Report-II

Report on
Issues and Options for Agricultural Research and Development in Haryana






Haryana Kisan Ayog
Government of Haryana

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August 25, 2014

Haryana Kisan Ayog
Government of Haryana
Sector-20, Anaj Mandi, Panchkula- 134116

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FOREWORD

Agriculture sector in Haryana is gradually becoming a technologically driven dynamic profession. It is evident from much faster adoption of technologies under different agro-climatic conditions. Earlier, the primary focus of agriculture in the State had been to increase food production and to improve livelihood of farmers, a strategy that worked successful to a greater extent. The average productivity of total food grains has reached 35.27q/ha in the State as against 19.2 q/ha at National level, whereas, for wheat Haryana has attained highest per ha yield of 5.2 tonnes. This all should be possible due to strong support from the government for agriculture research and development activities, besides the creation of required infrastructure facilities.

This change over in agriculture in the State has also led to the second generation problems of Green Revolution. Emerging problems of land and water will have to be tackled on priority and Haryana agriculture has to rapidly diversify towards farming systems mode, including secondary and speciality agriculture, while linking farmers to market for better economic returns and sustainability of agriculture. Also the farmers will have to reduce existing technological gaps and adopt new innovations as well as good agricultural practices. However, to ensure such a paradigm shift, farmers would need continuous technological, developmental and policy related support.

In order to assure emerging needs, continuous interaction with farmers and stakeholders is critical. Accordingly, the Haryana Kisan Ayog has continuously been interacting with the farmers (including women and youth) to understand their views on issues requiring technological backstopping, development and policy related support for emerging problems. The first report on "Policy Issues and Options" based on interface with farmers, has already been submitted to the Government. This second report entitled "Issues and Options for Agricultural Research and Development in Haryana" has now been attempted to draw attention of all stakeholders to address important issues concerning future growth and resilience in agriculture of Haryana State and to improve further the livelihood of farmers to make agriculture a respectable profession.

August 25, 2014

(R. S. Paroda)

Dr R.S. Dalal
Member Secretary
Haryana Kisan Ayog

ACKNOWLEDGEMENT

Haryana Kisan Ayog earlier prepared a report on "Policy Issues and Options Based on Interface with Farmers" and submitted to Government of Haryana. In continuation to that another report entitled "Issues and Options for Agricultural Research and Development in Haryana" has been prepared. In this report the critical issues in Research and Development have been identified and options have been suggested for the possible solutions of the problems. I am highly grateful to Padam Bhushan Dr R. S. Paroda, Chairman, Haryana Kisan Ayog, for providing generous guidance and encouragement to all of us which helped in preparation of this inclusive and exhaustive report. It is pertinent to mention here that under the able and dynamic leadership of Dr Paroda, as many as eleven reports have already been submitted to the Government. The Haryana State Agriculture Policy prepared by HKA has already been adopted.

The Ayog is highly thankful to Dr D.P. Singh, Ex- VC, JNKVV, Jabalpur and Ex- Consultant, HKA for sparing precious time to draft this report after consultation with several stake-holders. In this endeavor, the valuable help extended by Dr J.C. Katyal, Ex- VC, CCSHAU, Dr M.P. Yadav, Ex-Director & VC, IVRI, Dr M.L. Chadha, Ex- Consultant, HKA and Dr. S.P. Singh, Former Director, NBAII, ICAR, Bangalore is sincerely acknowledged.

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Finally, I am thankful to the scientists and other stakeholders of the State who put forward their views and offered suggestions in preparation of this report.

August 25, 2014

(**Dr R. S. Dalal**)

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INTRODUCTION

Since its establishment in July, 2010, the Haryana Kisan Ayog (HKA) has held series of participatory meetings with a large number of farmers of Haryana, officials of State Government, senior experts of both Agriculture and Veterinary Universities, Central Soil Salinity Research Institute (CSSRI), Karnal, National Dairy Research Institute (NDRI), Karnal, National Bureau of Animal Genetic Resources (NBAGR), Karnal, Directorate of Wheat Research (PD Wheat), Karnal, Indian Agricultural Research Institute (IARI), New Delhi, Regional Cotton Research Station, Sirsa, CSWCRTI Research Centre, Chandigarh and the functionaries of Indian Council of Agricultural Research (ICAR), New Delhi. Meeting of progressive farmers was held in each division of the State to get their views. In addition, special meetings were held with the livestock farmers at NDRI Karnal and the farmers facing problem of soil salinity at CSSRI, Karnal. A number of meetings with progressive farmers, Presidents of Kisan Clubs of all districts were held, besides special meetings with woman farmers, young entrepreneurs those practicing organic farming, protected cultivation and bee keeping. These meetings were invariably attended by the Chairman and the members as well as consultants of the Haryana Kisan Ayog. Also, the senior officers of the concerned departments of Government of Haryana, scientists of CCS Haryana Agricultural University, LLR University of Veterinary Sciences, Hisar had participated. The farmers were apprised of the objectives of the Ayog and their specific suggestions, both verbally and in writing, were invited to solicit problems being faced by them and possible suggestions for the overall agricultural development in Haryana. All these meetings proved highly useful to assess various issues while ensuring a bottom up approach for need assessment relating to various researches, development and policy issues.

Haryana Kisan Ayog also constituted several expert working groups for addressing the issues related to Agriculture Policy, Natural Resource Management, Animal Husbandry and Dairying, Fisheries, Horticulture, Protected Cultivation, Conservation Agriculture, Enhancing Crop Productivity, Rainfed Area Development, Linking Farmers to Market Agriculture Extension, etc. Besides these activities, the Chairman of Haryana Kisan Ayog and Chairman of different working groups had organized special workshops/meetings and interactions with the Directors of ICAR and other institutes located within the State, Presidents of District Kisan Clubs, Private Dairies, NGO's/other stakeholders and progressive women and innovative farmers. Also the proceedings and recommendations of these meetings were circulated by the Ayog to concerned Departments/ Institutions/Agencies for possible follow up action.

Based on various interaction meetings and discussions, as stated above, several important issues emerged for review and consideration of Haryana Kisan Ayog. As a result the first report entitled "Report on Policy Issues and Options Based on Interface with Farmers" was submitted by the Ayog to the Government of Haryana. This second report covers a synthesis of priority issues as well as possible suggestions related to research, development and policy aspects that need to be addressed on priority by the concerned Departments and SAUs/Institutions for scaling up agricultural research for new innovations and for initiating development and policy related initiatives for large scale adoption and impact.

