrigerated transport to the quick freezing facilities should be set up. The facilities for cleaning, grading, packaging and quick freezing should be created as the essential part of the vegetable collection centres. Such centres should be established by farmers' marketing cooperatives for which capital assistance should be provided by the Government. These can also be set-up in partnership with farmers group/ cooperatives/large retail chains.

6.14.3 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.

6.15 Agricultural Marketing

6.15.1 The State has a vast net work of regulated markets covered under the Agriculture Produce Market Committee (APMC) Act. The annual market arrivals consist of more than 33 million tonnes of food grains and non-food grains in the State. The

procurement of wheat and paddy can be termed as satisfactory, but the marketing of fruits, vegetables, maize and basmati rice pose many problems as stated earlier particularly the lack of required infrastructure for perishables, long chain of middlemen, low price received by the producers and higher prices paid by the consumers and collusion/exploitation by the exporters.

6.15.2 The APMC Act should be amended to provide for direct marketing by farmers and development of private markets to create an enabling environment for increased investment and to provide farmers the alternative options. Farmers are assured of marketing and prices in case of wheat and paddy. However, there are no such arrangements for other crops namely maize, pulses, oil seeds, vegetables and fruits. These are the crops which are proposed for diversification and part replacement of paddy area for long term sustainability. Therefore, competitive/optional marketing facilities are necessary. The product specific markets, e.g. for maize, basmati, potatoes, chillies, flowers, milk products should be developed to facilitate the handling of produce and its aggregation for purchasers. Producer's markets on the lines of Apni Mandi / Cooperative Markets should be encouraged in all the major towns of the State. A regulatory mechanism should be set-up for regulation and efficient operation of public and private markets.

6.15.3 Contract farming as a means for providing ensured market to the producers should be encouraged by making the mutual contracts enforceable. The APMC Act amendment should have provisions for Contract Farming or a separate Contract Farming Act should be legislated to ensure smooth execution of contract between the contracting farmers and the contractor.

6.15.4 Due to lack of sufficient storage, a large quantity of stored wheat and rice is damaged by insects and rain, etc. Major thrust needs to be laid on construction of modern / scientific storage facilities for food grains particularly silos in Public Sector or in PPP model. Such silos should be declared as purchase Centres.

6.15.5 The Agreement on Agriculture of WTO can cause serious ripples in market prices of agricultural commodities including dairy products. To safeguard the interests of farmers a Centres for market intelligence needs to be set up to explore the domestic and international markets and advise the State and the farmers accordingly.

6.15.6 Ensured marketing for crops substituting paddy is essential. Currently, MSP is fixed for such crops but the arrangements for procurement are lacking. The state agencies viz. Markfed, Punsup, PAFC, Punjab Warehousing Corporation, Pungrain should be allocated specific areas for procurement of alternative crops. These agencies should make arrangement for marketing of these products. The losses incurred, if any, should be made good by the state. For this purpose, the State should set up a Price Stabilization Fund of Rs.2500 crore. The State Government may approach Government of India for one time assistance to set up proposed Corpus Fund.

6.15.7 Punjab, being a land-locked area, becomes uncompetitive to export its agricultural surpluses to other countries due to high transportation costs to sea ports. The freight subsidy to export agricultural produce through sea routes should be given to the farmers to improve its competitiveness in the international markets. Efforts should be made to expand the cereal trade also with Pakistan through Wagha border. The tax structure should be reviewed and rates of taxation should be structured to make local products competitive both in domestic and international markets.

7. The Livestock Sector

7.1 Livestock, in addition to yielding regular income, also provides house hold nutritional security, more employment to small and marginal rural households. Growth in livestock sector is demand driven in view of increase in income, rapid increase in consumption of animal food products, a fast-growing urban population, burgeoning middle-income class and changing lifestyles. For meeting the ever increasing demand for livestock products, a sustained growth rate in excess of 5 per cent per annum as

against 3.7 per cent at present would be essential. This, however, would require addressing challenges of effective breed improvement programs, high reproductive disorders, shortage of fodder and quality feed and occurrence of some deadly diseases. Livestock farming is now gradually moving out from part-time farm production to specialized farming. Appropriate incentives to encourage farmers to adopt livestock farming, especially dairying as an independent entrepreneurship need to be provided. A systematic planning and development of various segments like breeding, input delivery, procurement of livestock produce, processing, value addition, marketing and extension services need to be put in place to achieve the target growth rates.

7.2 Development of Dairy Sector

7.2.1 Although, the number of dairy animals in the State has come down over time and the milk production has increased, still there is vast potential for increasing the productivity of milch animals. According to Livestock census of 2007, there are about 39 lakh milk producing animals – 29 lakh buffaloes and 10 lakh cows in the state. Most of the farmers rear about 2-3 milch animals. This practice of rearing a few animals in the mixed farming system is not a commercial venture but will continue for meeting the domestic milk consumption and also for sale of some quantity to meet their day to day financial needs. As such dairy based farming system both at large and small scale need to be promoted to improve the livelihood in rural areas.

7.2.2 To develop dairy farming as a profitable venture, large dairy farms with high yielding cross bred cows, Sahiwal cows, Murrah and Nili Ravi buffaloes should be set up and the farmers should be trained for the management of these farms. They should also be assisted to meet part of the capital investment. The rate of expansion in large dairy farms, however, will be subject to the availability of high yielding milch animals of above breeds. **(Annexure-VI)**.