1. NATURAL RESOURCE MANAGEMENT

Haryana has made great strides in food production during the era of Green Revolution. However, this success has also led to the second generation problems such as declining resource base, especially reduction in soil organic carbon content, multi- nutrient deficiencies, soil degradation, decline in factor productivity, increase in cost of cultivation, hydrological imbalance and decline in underground/above ground biodiversity and pollution of soil, water and environment. About 65% of ground water of Haryana is of poor quality. There is also an emerging threat of climate change. Therefore, there is an urgent need to address the complex issues of natural resource management for sustainable development of agriculture.

A. Soil Resources

The problems of soil degradation (soil compaction, soil salinity, sodicity, water logging, and pesticide residue), multiple nutrient deficiency, low organic carbon content and decline in the total factor productivity have been observed under different production systems in the State. Also the diversion of agricultural land for non-agricultural use is an emerging big problem. The specific issues relating to soil resource and its health, as highlighted by the farmers and other stakeholders, have been listed here along with their possible solutions.

Issues	Suggestions
(i) Soil Health	
• **Characterization of soil resource and its health** In the past, the issues of soil health have been understood and interpreted from a narrow perspective of increasing crop yields with little attention to improve also the soil fertility, hydrological and biological properties of soils	**A. Research:** • Need for undertaking long term experiments to monitor not only chemical properties (macro and micro nutrients) but also impact of agricultural practices on organic matter, physical and biological properties of soils under important production systems for maintenance of soil health and proper guidance to the farmers. **B. Development:** • Need to modify and improve soil health cards into a system of "Soil Nutrient Management" with greater emphasis on use of nutrients based soil analysis and to ensure increase in soil organic matter. • Training and guidance to the farmers for proper care of soil health and its optimum use. • Soil Health Card (SHC) services may be linked to "Decision Support System" and information network. • Education, initial hand holding and incentive and reward for those who practice and promote CA and water saving techniques and methods. • Involving farmers would be must while devising and instituting farmers role and participation.

(ii) Soil Degradation	
• **Soil compaction and low carbon content in the soil**	**A. Research:** • There are reports that rotavator creates soil compaction in puddled rice. Hence, there is need to intensify research to test efficacy of modified rotavator in comparison to Happy Turbo Seeder both in terms of cost and efficiency. **B. Development:** • Since the organic carbon is the key issue to improve soil health in the puddled rice fields, there is a need for promotion of green/brown manuring through Dhaincha (sesbania), use of organic manure (FYM/compost/vermi-compost) and in situ residue management to improve carbon content and soil health in rice-wheat system. • Strict laws and proper education of the farmers to stop burning of rice and wheat straw in the fields have to be ensured. Promoting CA based technologies and crop residues management strategies are needed.
• **Soil salinity and resodification** There is an increasing trend of sodicity after a few years of soil reclamations, whereas the problem of soil salinity in areas with underground high water table and brackish water conditions is emerging. Substantial area of land is affected by water logging, particularly in Rohtak, Jhajjar, and Sirsa and water deficit districts of Mewat and Bhiwani. Around 50,000 ha area is under critical water table depth, which needs proper attention for its reclamation and proper use.	**A. Research:** • In flood irrigated areas with brackish underground water, soil salinity is increasing in the absence of effective drainage. Also the reclaimed sodic soils are showing resodification symptoms after 6-7 years. These issues need regular monitoring both by the scientists of CCS HAU, Hisar and CSSRI, Karnal. • Need for a comparative study of different reclamation and rehabilitation measures to arrive at a long term strategy which is efficient and economic. **B. Development:** • Since soil salinity and resodification are the problems of recurring nature, the mandate of HLRDC be now changed/ enlarged to cover reclaim both sodic and saline soils in the State. • The strategy for reclaiming saline soils with high water table be reviewed to ensure effective drainage system laid in entire area by next ten years by refixing annual targets and increased allocation of funds by almost 5 times (around 30 crores annually). Unfortunately, in last 15 years, the State has covered only 9,000 ha area under horizontal drainage system. The speed has, therefore, to be speeded up.

	• The Department of Agriculture to look into the possibility and implications of making HLRDC responsible for SSD activities in Haryana and to set up a drainage machinery workshop in Rohtak or Jhajjar districts where most SSD projects are to be implemented aiming for installation of SSD in 50,000 ha waterlogged saline area in Haryana in 10 year period.
• **Bioremediation of water logged soils** Salinity problem in high water table areas need immediate bioremediation solutions.	**A. Research:** • Need to initiate a pilot demonstration project on forestry in Mewat area on a compact block of 500 to 1000 ha by growing Prosopis juliflora for coal/charcoal making. Other species such as Salvadora, Prosopis cineraria, and those for lac cultivation may also be experimented. Value addition and processing in farmers participatory mode by involving CCSHAU and State Department of Forestry with full monitoring of its impact on natural resources and cost: benefit ratio for livelihood security of farmers should also be undertaken. **B. Development:** • Need to popularize the drainage/biodrainage system to reclaim water logged saline areas. For rehabilitation of such water logged saline areas, suitable clones of Eucalyptus and other species be planted for effective bio-drainage. • The pisciculture could be another option in saline water logged areas either alone or along with agro-forestry system.
• **Decline in total factor productivity** Farmers are invariably having concern for consistent decline in factor productivity, which has resulted in increased cost of cultivation. The low response to higher inputs especially, nutrient application is an emerging problem.	**A. Research:** • Research on site-specific, cropping system based fertilizer recommendations, following CA based technologies; need concerted efforts as a matter of priority. CA based technologies have shown possibilities for reduction in fertilizer and irrigation water requirements through crop residue recycling and reducing evapotranspiration (ET) losses in zero tilled rice-wheat-mungbean system. • Intensive research efforts are also needed to fine tune different resource conservation technologies (DSR, raised bed planting, residue incorporation, mulching, brown manuring, etc) under different production systems. • Need to study alternate technologies for crop residue management in rice-wheat and cotton-wheat cropping systems. **B. Development:** • Long term fertility experiments conducted at CCS HAU, Hisar suggest that the combination of organic manure, chemical fertilizers and bio-fertilizers could maintain

	productivity of soil over a long period of time. This needs greater attention to convince the farmers for adoption of INM in different production systems. • Promoting integrated agricultural practices and strategies which improve organic carbon content of soils. • Special drive for inclusion of green manure and legumes in different cropping/ production systems as catch/inter/mixed crops to improve soil health. • Need to establish more units for bio-fertilizer production in different parts of Haryana. • Promotion of brown manuring in rice, spring planting of mungbean / relayed mungbean in wheat • Use of off-barring machine and deep fertilizer placement in sugarcane. • Developing alternate technologies for crop residue management in rice-wheat and cotton-wheat cropping systems and use of biochar from crop residue to enhance C-sequestration.
• **Development of scientific data base for sustainable land use planning**	**A. Research:** • It will be desirable to bring out 'The State of Natural Resources' report in digital form, every five years by undertaking regular mapping and characterization of natural resources (land, soil, water, climate, vegetative cover) and natural calamities (drought, frost, flood etc) using modern tools of remote sensing/GIS. The first report should be planned within the next two years. The initiative for this must come jointly from HARSAC and CCSHAU. **B. Development:** • Building of scientific data base on current status of soil resources and soil health and other aspects of NRM at 1:10000/20000 scale by using GIS/Remote Sensing for proper land use planning under different production systems and agro-ecological conditions will help in rational use of natural resources. It requires strengthening of soil survey and soil testing units, along with proper infra-structure. Coordinated efforts of the scientists of HARSAC, Regional Research Stations and KVKs of CCS HAU, Hisar and ICAR institutes will be needed for monitoring soil health (physical, chemical and biological properties), cropping and farming systems characteristics and socio-economic aspects of farmers for developing scientific Land Use Planning in the State. • Link specific soil problems with concrete corresponding action.

• **Setting-up of school of "Natural Resource Management and Environmental Sciences" by the SAUs** Research and development in relation to NRM have not been tapped meaningfully to address NRM issues in relation to sustainability of agriculture. The dimension and magnitude of the problems of degradation of natural resource base and environment calls for a relook at the institutional needs for addressing the present and futuristic challenges of NRM related issues to sustain agriculture growth in the State.	**B. Development:** • This should draw a school of multidisciplinary team of scientists (say 10-12) involving scientists for Social and Bio-Physical Sciences, with expertise in areas such as remote sensing – GIS applications, groundwater hydrology, watershed management, resource optimization, farming systems' research, and agro ecology etc. The main objective of the school should be prioritizing, undertaking and guiding education, research and development toward sustainable resource management by addressing the following areas: ✔ Strategic interdisciplinary research in watershed, development, subsurface basin management and farming systems perspective. ✔ Characterization and monitoring of the State resources, including soil water and the polluted sewage waters.

B. Water Resources

At present, agriculture consumes about 80% of water. The availability of good quality water for assured irrigation is about 60% in the State. This availability of irrigation water will further decline in future due to more demand of fresh water for domestic and industrial use. About 65% of ground water resource in Haryana is brackish. Moreover, the fresh water is being polluted through release of untreated industrial effluents and sewage water in the canal system. In North Eastern part, there is deterioration in underground water quality due to over exploitation of good quality ground water and in turn its mixing with poor quality aquifers. In Central inland basin, the ground water is brackish and deep percolation and seepage losses from canals along with poor on-farm water management practices led to rise in water table and water logging conditions. Moreover, the problems of water management are location specific and thus, concerted efforts are required to address them accordingly in farmer's participatory mode under different production systems and agro-ecological conditions.

Issues	Suggestions
• **Need for mapping the dynamics and status of water resource in a coordinated way**	**A. Research:** Need to monitor on regular basis the current status and dynamics of surface and ground water resources, its quality and availability which is changing with space and time. It will help in generating good data base. **B. Development:** • A core group of scientists consisting of CCS HAU, Hisar, HARSAC, CSSRI, Karnal and the officials of State Groundwater Cell and Irrigation Department be formed for resource mapping and regular monitoring of the availability

	of surface and ground water data in digital form. This inter-departmental group could thus facilitate and advice on regular basis the stakeholders for proper conservation, augmentation and utilization of surface and ground water for improving water productivity under different production systems.
• **Promotion of location specific scientist-farmer connect- adaptive research**	**A. Research:** • Adaptive research projects are needed to address priority issues in respective agro-eco regions ◆ RRS Uchani, Karnal to address the problem of decline of ground water table and deterioration in the ground water quality and interlinked issues. ◆ RRS Rohtak to address the problem of rise in water table of inland basin underlain with poor quality water and irrigated with canal water. ◆ RRS Bawal to address three different specific problems in the region: a. Semi-arid area of south-west Haryana irrigated with poor quality underground water b. Water logged, saline and water scarcity area of Mewat, and c. Lift canal irrigated area with scientific and technical support from university Headquarter. ◆ RRS Sirsa to address problems of rise and decline in water table and all interlinked issues in the region. **B. Development:** • Need to formulate multidisciplinary team of scientists at different Regional Research Stations and KVKs to undertake adaptive research in a farmers' participatory mode by creating expertise in the area of water science, social science and farming systems' research for proper monitoring the status and dynamics of NRM and interlinked socio-economic settings, and come out with location specific, need based solutions and training needs of stakeholders. • In these research-cum-development projects, characterization and monitoring of resources in relation to selected technological interventions, alternate cropping systems/ farming systems, use of pressurized system of irrigation, other improved on-farm water management practices, including water recharge needs and the impact on natural resources would be important. The involvement of Govt. departments and other extension agencies in such research cum development projects in farmers participatory mode, will be important for better understanding and sustainable use of water resources.