7.2.3 Majority of the farmers and landless agricultural labourers will continue to keep 2-3 milch animals. Efforts should be made to promote rearing of milch animals

with improved milk yield by implementing an intensive programme of breed improvement. Currently 200 Integrated Breed Development Centres (IBDCs) have been set up covering about 1600 villages. **(Annexure-VI)**. The results are very satisfactory and the entire State should be covered for providing better Artificial Insemination services at the door step of the farmers. This programme of genetic improvement will have to be a regular activity, with a system set up for its monitoring and coordination. Trained and experienced Lay Inseminators should be encouraged to adopt this activity as a full time vocation.

7.2.4 For inclusive growth of livestock sector, the following supportive measures should be taken:

(i) Conservation and genetic improvement: Effective breed improvement programs should be put in place and semen banks strengthened so as to make available about 60 lakh semen doses annually (32 lakh for buffalo and 28 lakh for cows) of quality semen for crossbred cows, Sahiwal cows, Murrah and Nili Ravi buffaloes. The high quality semen including sexed semen should be imported as per needs. Embryo transfer and other associated technologies should be made an integral part of breed improvement program. Some natural service will continue in villages to some extent. So a scientific programme for providing disease free high yield bulls in the villages should be launched. All the breeding programmes should be implemented strictly in accordance with the existing breeding policy of the State.

(ii) Development of veterinary care services: Existing facilities of veterinary dispensaries, hospitals and veterinary staff should be strengthened. Thrust needs to be given to create Mobile Veterinary Units, at least one in each district for doorstep delivery of services. Three state of the art disease diagnostic laboratories, at least one in each region, need to be established to provide accurate disease diagnosis and to control and eradicate diseases. Vaccination for H.S. and Foot and Mouth disease should be made mandatory in order to prevent the incidence of these diseases.

(iii) Development of feed and fodder: Though feed and fodder is one of the most important and critical input to improve productivity, its development has not received required focus. There should be research focusing on developing new high-yielding fodder varieties, which are also more nutritious. Conserving fodder by making silage should receive priority to provide nutritious feed during the lean period and to cut down cost on concentrate feed. Issues of cattle feed safety and quality need to be addressed through strengthening laboratory support, supervisory mechanisms and legal framework. The state needs to be mapped for mineral status, if not already done and area specific mineral deficiencies so as to take up the corrective steps to address the mineral deficiency which affects significantly both reproduction and production of livestock.

(iv) Quality control of milk and milk products: An awareness campaign among the stakeholders on food safety and quality aspects of milk and milk products should be started. The well equipped state quality control laboratories with mobile vans should be put in place to check quality of milk and milk products.

(v) Strengthening of milk cooperatives: Increased milk production through technological interventions shall necessitate assured marketing of milk and value added milk products. A programme to enhance capacity and technological up-gradation of milk plants in cooperative sector should be taken up to increase milk procurement, reduce cost of processing and produce high value added products in organized sector. Export potential of traditional milk products need to be exploited using improved production technologies and following the International quality standards.

7.3 Fish Farming

7.3.1 The fish output in Punjab is from inland fisheries consisting 70 % from aquaculture and 30% from capture sector. The aquaculture productivity is about 6 tonnes/ha/year and is the highest among the States, but there is still further scope to

raise it. Both quality seed and feed are critical inputs to raise productivity. New hatcheries should be established to produce required quality fish seed and make it available at affordable prices. The electricity charges for tube-wells installed at fish farms should be at par with those used for crop cultivation. New technologies for reduction of feed cost by incorporating aquatic plants (*azolla*, duck weed) in fish feed should be propagated.

7.3.2 For extension of Fish Farming particularly in water logged and salinity affected area farmers should be provided assistance for digging fish ponds. To meet the demand of seedlings, two new Fish Seed Farms at Mukatsar and Fazilka need to be developed with annual production capacity of 50 lakh seedlings at each farm during 12th Five Year Plan.

7.3.3 Fish markets with facilities for storage and value addition, cold chain network should be established along with an environmental friendly waste management plant for converting fish waste into fish meal and oil.

7.3.4 Poultry Farming

Poultry has been developed as a full fledged industry in the State. However, there is further scope for its expansion by establishing new poultry units especially broiler units and processing plants. Emphasis should be laid on the promotion of rural backyard poultry and other species of poultry for supplementing the income of farmers and making available poultry products in the rural areas also. Financial assistance should be given to such units.

7.3.5 Pig Rearing

Pig rearing offers a good scope to supplement income of small farmers. To strengthen pig rearing, financial assistance and latest technical know how should be provided to the farmers for establishing commercial pig farms. Pork processing industry needs to be encouraged for providing remunerative market to the pig farmers in the State.

7.3.6 Goat Rearing

Goat rearing offers an excellent opportunity for small farmers to improve their income because very low investment is needed to set up a goat farm and it can be started as a back yard activity also. Goats are prolific breeders and achieve maturity at the age of 10-12 months. Goat meat is in great demand and is sold at a very high price. At present the goat population in the State is about 2.75 lakhs and main concentration is in Sangrur, Muktsar, Amritsar, Ludhiana, Bathinda, Jalandhar and Ferozepur districts. The steps should be taken to provide technical and financial assistance to farmers in setting up goat farms for hygienic production and distribution of goat meat.

8. Institutional Framework

8.1 Land Tenancy and Acquisition Laws

8.1.1 The Land Tenancy Act should be suitably amended for legally providing land on lease for cultivation to increase the size of operational holdings and its automatic resumption to the legal owners on the expiry of agreed lease period. A legislation should be enacted for recognizing the rights of tenants and share croppers as 'licensed cultivators' to enable them an easy access to short term institutional credit, subsidies and compensation in case of crops failure due to drought, hail-storm etc.. However, the Land Tenancy Act shall be applicable to all tenants.