• **Need for refinement of irrigation technology** • **Pressurized system of irrigation** Currently, the irrigation intensity from Bhakara Canal system is 62% while from Yamuna Canal system it is about 50%. For lift canals, the irrigation intensity varies from 4 to 38 % depending on availability of water and electricity. Hydrological Imbalances	**A. Research:** • Microirrigation: there is lot of emphasis on more crop per drop. Therefore, the technology development program in this area should receive priority. Technology should be cost effective and easy to adopt. • Fertigation: the nutrient use efficiency need to be enhanced to reduce the cost of cultivation. By this method, fertilizer use efficiency is increased from 80 to 90 per cent. **B. Development:** • Integrated approach involving on-farm water management, conjunctive use of brackish water (20%), pressurized system of irrigation and other water saving micro-irrigation devices, surface and subsurface drainage, recharge of aquifers, crop diversification, command area based technologies and holistic watershed management through water users association or community ownership are needed. • Farmers are interested to shift from flood irrigation to sprinkler and drip systems of water application in canal command area (CCA). However, there is need for construction of secondary reservoir in CCA and scientist-farmer connect-adaptive research and proper technical support to guide and help the farmers for adopting pressure system of irrigation under different production systems.
• **Fine tuning of existing irrigation scheduling** Water is most crucial for improving the efficiency of other inputs (seeds, fertilizers etc) used for agricultural production. However, its proper utilization and management vary with space and time.	**A. Research:** • The recommendations of irrigation scheduling are mostly based on the research work carried out at the Agricultural University, Hisar for different crops. Thus, there is a need to fine tune the existing recommendations and develop location specific data base for irrigation scheduling and resource optimization using modern technologies under different production systems and agro-ecological conditions. • In cotton-wheat system, the ridge and furrow system of irrigation in alternate furrows or in paired rows in 30+120 cm system of crop geometry results in 40-50% saving of irrigation water over border system of flood irrigation. There is also need to compare the effects of drip system and alternate furrow system of irrigation on productivity, as well as cost: benefit ratio in cotton. • Need to assess the impact of poor quality water on fruit and vegetable crops under high tech pressurized system of irrigation/fertigation with and without plasticulture.

	B. Development: • Need to recruit more man power for the formation of functional multidisciplinary groups of experts consisting of agronomists, soil scientists, irrigation engineers and social scientists at the HQ, RRSs and KVKs on priority basis. • Popularize both ridge and furrow irrigation systems in widely spaced crops (cotton, sugarcane, mustard, chickpea etc) and Furrow Irrigated Raised Bed (FIRB) in wheat including pressurized system of irrigation to economize irrigation water application and improve overall water productivity. • Encourage other water saving devices such as laser leveling, water conveyance through underground pipes, including other resource conservation technologies (bunding, CA based technologies, mulching, use of plastic etc), to save irrigation water etc. • Training of stakeholders on high-tech irrigation and other water saving devices.
• **Use of brackish water for crop production**	**A. Research:** • Need for ameliorating poor quality ground water in inland basin through injection technology using cyclic process of ground water extraction and recharge with good quality water by initiating pilot scale adaptive projects in farmers' participatory mode. • Need to develop suitable research recommendations for conjunctive use of brackish water with canal water in both food and horticultural crops by using pressurized system of irrigation at the University farm and farmers' fields. **B. Development:** • Farmers and officials in the Irrigation Department need to be guided for conjunctive and judicious use of upto 20% of brackish water in the long term interest of sustainability of soil and cropping systems under different agro-climatic conditions. • Some of the sulphate dominated brackish water could be used safely even in sensitive leguminous crops as per scientific recommendations. However, there is a need to properly guide the farmers to use ground water as per its chemical composition, soil types and cultivation of crops. • There is an urgent need to convince the irrigation department officials and the farmers for mixing of brackish water with good quality canal water upto 20% limit to augment the irrigation water supply and to mitigate the ill effects of water logging in inland basin of Haryana.

• **Treatment of industrial effluent and sewage water for irrigation purpose**	**A. Research:** • There is an urgent need to conduct more research to monitor load of microbes and heavy metals in soil, plant and environment systems in the areas irrigated with sewage water and industrial effluent and come out with suitable recommendations for reclamation and safe use of sewage waters, especially for irrigating peri-urban horticulture, vegetables and fodder crops. A core group of scientists consisting of CCS HAU, Hisar, CSSRI, Karnal and staff of State Departments of Agriculture and Irrigation and Central Pollution Board could be constituted to conduct research and advise the Govt. agencies on regular basis for undertaking corrective actions. • Developing full scientific package for use of waste water in peri-urban areas of the State, particularly for cultivation of vegetables and fodder crops around big cities. • Initiate comprehensive inter-disciplinary research on bioremediation using trees, grasses and microbes for effective sewage water treatment for reuse in agriculture. **B. Development:** • The Govt. of Haryana has planned to commission about 80 water treatment plants to cover major cities. Efforts are being made jointly by Govt. of Haryana, U.P. and Delhi, to ensure that any untreated water is not diverted in Yamuna River and its canals. However, there is an urgent need to enforce strict laws and speed up plans to treat the industrial effluents and sewage water for use in agriculture. • This issue needs an urgent attention to safe guard both soil and human health, including protection of environment.
• **Water conservation and water shed management** Haryana is water deficit State if one considers the available data of average rainfall (550 mm), potential evaporation (1500 mm) per annum and availability of canal water in the State. Declining water tables are leading to water scarcity	**A. Research:** • Good work has been done in the Dryland Agriculture (DLA) Research Project at CCSHAU Hisar for in situ water conservation and for growing field crops. There is an obvious need to further refine and extend this work to cover horticultural crops and agro-forestry systems using drip irrigation. • Need to strengthen efforts to conserve every drop of rain water by field bunding and soil configuration approach of micro-water harvesting (soil configuration, ridge and furrow system, contours/crop geometry/ intercropping/ agroforestry/ agro-horticulture means etc) in situ and in the field ponds/ village ponds and use it more efficiently in a multi-enterprise mode.

- The holistic approach of watershed management is the need of the hour to select crops, silvi-pasture, agro-horticulture and agro-forestry systems by including livestock and other need based enterprises for resource use optimization, employment generation and increasing the income of the farmers. Such a model has successfully been implemented in Bunga Project. It has also been developed by few innovative farmers in Haryana. Thus, there is an urgent need to strengthen adaptive research in multidisciplinary mode to develop location specific multi-enterprize based models by involving the scientists of RRS, Bawal and KVKs in the arid region.

B. Development:

- Sincere efforts are required to construct small dams to conserve more water for post rainy season irrigation and recharging of ground water through sub-surface structures (recharge galleries) and water conveyance through pipes for agriculture and drinking purposes in the foot hills of Shivaliks.
- Need to desilt and renovate old water storage structure (ponds, johr) in villages with the help of MGNREGA fund by the Panchayats.
- Increased availability of Laser levelers in a cluster of villages.
- Promote ground water recharge in transition zones.
- Rainwater management by the farming community.
- Direct seeding of winter crops without pre-sowing irrigation, such as use of CA technology.
- 50% area under basmati rice be planted as DSR with pre and post sowing herbicide use.

2. CROP IMPROVEMENT

The agricultural sector in Haryana has undergone a radical change over the last few decades leading to many fold increase in production and productivity of crops. Adoption of HYV/Hybrids along with production and protection technologies, supported by appropriate infrastructure and policies, led to these significant achievements. Haryana took an early lead in this endeavor which helped in transforming the rural economy of the State. Currently, Haryana is second largest contributor to the national food basket. The role of crop varieties/hybrids in enhancing crop productivity has been tremendous because the varieties adopted by the farmers were input responsive and resilient to agro-climatic conditions of the State. However, over last one decade, it has been realized that new set of problems and opportunities are emerging. Therefore, targeting and reorientation of crop improvement program is needed to accelerate agricultural growth rate in the State.

Issues	Suggestions
• **Crop improvement for increasing productivity and addressing the concern of climate change** The State is experiencing yield plateauing and adverse effects of climate change in many crops.	**A. Research:** • Need to develop varieties/hybrids tolerant to abiotic stresses, especially emphasis on the development of terminal heat tolerant varieties of wheat and other crops. • Intensification of research is required for the development of GM cotton in the background of locally adapted high yielding varieties. • Special attention required on the development of low input requiring rice and wheat hybrids. • Attention on the development of early maturing varieties of arhar and moong is needed both for inter and intra cropping. • Soybean can be a remunerative crop and, therefore, varietal development program on this crop must be systematically pursued. **B. Development:** • Any climate variability would directly affect agriculture and thus impact the local food production and livelihoods in the State. There is need to promote specifically abiotic stress tolerant hybrids and varieties. • Transferring technology, awareness creation, facilitating interaction and encouraging farmers to adopt superior varieties/hybrids tolerant to abiotic stresses be emphasised. • Climate smart agriculture involving relay cropping, staggered planting, bed planting and mixed planting has to be popularized. • Farmers' organizations can be very effective mechanism for establishing links between government efforts and farmer activities in adopting new technologies.

	• The technologies such as wet and dry planting of rice can help considerably in reducing methane emission and hence be popularized.
• **Crop improvement in consonance with export demand** The State should not be limited to production of few crops. It can become a strong stakeholder in export market for many agricultural products and hence must be proactive towards agricultural diversification.	**A. Research:** • Need to re-strengthen research programs on the development of improved varieties of specialty crops, with high quality traits, like *basmati* rice, *guar*, maize (QPM), sunflower, castor etc. The products of these crops are in high demand. The crops like *bajra* and barley also have industrial application and accordingly, varieties need to be developed keeping in view the industrial needs, including their suitability for processing. **B. Development:** • Globalization has opened up new opportunities for exporting agricultural products. Accordingly, specialty crops having niche in Haryana be promoted to capture markets abroad.
• **Development of varieties to cope with new technologies/cropping systems** Resource conservation technologies have to be adopted to reduce the cost of cultivation and to ensure efficient management of resources.	**A. Research:** • Need to develop specific varieties most suited for resource conservation technologies such as rice varieties for DSR, wheat varieties for zero tillage, short duration varieties of mungbean to fit in R-W cropping system, varieties for inter-cropping in sugarcane etc. **B. Development:** • Increasing agricultural production in future would demand promotion of varieties which can successfully be grown for promoting resource conservation technologies. Accordingly, the technology transfer programs would have to be up-scaled.
• **Emerging new diseases/ pests** In the recent past, disease like yellow rust in wheat has appeared as a major challenge in Haryana. Similarly, management of weeds has emerged as a major problem while adopting DSR and CA technologies.	**A. Research:** • Development of varieties/hybrids resistant to biotic stresses particularly to counter newly emerging diseases and pests especially yellow rust of wheat has to be addressed on priority now. • Need to develop wheat varieties resistant to Karnal bunt, yellow and brown rusts. • Need to develop suitable technology for the control of weeds in DSR and zero tillage/conservation agriculture.

	B. Development: • There is need to strengthen survey and surveillance mechanism in the State to monitor emergence of new diseases and pests. Accordingly, the research program would need reorientation. • For the development of varieties resistant to newly emerging biotic stresses, there is need to setup laboratories utilizing new biotechnological tools like identification of molecular markers associated with disease resistant genes followed by MAS and introduction of these genes in varieties through gene pyramiding etc.
• **Enhancing availability of good quality seed** Quality seed ensured 15-20% yield enhancement in different crops. Farmers often face difficulties in getting good quality seeds of improved varieties/hybrids prior to the sowing time. Availability of fodder seed is a big constraint for promoting Dairy sector in Haryana.	**A. Research:** • Need to breed improved varieties and parental lines of hybrids. Production of hybrid seeds in maize, *bajra*, rice, cotton, sunflower, pigeon-pea, mustard, castor etc has to be taken up aggressively to increase area under hybrid cultivation. Also maintenance breeding requires attention. • Strengthening of guar seed production program is urgently needed. • Dairy development in the State would require availability of good quality fodder seeds. Accordingly, varietal development and seed production program in forage crops must be strengthened. **B. Development:** • Launching of "State Seed Mission" for effective implementation of seed production programs of different crops in different regions is required. • Creation of "Hybrid Seed Production Cell" under Department of Agriculture to promote collaboration between CCSHAU and private sector. • Upgradation of seed testing laboratories of CCSHAU and Department of Agriculture and their accreditation. • Regular capacity building of staff of certification and seed production agencies. • Inclusion of notified and/or protected varieties and hybrids in package of practices developed by different institutions /sectors need to be done in shortest possible time.

• **Strengthening of genetic resources**	**A. Research:** • Collection, evaluation and conservation of genetic resources will strengthen various crop breeding programs to address the emerging biotic and abiotic stresses and also to enhance the crop productivity. **B. Development:** • Establishment of a "Gene Bank" in the State for conservation of valuable plant genetic resources is required. In addition, the Seed Banks for important crops and especially for fodder crops be created by the State under the technical guidance of CCS Haryana Agricultural University for sustainability of farming systems and for meeting the emerging requirements.

3. INTENSIFICATION AND DIVERSIFICATION OF PRODUCTION SYSTEM

In Haryana, the major cropping systems are rice-wheat, cotton-wheat, pearlmillet-wheat, clusterbean-raya/wheat, fallow-rapeseed & mustard and sugarcane. Some of the important issues related to these cropping systems and diversification and their probable solutions are summarized in this section.