8.1.2 An appropriate land acquisition policy should be prepared keeping in view the livelihood security of the farmer and in the interest of economic development. Unless un-avoidable, fertile agricultural land should not be acquired. Before their actual alienation from land, a system should be developed whereby regular income of the farmers is ensured. The time lag between land acquisition and payment of compensation should be minimized. The farmers and the other affected people should get an equity share or some other kind of partnership in the proposed project. In case of housing projects, adequate number of plots both residential and commercial should be earmarked for affected families. The acquired land should be used only for the purpose for which it has been acquired.

8.2 Research Infrastructure

8.2.1 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. Therefore, long term financial planning will be essential. Adequate staff qualified in various research disciplines of agriculture and livestock is another limitation with research institutes. There is a dire need for capacity building of research scientists through regular training at the national and international institutes of repute.

8.2.2 In view of the importance and role of research, the State should ensure adequate budgetary support to both PAU and GADVASU for strengthening and restructuring their research programmes, to meet the urgent and anticipated future needs.

8.2.3 In addition to the normal budget provision both by the State and the Government of India, the users of technology should bear a part of the cost of technology development. An Agricultural/Livestock Research Development Fund should be created by levying a cess on producers @ 0.25 per cent of the value of market arrival of wheat, paddy and cotton and on milk procured by dairy plants/milk procurement agencies. A Research Programme Committee under an eminent Agricultural / Livestock scientist and having scientists and farmers' representatives as members should be constituted for approving the Research Projects out of the Agricultural/Livestock Research Development Fund. The committee should review the progress and bottlenecks if any, annually.

8.2.4 Two Centres of Excellence for strengthening research, one each on soybean and pulses should be created in the Punjab Agricultural University, Ludhiana for which adequate staff and research facilities should be provided either in contract basis or in participation in developing suitable varieties of soybean and pulses.

8.3 Extension Services

8.3.1 The delivery of technology package generated by the University/Institute 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 should be prepared and necessary funds provided.

The extension services in the crop sector including horticulture have not kept pace with the knowledge needs of the farmers and in the livestock sector the extension services are almost missing. Obviously there is a need to revitalize the extension services to meet the requirements of every single client i.e. farmer. The endeavour should be 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.

8.3.2 Strength of Extension staff of Agriculture, Horticulture, Soil Conservation, departments should be determined to meet the specific needs of each region and crops/fruit plants. Currently, the extension staff of the departments of Agriculture, Animal Husbandry and Dairy Development is highly inadequate both in terms of numbers and subject matters (Agriculture, horticulture, soil conservation, livestock management). Even against the sanctioned cadre strength of these departments, at present there are a large number of vacancies. Until the required staff strength is determined, all currently vacant positions must be filled.

For regulatory work with regard to enforcement of quality standards of seeds, pesticides and fertilizers, one officer per development block should be designated. The officer should also assist the functioning of the office at block level.

8.3.3 Extension services are also provided by private companies but their major object is to promote their own products. Thus Public-Private-Partnership (PPP) in the delivery of services should be promoted for convergence and sharing of resources. However, the related department should have a regulatory authority for effective coordination and determination of deliverables in a particular sub-sector and region.

8.3.4 Restructuring of the Departments of Dairy Development, Animal Husbandry and Milkfed should be carried out on priority. In view of the importance of livestock sector in the overall economy of the State and of individual farmers, extension services in the livestock sector need to be strengthened through building up an exclusive cadre of livestock extension specialists, establishment of livestock dedicated KVKs and strengthening ATMA with animal husbandry experts. Public- Private- Partnership (PPP) in the delivery of services should be promoted for convergence and sharing of resources.

8.3.5 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. There should be annual meet to review the previously recommended technology and for approval of the same for the next year with modifications if any, recommended by the Research Scientists.

8.3.6 The information technology system should also be used progressively for improving the knowledge of extension functionaries as well as delivery to the farmers effectively. The State Agricultural University should start a dedicated agricultural channel in collaboration with the line departments for dissemination of knowledge.

8.3.7 Documentation of traditional knowledge with regard to agriculture and animal husbandry practices followed by the farmers should be taken up and those found superior than the current practices should be propagated.

8.4 Agricultural Credit

8.4.1 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. Major source of agriculture credit is cooperatives. 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.

8.4.2 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.

8.4.3 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.

8.5 Development of Skills for Off-farm Employment

8.5.1. The major agrarian issue in Punjab is "how to improve small farm economy" i.e. the economic viability of more than 3 lakh (out of about 10 lakh) operational 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 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. The state should provide stipends to get training in the required trades. Simultaneously, the new industrial units in the rural areas should be encouraged and mandated to recruit persons from the surrounding rural areas.

8.5.2 Empowerment of farm women: Farm women play an important role in agricultural sector. Special courses should be organized for training in milch cattle management, preservation of seed, allied farm activities such as bee keeping, mushroom production etc. They should be organized into Self-Help groups to prepare and process farm based products such as achar, murabas, milk products etc. according to specified standards of quality. A special wing be created in the Punjab Agro Industries Corporation with sole objective of encouraging formation of such groups and their training including quality standards.