Issues	Suggestions
• **Rice-wheat system** There is drastic decline in water table in rice-wheat areas in the north eastern zone of Haryana.	**A. Research:** • As stated earlier, there is an urgent need to strengthen strategic and adaptive research to ensure crop diversification especially by replacing puddled rice system with DSR and low water requiring crops (maize/soybean) to avoid excess underground water exploitation. Research on recharge of the ground water, using water injection technology with fresh rain water in north eastern region has to be strengthened. • Research efforts are also needed to control the problem of weeds and nematodes in direct seeded rice (DSR). • Maize, soybean, castor, sunflower, groundnut, gram, *guar*, autumn planted sugarcane and arhar have the potential to diversify the water intensive rice-wheat system in Haryana. The research efforts to evolve climate resilient high yielding hybrids/varieties of these crops may be further intensified. • There is also need to test the intercropping of soybean+ maize/soybean+ pigeon pea using ridge and furrow system of crop geometry. **B. Development:** • Concerted efforts are needed to promote maize in *kharif* and spring seasons, soybean, castor and pigeon pea hybrids in rice-wheat areas. • Promotion of "Happy Seeder" to reduce soil compaction for better resource conservation in rice-wheat system is required.
• **Cotton-wheat system** There is delay in planting and low yield of wheat in cotton based cropping system.	**A. Research:** • Breeding for GM cotton varieties as against hybrids to be taken up on priority. • Breeding for suitable varieties of mungbean as intercrop and wheat as relay crop in cotton be taken up. • To refine the technology for planting wheat as relay crop in cotton-wheat system. **B. Development:** • Promotion of wheat sowing in standing cotton using zero till approach to be taken up on large scale. • Popularization of alternate furrow and drip irrigation in cotton.

• **Sugarcane based cropping system**	**A. Research:** • Develop red rot resistant and high sugar content early maturing varieties both for autumn and *zaid* season planting. • In order to enhance the income of farmers from sugarcane-based cropping system, inter-cropping need to be encouraged. Extensive studies are needed on intercropping of mustard, wheat, onion, garlic, coriander and vegetables in sugarcane. **B. Development:** • Promoting both autumn planting and intercropping of mustard, wheat, onion, garlic, coriander and vegetables in sugarcane. • The early maturing varieties having high sugar content need to be promoted.
• **Intercropping** The land holdings of the farmers are becoming smaller and smaller with further division and fragmentation. Farmers need efficient technologies for enhancement of productivity and profitability on sustainable basis.	**Development:** • There has been lot of good work in the past to increase LER (Land Equivalent Ratio) and ATER (Area Time Equivalent Ratio) as one of the indicators to get more yields on a given piece of land. However, farmers need more information on productivity, cost: benefit ratio and location specific agro-technological packages to adopt following intercropping practices on their farms: ◆ Promoting conservation agriculture in rice-wheat cropping system and recycling of crop residues (straw of both rice and wheat). ◆ Substitution of rice with maize or soybean as sole crop or intercrop on raised beds with pigeonpea. ◆ Promotion of potato-spring maize rotation in northern Haryana. ◆ Growing of wheat in standing cotton as relay crop. ◆ Sugarcane in autumn with either garlic/vegetables/ mustard as intercrops. ◆ *Guar* + cotton and and pearlmillet + *guar* ◆ Sugarcane ratoon-potato/ spring maize/ sunflower rotation in well irrigated areas ◆ Dual purpose (fodder and seed) wheat/wheat+ berseem as intercrop.
• **Use of CA based technologies** CA based technologies have not yet reached/adopted by majority of the farmers	**A. Research:** • Comparison of Zero till and minimum till for increased income and improved soil health. **B. Development:** • The zero till technologies covering rice-wheat and other cropping systems need popularization on farmer's field to

	cover atleast 50% area under this technology in the State. Similar efforts are needed to popularize kharif maize/ spring maize, DSR and mungbean in rice-wheat system. • There is need to establish CA based machinery outlets for custom hiring so as to help the small farmers for faster adoption of CA based technologies.
• **Organic farming** There is an increasing demand of organic food within and outside the country. However, there is a fear in the minds of farmers with regard to productivity, income etc. through organic farming.	**A. Research:** • Development of organic input responsive varieties of different crops. • To make real advancement in the organic farming portfolio, consistent strategic research would be utmost important to support the farmers. Specific agro-technologies need to be worked out to make organic farming a profitable and sustainable preposition. **B. Development:** • Creation and accreditation of Laboratory for certification of organic products in the State. • Identify specific areas and crops for organic farming. • Farmers be given proper training to produce their own quality organic manure, compost/vermi-compost and biopesticides. • Farmers be advised for raising specialty crops such as baby corn, mushrooms and vegetables such as broccoli, artichoke, cucumber, capcicum etc. • To create special market outlets for organic produce and required incentives, including advise on marketing to farmers.
• **Integrated farming system** There is need to shift the focus from crop/commodity to multi-enterprized based farming system's approach in order to increase employment, income and livelihood security of small holder farmers.	**A. Research:** • Need to reorient our research agenda from crop/commodity to integrated farming system's (IFS) approach for resource optimization as per location specific needs of the farmers. • Strengthening of adaptive research for fine tuning the nutrient requirement, water management, pest dynamics, and carbon credit, choice of the cultivars in relation to diversification/intensification of production systems under different agro-ecological conditions with and without CA based technologies. **B. Development:** • Develop viable units for hands on training and visit in farming systems' perspective with emphasis on multi-enterprize based intensification/diversification and value addition. Special efforts are needed to train students, farmers and other stakeholders to develop entrepreneurship skills for employment/self-employment and increased income.

• **Development of small farm machinery and implements** There is a need to modify existing implements/develop new implements as per local needs of small holder farmers.	**A. Research:** • Need for adaptive research on farm mechanization and precision farming for labour saving, precise application of costly inputs, yield enhancement and reduction in the cost of cultivation. • Need for developing and testing cost effective and highly efficient rice transplanter, sugarcane trash harvester, straw chopper, etc. • Long term studies to be conducted on soil structure and compaction due to trafficking of heavy farm machinery.
• **Small farm mechanization** Efforts have been made in the past to develop farmers' friendly small tools and agricultural implements by SAU's and ICAR Institutes. These are either not available to the farmers or they are not convinced with their working efficiency, hence not adopted on large scale.	**A. Research:** • More directed efforts are needed to develop small farm tools and implements. • Need to modify/multiply the already developed farm tools/ small processing equipments/units, especially for interculture operations, grading and processing to help the small farm holders. A project in PPP mode using revolving fund scheme of ICAR in SAUs, CIAE Bhopal and CRIDA have developed many small tools and implements which require further refinement and testing for large scale adoption. **B. Development:** • A "Mission on Small Farm Mechanization" be initiated in the State. • Promotion of machine banks and agro-service centres for farm implements, especially to popularize CA based technologies to help the resource poor small holders.

4. HORTICULTURE PRODUCTION SYSTEMS

Inadequate availability of quality seeds of vegetables, flowers, spices, planting material of fruits, their higher cost and timely availability are some major constraints in promoting horticulture in the State. Farmers also need proper knowledge for controlling various pests and diseases, including processing and marketing of their produce.

Issues	Suggestions
• **Inadequate availability of quality seeds and planting material of fruits** Farmers have reported the paucity of genuine planting material and very high cost of hybrid seeds supplied by private seed companies.	**A. Research:** • Efforts on developing hybrid seeds of vegetable are to be intensified. • Improved varieties need to be developed especially for protected cultivation, since available varieties are mostly imported. • Department of Horticulture, CCS HAU, Hisar needs to enhance its efforts for availability of quality seeds and planting material of horticultural crops to meet the farmers need. • Need to strengthen tissue culture laboratory facilities to ensure supply of healthy planting material. • Strengthening research capacity for timely supply of quality spawn of mushroom through different production sites. **B. Development:** • Need for more registered nurseries, duly accreditated, to produce and supply quality planting materials of horticultural crops, especially fruits and important vegetable crops. • Keeping in view the potential for increasing area under Kinnow, a few processing units be established in the State. • Haryana has enormous potential to produce seeds of summer, winter and autumn flowers for domestic and export markets. This should be exploited. • Technologies available for raising disease free planting material like micro- propagation in banana, shoot tip grafting and bud wood certification in citrus need to be promoted.
• **Improving availability of horticultural produce** The availability of horticultural produce has to be improved to meet the increasing needs of population resulting from urbanization, change in food habits and growing emphasis on nutritional security, value addition and export.	**A. Research:** • The increased production can be achieved by area expansion of horticulture crops especially in arid areas, wastelands and intensive cropping systems after proper research backup and scientific support. • There is special need to have good quality mother plants and proper root stocks for speedy multiplication of planting material of horticultural crops in SAU and State Horticulture Department.

	B. Development: • Emphasis to bring 10% of cultivated land under horticulture crops, identification of new clusters, greening of arid areas and reclamation of wastelands for horticulture/agro-horticulture cropping system. • Multiplication of quality planting material through traditional propagation and modern technology of tissue culture. • Intercropping with short duration crops is recommended in widely spaced perennial fruit trees to ensure optimum use of space and increase in production per unit area.
• **Improving productivity and quality** The per unit productivity of most horticulture crops in Haryana is low compared to the best obtained in other States.	**A. Research:** • Development and promotion of high yielding, good quality and disease free varieties including pollination enhancement through Bee-keeping. **B. Development:** • Adoption of improved package of practices of horticultural crops developed in the State or in other parts of the country. • Promotion of High Density Planting (HDP) with proper input management, including drip and fertigation system, scientific pruning, harvesting and processing. • Horticulture is labour intensive and also requires skilled labour. Labour cost forms a major part of cost of production. Mechanization/ automation are, therefore, recommended to bring down the cost, reduce drudgery and improve product quality. • While the policy of promoting bee keeping for honey production is good, preference should be given to supply of bee hives for enhanced in pollination of horticultural crops to promote productivity.
• **Incentives on new crops** Little or no provisions of incentive for the innovative farmers cultivating new crops like strawberry, mint, aloe vera, spices and stevia etc.	**A. Research:** • The university should start systemic research work on these new crops as well as other potential underutilized horticultural crops and develop complete package of practices to utilize the full potential of these crops. • Adaptive research on these crops to be initiated. • The availability of planting material of these crops should be assured as per demand. • Introduction and evaluation of low chilling varieties of pome and stone fruits in northern districts of Haryana. • Development of varieties and technologies for promoting kharif onion cultivation. • Development of potato varieties resistant to PALCVD and late blight.

	• Development of varieties suitable for urban and peri-urban horticulture, off season and all the year round production in vegetables including homegardens. • Standardization of high density planting in mango, guava, kinnow, sapota and litchi. **B. Development:** • Adaptive research and special demonstrations should be organized and inputs cost should be provided to the farmers interested in growing new emerging crops like strawberry, mint, aloe vera, spices, chicory, scented roses and stevia etc • Special assistance is required in marketing, processing and export supported by marketing intelligence. • A number of crops namely radish, carrot and cauliflower can now be raised the year round as a result of development of new varieties. Such varieties be popularized.
• **Development of package of practices** There is inadequate knowledge of net-house/green-house technology and the structural designs. Also there is need to accelerate protected cultivation in the State.	**A. Research:** • Research programs for developing/ identifying varieties suitable especially for low cost protected cultivation structures should be strengthened. • Improved production technology and cropping sequences for protected cultivation have to be evolved. **B. Development:** • Need to popularize the net/green-house technologies by educating farmers through special training programs on protected cultivation by the CCSHAU, Hisar and the Department of Horticulture, Government of Haryana. • Need for establishment of protected cultivation clusters at desired sites for specific crops. • Government should promote input hubs with the help of scientists and farmers, for protected cultivation clusters, so as to ensure timely availability of inputs and technical backstopping.
• **Post harvest management and value addition** Inadequate infrastructure facilities for storage, marketing, processing, value addition and post harvest handling of perishable horticultural produce.	**A. Research:** • Researches are required to develop viable units of post-harvest management covering perishable horticultural crops in the agriculture university. Also research must be further intensified on low cost storage facilities and their management. **B. Development:** • There is need to develop special/ modern mandies and processing houses for vegetables and other horticulture produce with cold chain facilities providing primary

	• processing, value addition and packaging options in the State, especially around production sites in rural areas. • Vapour Heat Treatment (VHT), which is an effective means of controlling infestation of fruit flies, should be promoted in case of fruits like mango and guava intended for export. • Adequate availability of corrugated fiberboard boxes (CFB) and plastic crates for packaging and long distance transport have to be ensured. • Mechanized and efficient sorting, grading and handling systems need to be introduced at different clusters. • Multipurpose cold storage and pledged storage facilities, focusing requirements of different commodities, should be encouraged near production sites and large markets so as to prevent distress sale of horticultural produce. • Policy support and funding is required for the creation of multipurpose low cost rural based agro-processing complexes/ parks in clusters, especially meant for horticultural produce with an efficient quality control system.
• **Database** Database system is one of the weakest links for the development of horticulture.	**Development:** • There is an urgent need for scientific collection of reliable data on area, including area under homegardens production and yield, which can ensure systematic horticultural development in the State.