8.6 Administrative Co-ordination and Monitoring

8.6.1 To usher in the second green revolution in the State, the policy-module suggested includes pushing up the capital formation, improving the infrastructures, restructuring the incentives towards water-saving and high-value alternatives and streamlining the institutions. The Agriculture sector comprises diverse activities covering Animal Husbandry, Dairy Development, Crop sector, Horticulture, Fisheries, Poultry, Soil Conservation, Cooperation for credit and marketing , State Marketing Infrastructure etc. These activities need proper planning and timely, rather simultaneous executions. The co-ordination of such activities becomes essential. Therefore, a position senior to the Principal Secretaries of various concerned departments should be created for coordinated implementation of various programmes of the Agricultural Sector.

Summary and Recommendations

The Punjab State made an outstanding progress in agriculture and contributed extensively to the food security of the country. Over the time, serious problems have arisen and at present there is stagnation in growth, decline in real farm income and over-exploitation of soil and water resources. The very sustainability of the current cropping system is under threat. This Policy paper has been prepared to suggest the measures to overcome these problems. Major thrust areas of the policy are:

- i encouraging the optimal use of natural resources for long term sustainability of agriculture;
- ii enhancing the productivity of crops and live-stocks through strengthening research, public and private investments and development programmes;
- iii improving the economy of farmers;
- iv encouraging the cultivation and addressing the problems of high value crops;
- v addressing the constraints through restructuring of the incentives, market orientation, credit delivery system and value-addition to produce both at village level and industrial scale; and
- vi restructuring of various development departments for coordinated implementation of various development programmes.

The major recommendations are as under:-

A Sustainability-Diversification

- 1 Area under paddy should be restricted to 16 lakh hectares for maintaining the ground water balance. The remaining 12 lakh hectare, out of 20 lakh hectares currently under paddy, should be diverted to other crops viz. maize, pulses, soybean, cotton, sugarcane, fruit and vegetables etc.
- 2 Procurement of alternate crops at MSP should be ensured. Currently, MSP is fixed for such crops but arrangements for procurement are lacking. The State agencies should be entrusted with their procurement and disposal. The losses, if any, incurred in this process may be met out of a Corpus viz. Price

- Support Operation Fund of Rs.5000 crore, created over a period of five years with financial assistance of Government of India.
- 3 To increase the demand for maize, its processing for ethanol should be encouraged. To start with, one ethanol production plant should be set up either by the PSIDC, PAIC or Markfed.
 - 4 Kharif pulses and soybean are other important crops for replacing paddy and also for improving soil fertility. Once varieties of these crops, which are economically competitive to paddy, are available, these should be encouraged on large scale.
 - 5 Area under fruits and vegetables should be extended both for diversification and improving farmers' income. More emphasis needs to be given to develop suitable varieties of vegetables for protective cultivation, and fruits for higher yield and processing e.g. seedless Kinnow for better juice quality. Work on root stocks of different fruits need to be strengthened for tolerance to biotic and abiotic stresses.
 - 6 The productivity of the existing area under fruits should be increased by imparting training and timely advice to farmers for various operations. Modern machinery necessary for pruning, spraying and inter culture should be arranged and supplied on custom hiring basis.
 - 7 Special efforts should be made to develop Kandi area as a horticulture belt for fruits like Amla, Galgal & Kinnow and organic farming.
 - 8 Planned and integrated development of farm forestry and wood based industries and positive policy framework for large scale investments are prerequisites for exploiting the potential. The regulation of local timber marketing is necessary. The State should develop 4-5 modern timber markets in the State with latest infrastructure for drying, seasoning and saw mills which the farmers or their groups could use and make value-added products.
 - 9 Specific programmes to promote organic farming should be taken up. Necessary facility for certifying the produce should be created.

B Soil and Water Conservation

- 1 Major thrust should be given to rational utilization and conservation of water resources. The modernization of Canal Regulation System and rehabilitation of natural water bodies should be given priority. A "Water Resources Regulatory Authority" should be set up to promote and regulate the optimum use of surface and ground water.
- 2 Efficient on-farm water management should be promoted to conserve water at field level by lining field channels and promoting cost-effective water-saving technologies such as laser leveling, drip irrigation systems, bed planting of maize and sugarcane and direct sowing of paddy etc.
- 3 Conservation through construction of water harvesting structures in Kandi area on watershed basis should receive special attention.
- 4 For improving power and water use efficiently, power supply should be metered and charged beyond a fixed level of free supply. The subsidy so saved should be used for Agricultural Research & Development and skill development for rural unemployed.

C Soil Health

- 1 Soil health cards should be prepared for every farmer in the State indicating the status of macro and micro nutrients as well as chemical properties of the soils for judicious and balanced application of organic, inorganic and bio-fertilizers.
- 2 For higher fertilizer response, fertigation technology with drip irrigation needs to be promoted for horticultural crops both for protected and open field cultivation.

D Plant Protection

- 1 Insect and disease surveillance should be streamlined for timely action to reduce/avoid losses to crops. Integrated pest management modules should

- be developed and promoted for all the major crops for need-based application of pesticides.
- 2 A state-of-the-art laboratory should be established for residue analysis of pesticides and heavy metals in the crop produce. Supply of quality pesticides to the farmers should be ensured.

E Dairy Development

- 1 For promoting dairy farming, the farmers need to be trained and assisted to meet a part of the capital investment to establish commercial dairy farms of high-yielding cross bred cows, Sahiwal cows, Murrah and Nilli Ravi buffaloes.
- 2 Current situation where 2-3 milch animals are kept to meet the milk requirement of the family and a small surplus for sale to meet the day to day financial needs will continue. To improve the income of farmers, the milk yield of the milch animals which is currently very low should be increased. The existing programme of breed improvement through Integrated Breed Development Centres should be extended to cover the entire State.
- 3 The current annual semen production at semen banks in the State is about 40 lakh doses needs to be enhanced to at least 60 lakh doses; 28 lakh for cows and 32 for buffaloes during the 12th Five Year Plan. It should also be ensured that the milk yield potential of buffalo and cow semen is at least 4000 litres and 7000 litres per lactation respectively.
- 4 To improve the female calves ratio and milk production at least 1 lakh doses of sexed semen should be imported annually both by the Public and Private sector.
- 5 Rearing calves particularly of high yielding buffaloes should be encouraged.
- 6 High pedigree young buffalo bulls should replace the scrub bulls for natural service in the villages at regular intervals till 100% coverage with AI is achieved.
- 7 Silage is necessary for uniform supply of feed throughout the year. For its popularization and adoption amongst dairy farmers having 20-30 milch animals, capital assistance should be provided for constructing silo towers.

Dairy Machinery Service Centres should be set up for providing machinery for harvesting and silage /hay making on custom hiring basis.

- 8 The rate of interest for dairy farmers should be same as applicable to agriculture both in case of term loan and working capital. The recovery period for term loan of dairy farming should be rescheduled to 10 years from existing 5-7 years.

F Veterinary Care

- 1 At least one Mobile Veterinary Unit to provide animal health care at the farmers door step should be set-up in each sub-division.
- 2 Currently there is only one disease diagnostic laboratory in the State. Three more state-of-the-art disease diagnostic laboratories should be set up.
- 3 Vaccination of Foot and Mouth disease (FMD) and H.S. should be made mandatory to treat every source of infection.
- 4 Prevalence of Brucellosis disease in milch animals is cause of concern. With a view to effectively control this disease, the vaccination of female calves, non-pregnant and non-lactating adults with the approved vaccine should be taken up on a large scale.

G Milk Marketing and Processing

- 1 Milk plants in the cooperative sector should be modernized and their handling capacity be enhanced to reduce the cost of processing and also to produce high value added dairy products.
- 2 Milk Price Stabilization Fund should be created in Milkfed Punjab to insulate the milk producers from variation in the prices both in domestic and international market.

H Fish Farming

- 1 For extension of fish farming, particularly in water logged and salinity affected areas, farmers should be provided assistance to dig fish ponds. To meet the demand of seedlings, two new Fish Seed Farms at Muktsar and

Fazilka need to be developed each with an annual capacity to produce 50 lakh seedlings.

- 2 The fish and meat markets with storage facilities, value addition and cold chain network should be established along with an environmental friendly waste management plant for converting fish waste into fish meal and oil.

I Poultry, Piggery and Goat Farming

- 1 Financial assistance should be provided to small farmers to set up rural backyard poultry and other species of poultry.
- 2 Technical and financial assistance should be provided to farmers for establishing commercial farms of small ruminants like pigs, goats etc. Pork/meat processing industry in the State needs to be encouraged to provide a remunerative market to the pig/goat farmers.

J Improving Farmers' Income

- 1 To improve farm economy, the farmers have to be assisted to adopt high value crops, namely vegetables and fruits, take up commercial dairy farming, fish, poultry, pig and goat farming and improve milk yield of existing milch animals. Necessary marketing facilities must be created.
- 2 The low cost net houses technology for cultivation of vegetables, which improves quality and productivity of vegetables and increases the income, needs to be further improved and extended on a large scale to cover as large a proportion of small farmers as possible.
- 3 Small farmers remain under employed/ unemployed for most of the time and must be given some skill training to ensure off-farm employment.

K Farm Mechanization

- 1 Labour availability and its cost are posing serious problems. Suitable machinery for rice transplanting, sugarcane harvesting, cotton picking and mechanization of cultivation of vegetable and horticulture plants should be introduced/developed and promoted.

- 2 Farmers should be assisted to reduce their capital investment particularly in agricultural machinery. Agro Service Centres should be established to supply water saving, cost-effective and yield enhancing farm machinery on custom hiring basis. This programme should be extended to cover the entire State.
- 3 Incentives for promoting mechanization, processing and export of vegetables such as chilli, onion, potato, garlic, muskmelon, etc. should be provided at village level.

L Marketing

- 1 To provide competitive alternate option to farmers to market their produce, the APMC Act should be amended. The amendment should have provisions for setting up private markets and contract farming.
- 2 20 specific Maize Market Yards equipped with maize drying facility should be set up. To start with, maize drying facilities should be set up immediately at least in three markets.
- 3 Producers' markets on the lines of Apni Mandi should be encouraged in all the major towns of the State.
- 4 Modern marketing facilities for fruit and vegetables be created to serve the additional area under fruit and vegetables. Capital assistance for creating marketing chain starting from pre-cooling at the farm level and refrigerated transport to the quick freezing facilities should be provided by the Government. At least one such centres may be created in each district during the current Five Year Plan. These may be set-up by the farmers' groups in partnership with cooperatives/ large retail chains.
- 5 The state tax structure should be reviewed to make the agro-industrial units more competitive for processing the state produce for value addition.
- 6 Major thrust needs to be laid on construction of modern / scientific storage facilities for food grains particularly silos in Public or Private Sector or in PPP mode. Such silos should be declared as purchase centres.
- 7 Efforts should be made to expand the cereal trade also to Pakistan through Wagha Border.

- 8 Seed testing laboratories in the State should be strengthened and equipped for testing of GM crops and DNA fingerprinting etc. The role of the private sector in strengthening seed production of the high yielding varieties / hybrids developed by it and PAU needs to be expanded PPP mode.

M Technology Development

- 1 Research priorities and mandates of PAU and GADVASU need to be re-examined. The main thrust should be on breeding of crop varieties requiring less water and which are resistant/tolerant to pests and diseases, with better quality, tolerance to biotic and abiotic stresses, high nutritional value and suitable for processing. The use of biotechnology should be the hallmark of future breeding programme.
- 2 A clear policy decision should be taken for introduction of genetically modified (GM) crops in the State. The research facilities for development of such crops should be accordingly strengthened.
- 3 A Centres of Excellence for R & D in pulses and soybean should be established. Suitable genetic material may be collected from different countries and bred for higher yield. Private sector should also be involved in developing suitable varieties of soybean and pulses.
- 4 Maize hybrids during the kharif season suffer from pest attack. The research in developing high yielding hybrids of maize which are tolerant to pest attack should be encouraged both in Public and Private sector.
- 5 In view of climatic change special efforts need to be made to develop suitable technology for prediction of extreme weather events such as excessive rainfall in a short period, frost, hailstorms etc. and identify crop genotypes showing tolerance to such extremes.
- 6 Necessary scientific equipment and adequate staff strength in various research disciplines of agriculture and livestock should be maintained. The capacity building of research scientists through regular training at the national and international institutes of repute should be ensured.

- 7 Allocation of funds for research, to both PAU and GADVASU must be increased to give much needed thrust to the development of new technology.
- 8 The users of technology should bear a part of the cost of technology development. In addition to the normal budget provisions an Agricultural Research Development Fund should be created by levying a cess @ 0.25 per cent of the value of market arrival of wheat, paddy and cotton and on milk procured by dairy plants/milk procurement agencies. A Research Programme Committee under an eminent scientist having scientists and farmers' representatives as members should be constituted for approving the Research Projects from the proposed Fund both in crop and livestock sector.

N Institutions

- 1 An appropriate land acquisition policy should be prepared keeping in view the livelihood security of the farmers and economic development of the State. If acquired land is not utilized for the purpose for which it was acquired, it should automatically be reverted to the original owners.
- 2 The Land Tenancy Act should be suitably amended for (i) legally providing land on lease for cultivation and its automatic resumption to the legal owners on the expiry of agreed lease period and (ii) recognizing the rights of tenants and share croppers as 'licensed cultivators' to raise crop loan.
- 3 There is a need to revitalize the extension services and up-gradation of the skills of extension workers. Re-structuring of Agriculture and allied departments should be carried out on priority. An exclusive cadre of livestock extension specialists should be established along with the establishment of livestock dedicated KVKs and strengthening ATMA with animal husbandry experts. Public- Private- Partnership (PPP) in delivery of services should be promoted for convergence and sharing of resources.
- 4 Outreach of institutional credit should be improve to meet the major credit needs of the farmers. The private money lenders should be registered and necessary legal mechanism be created through legislative measures.

- 5 A position senior to the Principal Secretaries of various line Departments of Agriculture sector should be created for coordinated implementation of various programmes.

ANNEXURE-I**CONTRIBUTION OF THE STATE TO THE CENTRAL POOL**

Year	Rice (%)	Wheat (%)
1980-81	45	73
1990-91	41	61
1995-96	35	59
2000-01	33	58
2001-02	33	52
2002-03	50	52
2003-04	39	57
2004-05	37	55
2005-06	32	65
2006-07	31	75
2007-08	28	61
2008-09	25	38
2009-10	35	38
2010-11	30	44

Source: Agriculture at a Glance: Deptt. Of Agriculture, Punjab

ANNEXURE-II**DECLINE OF WATER TABLE IN CENTRAL PUNJAB**

Year	Percent area with depth to water table more than		
	10m	15m	20m
1973	3.7	0.6	0.4
1980	5.7	0.6	0.4
1990	26.7	2.9	0.4
2000	53.2	14.1	0.1
2001	65.7	21.7	1.2
2002	72.7	26.1	4.3
2003	79.9	32.7	5.7
2004	84.6	36.6	12.5
2005	85.4	42.1	14.5
2006	85.5	52.0	19.2
2007	80.4	46.4	26.3
2008	86.5	60.5	32.1
2009	81.9	62.9	34.5
2010	91.6	75.1	50.5

Source: Department of Agriculture, Punjab, Chandigarh

ANNEXURE-III**PROPOSED ALTERNATIVE CROP CHOICES FOR DIVERSIFICATION**

Crop	Current area (lakh ha)	Potential area (lakh ha)	Districts
Rice	28.0	16.0	Amritsar, Gurdaspur, Tarntarn, Ferozepur, Kapurthala
Maize	1.3	5.5	Traditional areas
Cotton	4.8	7.0	South-western districts
Sugarcane	0.7	2.6	Majha and Doaba regions
Guar	-	0.3	South-western districts
Kharif Fodder	4.0	5.5	Throughout the state
Arhar	Negligible	0.6	Central districts
Mungbean	0.2	0.6	Central districts
Kinnow	0.4	0.8	Traditional areas
Guava	0.1	0.2	Hoshiarpur, Ferozepur,
Agroforestry	1.3	3.0	Kandi belt and Central districts (Poplar); South-western districts (Eucalyptus)
Groundnut		0.2	Hoshiarpur, Nawanshahar
Turmeric, chilli, tomato, garlic, Capsicum, Kh. Onion	0.2	0.5	Hoshiarpur, Kapurthala, Jalandhar, Amritsar

Source: Based on historical data of area under various crops, Department of Agriculture, Pb.

COOPERATIVE AGRO SERVICE CENTRES

The 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 the debt burden. Some of the modern technologies need expensive equipment such as laser levelers, ridgers, bed-planters, happy seeders etc. which not only improve water-usage efficiency but yield also. Happy seeders have been introduced, with which the farmers can sow wheat in standing stubbles of paddy and avoid burning. Use of Laser levelers saves lot of irrigation water but it requires a high horse power (expensive) tractor. These equipments are very costly and require to be used only for a limited number of days during the year. Thus, these remain out of the reach of most of the farmers particularly the small/marginal ones. In order to reduce the burden of heavy capital expenditure thereby cutting down the farmers' fixed costs and to promote the adoption of new technology, the Government has assisted to set up the service centres by the Primary Agriculture Cooperative Society (PACS) and private entrepreneurs. The assisted PACS have these implements particularly high power tractors, laser land levelers, happy seeder, ridgers, bed-planters and provide custom-hiring services at fixed prices. So far 1285 such centres have been set up in the State and of these 1025 are with cooperatives (PACS). The cost of such centres is estimated at Rs. 10 lakh and a capital assistance of 33%, subject to a maximum of Rs. 3.30 lakh, is provided by the Government. In addition to the benefit to the small farmers, these centres have improved the economic viability of the PACS. Also, the adoption of such machinery will help improve water usage efficiency, yields of crops as well as help reduce burning of paddy straw and improve environment and soil health in the long run. It is recommended that another 3000 agro service centres be set up with PACS over the next 4 years.

GROWING VEGETABLES UNDER LOW COST NET HOUSES

The cultivation of vegetables under low cost net houses has been demonstrated. This technology minimises the use of pesticides, increases not only the yield but also enhances the quality of produce with pesticide residue within the prescribed limits. Further vegetables are available in the market earlier as well as later in the season when prices are generally higher. The average annual net income from 500 sq. meter (1/8th of an acre) is estimated at Rs.50,000. A set of two will generate net income of about Rs. 1.0 lakh annually. About one thousand net houses have been set up covering all the districts of the State and the farmers are fully convinced about its usefulness.

This technology should be extended on a large scale and aim at covering one lakh small farmers on priority basis. Sufficient funds as capital assistance may be provided under Rashtriya Krishi Vikas Yojna (RKVY)/ National Horticulture Mission and other schemes. This will however, require assured marketing. The existing vegetable growers are close to the city centres but it is necessary to extend the cultivation in other areas. It is proposed that the vegetable collection centres be created in the new areas ultimately covering each block with at least one centres. At these centres there should be facilities of pre-cooling to enhance the shelf life, cleaning and washing, grading and packaging. The produce could be sold locally or outside the state. These centres should be established by Farmers' Marketing Cooperatives for which capital assistance should be provided by the government. These centres can also be set-up in partnership with large retail chains. The private players who are already in the retail market could be invited to set up such collection centres on scientific lines and also provide assistance to the farmers. The farmers however, will have the option to sell their produce anywhere they like.

STRATEGY FOR DEVELOPING DAIRY FARMING

1. Promoting Dairy Farming

In the last three to four years it has been successfully demonstrated that a farmer having 5 acres of irrigated land can keep 20 crossbred cows with an average milk yield potential of at least 4000 liters per lactation. Income from sale of milk and farm-bred female calves is appreciably higher as compared to growing wheat and rice or wheat and cotton in the same area. About 700-800 commercial dairy farms are now being set up annually. It had been experienced that major reasons for low profit of dairy farms of cows was faulty housing, costly loan and insurance and poor management. With the efforts of the State Government, corrective measures have been taken by concerned Departments/Organizations in all these areas. Farmers are now constructing model cattle sheds specially designed for housing crossbred cows, resulting in full exploitation of their milk potential. Training facilities for prospective dairy farmers have been set up in the state. These centres provide 45 days training in management and also for Artificial Insemination. The State government is also assisting farmers who adopt commercial dairy farming by providing incentive of Rs.1.5 lakh on construction of model cattle shed, 50% subsidy on insurance premium for 3 years and bearing full cost of chip inserted in the animals for identification. These measures of the Government have helped to promote the concept of commercial dairy farming to a great extent. The programme needs to be expanded to establish at least 15000 commercial dairy farms by 2020; starting with 1500 in the year 2013-14.

Credit facilities at affordable interest should be provided for capital investment for dairy farming. The repayment schedule for recovery of long term loans for dairy farming should be 10 years with a moratorium of first year and repayment of interest only during the next two years.

2. Enhancing Milk Productivity of Milch Animals

Genetic potential of milch animals needs to be improved by;

(i) Artificial Insemination facilities at the door-step of farmers

The most vital step towards developing dairy sector in the state is to ensure faster genetic improvement for higher milk yield of milch animals, by providing timely facility of Artificial Insemination (A.I.) with the semen of bulls of high genetic potential for milk production at the door steps of the dairy farmers. At present A.I. is not being generally adopted by farmers for breeding buffaloes. Farmers still prefer to avail the natural service of local nondescript bulls. In the case of cows however, use of artificial insemination technology by farmers is progressively increasing. To popularize A.I., following measures are required to be taken immediately;

- Providing A.I. facilities at farmer's door's step;
- Ensuring A.I. facilities on holidays and odd hours;
- Educating farmers regarding merits of A.I. in buffalo improvement;

(ii) Adequate availability of semen doses

There are about 29 lakh breedable buffaloes and 10 lakh breedable cows in the State. Of these about 65% buffaloes (19 lakh) and 70 % cows (7 lakh) require breeding facilities every year. The current annual semen production at semen banks of Animal Husbandry Department and Milkfed is about 40 lakh doses, of which 22 lakh are for cows and 18 lakh for buffaloes. This needs to be enhanced for producing 60 lakh doses; 28 lakh for cows and 32 lakh for buffaloes during the 12th Five Year Plan.

There is a great demand for sexed semen to improve the female calf ratio. At least 1 lakh doses of sexed semen should be imported annually by the Government and private organizations.

(III) Assured quality of semen used for Artificial Insemination

It is necessary that semen used for insemination qualifies the required parameters. For breeding buffaloes, the genetic potential of milk production of bulls should be minimum 4000 liters/lactation and for cows it should be at least 7000 liters /lactation.

(IV) Improving reproductive efficiency of milch animals

To address the problem of infertility and repeat breeding in buffaloes, emphasis should be given to educating the farmers and organizing camps in villages to treat the affected animals.

(V) Replacement of scrub bulls:

Scrub bulls should be replaced in phases by providing high pedigree young bulls to the Panchayats. It is essential to avoid in-breeding/ downgrading of the breed.

(VI) Embryo transfer technology

For faster multiplication of superior germ plasm and for producing quality bulls, the ETT programme should be strengthened.

(VII) Calf rearing programme

Farmers should be encouraged to rear calves of high yielding milch animals, particularly buffaloes to make available high quality male and female stock for breeding purposes.

3. Establishment of Integrated Cattle Breed Improvement Centres

Majority of the farmers in the state keep 2-3 buffalos. Estimated milk yield of these buffaloes is about 1400-1500 liters per lactation. If the milk yield potential of these animals is raised to 3000 liters/ lactation, it will provide appreciable economic

support to the farmers to meet their day to day needs. To achieve this goal, it is necessary to upgrade buffaloes through Artificial Insemination using semen of high milk yielding potential.

Recently, the State Government has set up 200 Integrated Buffalo Development Centres in Kandi, Bet, Border and Water-logged areas for exclusively upgrading breed of buffaloes in these regions by providing Artificial Insemination services at the doorstep of farmers, using high quality semen of bulls with milk production potential of minimum 4000 liters/lactation. Milkfed Punjab has been given the responsibility of implementing the programme. It has engaged two N.G.Os - BAIF and J.K.Trust, to set up, organize and run these centres for 5 years in the proposed areas. At the end of five year project, each such centres shall produce 1000 calves of upgraded milk potential; 50% of which are assumed to be female. The N.G.Os are being paid on the basis of calves born. These NGOs are charging Rs.30/- per AI from the farmers and same is deposited with Milkfed in a designated Fund, which is proposed to be utilized for continuation of the programme once these NGOs move out after completion of 5 year duration of the project.

By adopting this method it has been envisioned that existing milk yield of buffaloes will increase by more than 50% in 4th year and 100% in 8th year of the project. Cross bred cows with same extent of enhanced milk yields shall be available in 3rd and 6th / 7th year of the project.

It is proposed to broad base this programme to cover the entire State for providing AI services at the door steps of the farmers to cover almost 100% of cows and 60% of buffalo population by the year 2017. For this purpose additional 1000 such Centress should be set up during the year 2013-14.

4. Milk Price Stabilization Fund

To ensure remunerative and uniform farm gate milk price to the milk producers, a Milk Price Stabilization Fund should be created in Milkfed Punjab.

5. Registration of High Milk Producing Milch Animals.

This is a long term plan. It is proposed that all buffaloes producing at least 3000 liters and cross bred cows producing at least 5000 liters per lactation should be registered under the Herd Registration Act. The registered animals need to be applied identification mark and their performance data will be scientifically recorded and maintained. This shall go a long way to provide data for Progeny testing and also in identifying bull-mothers to raise male calves for future breeding. This shall also help new entrants to dairy farming venture in procuring good animals at reasonable price.

FOREWORD

The Punjab State achieved an outstanding growth in agriculture, particularly rice and wheat that contributed extensively to the food security of the country. Of-late problems of over-exploitation of natural resources of soil and water have emerged which are a cause of serious concern. There is decline in real farm income and near stagnation in growth. The agriculture in the State is in a crisis and a policy framework which improves the productivity, profitability and sustainability of farming is the only way forward to accelerate the growth.

The Government of Punjab constituted a "Committee for Formulation of State Agriculture Policy" so as to prepare a road map for future agricultural development in the State. The policy paper suggests the measures for encouraging the optimal use of natural resources and improvement in the economy of the farmers. A shift to high value agriculture and a more prominent role of livestock sector are a must but it will require increased investments in R&D and infrastructure. The State has to play a dynamic role in market development.

To prepare this document, the Committee, besides its internal meetings, held discussions with various experts and stakeholders as well as invited their comments on the provisional draft. The Committee benefitted greatly from these wide range of consultations and wishes to thank the participants in these deliberations. The Committee also expresses its appreciation to Dr. B. S. Sidhu, Member Secretary for capturing the spirit of comments and suggestions received from various sources and appropriately incorporating these in this policy paper. I would also like to appreciate the efforts of Consultants and staff of Punjab State Farmers Commission in bringing out this document.

The committee is privileged to submit its report to the State Government and is hopeful that it will be adopted to prepare an action plan for agricultural development in the larger interest of farming community of the State.

March 22, 2013

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