5. LIVESTOCK DEVELOPMENT

Haryana is endowed with rich livestock genetic resources. The State is well known for the best "Murrah" breed of buffalo and Hariana and Sahiwal breeds of cattle. Buffalos contribute about 83% of milk in the State. Poultry in Haryana has registered significant growth in the last two decades. Livestock sector contributed about 33% of agricultural GDP. It serves as a source of on-farm employment to women, landless and small holder farmers. For achieving higher farm income, livestock, poultry and fisheries, having potential for higher growth, need more focus including funding and policy support. In livestock rearing, about 60-70% expenditure is on fodder and feed alone. Hence, balanced nutrition, both quantitatively and qualitatively, is of paramount importance. In the integrated farming system, research on livestock (dairying, goatery, piggery and rabittory), poultry and fishery component should receive priority attention. To address these issues, following suggestions are made for undertaking R&D to enhance production and productivity of livestock in Haryana.

Issues	Suggestions
• **Livestock nutrition** Inadequate feed and fodder resources, in respect of green fodder (42% deficit), micronutrients and protein, and insufficient area under fodder cultivation are amongst the major hurdles in livestock production in the State.	**A. Research:** • Need to develop improved fodder crop varieties with higher yield, protein and nutritional value, encompassing different seasons. The cultivation of dual purpose wheat varieties be tested and encouraged. Better varieties of multicut sorghum, oats, lucerne and berseem need to be developed, addressing the problem of hydrocyanic acid (HCN) in sorghum and phyto-esterogens in lucerne and berseem. • Cotton being one of the important crops in Haryana, the feeding of cotton seed as concentrate to buffalos is commonly practiced by the farmers. In this context, research should be directed to solve the problem of gossypol toxicity in cotton seed through genetic improvement and/or appropriate processing before feeding to the animals. • To enhance nutritional quality and nutrient utilization of existing feeds and fodders, studies on bypass protein, bypass fat, nutrigenomics and other innovations are required for removing/reducing anti-nutritional factors, mycotoxins and methane production by the ruminants. • Development of cost effective total /balanced rations for different categories/species of livestock utilizing locally available raw materials should be accorded priority. • Research should be undertaken for developing better quality silage and hay by using different crops combinations, especially maize and oats. • To address the shortage of green fodder in peri- urban areas having more dairies with inadequate land for fodder production, research work should be taken up for producing Azolla and some green fodders using hydroponic conditions.

B. Development:

- A department of Forages Research and Feed Technology be created under LUVAS with the mandate of under taking research for developing appropriate forage and feed technologies and quality control standards, and breeding of better varieties of fodder crops, and grasses to enhance feed and fodder resources, both quantitatively and qualitatively.
- Augmentation of fodder seed production at government/ university and livestock farms. The AICRP on Fodder Production Centre at CCS HAU, Hisar, should be entrusted to produce Breeder and Foundation seed of fodder crops, namely sorghum, maize, oats, berseem, lucerene and cowpea.
- There is an urgent need to involve progressive farmers and the private seed sector to produce certified seeds of improved varieties/ hybrids of fodder crops, which must be linked with specified indents confirmed in advance by the Department of Animal Husbandry through a five year Rolling Plan. For production of fodder crop seeds, the requirement of foundation and certified seeds be dispensed with provided these are produced by Government Farms/Units and authorized seed producers.
- A Fodder and Feed Corporation should be created in the State with the specific mandate of ensuring the supply of quality fodder seeds and balanced ration for the livestock.
- Silage and hay making should be popularized and promoted by providing minimum 50% subsidy for the purchase of hay making machine.
- Incentives be provided for setting up feed manufacturing plants, and feed and fodder banks by the private sector in the State.
- For enhancing quality feed and fodder availability, various measures such as restriction on the export of cakes/oil meals; duty free import of feed ingredients for poultry and other livestock species, availability of mineral mixtures be promoted under Sate Livestock Mission.
- Ensure desired incentives, policy and funding support for development of feed and fodder resources, health care and protection, wider use of AI, use of certified sexed semen of progeny tested bulls, promotion of value added milk and dairy products including Mozzarella cheese in the interest of livestock development in Haryana.

- **Genetic improvement and breeding of livestock and poultry**

Although our indigenous breeds of livestock are better adapted to thrive under abiotic and nutritional stresses, their genetic potential for production parameters is much below their counterparts in the developed countries. Large numbers of low productive bovine, goat and sheep populations exert pressure on scarce feed and fodder resources and blamed for higher methane output from ruminants. As a result of mechanization in agriculture, farmers now prefer to keep high milk producing cross-bred or Sahiwal cows instead the dual purpose breed of Haryana.

A. Research:

- Need for developing and applying effective modern biotechnological tools for economic and endurance breeding of buffalo and poultry. Breeding for higher milk production and resistance against mastitis in buffalos and cows should be undertaken.
- Multiplication of superior/elite animals by developing and using non- conventional techniques like ETT, cloning, sexed semen and transgenic should be initiated by the State Universities and ICAR institutions (CIRB, Hisar; NDRI, and NBAGR, Karnal).

B. Development:

- Conservation of Hariana breed of cattle and its genetic improvement should be undertaken at government farms and selected Goshalas in the State.
- The State should have elite germ plasm of high yielding Sahiwal cattle and provide semen for AI to the farmers. The government should establish/maintain large cattle breeding farms for this purpose.
- Animal Breeding Farms/ Societies be established by the Deptt. of AH&D and registered for providing appropriate incentives.
- Program for increasing milk production should concentrate on indigenous milch breeds of cattle (Sahiwal, Hariana, Tharparkar, as the main breeds) with active involvement of Gosalas, crossbred cows (Holstein and Jersey crosses) and buffalo (Murrah, Nili-Ravi) based organized dairy farming having A2 milk lineage.
- Use of certified hygienic semen of progeny tested/pedigreed bulls for breeding of the animals/ herds belonging to the farmers, government, private sector and goshalas in networking mode should be encouraged.
- The State should develop infrastructure to provide certified semen, bulls, and day old chicks to the farmers.
- Modern biotechnological tools like embryo transfer and marker assisted selection should be employed for superior elite animals for faster multiplication and desired sex.
- Suitable incentives be given to the breeders for conservation and genetic improvement of cattle and buffalo breeds.
- There should be long term program to protect and improve the native breeds of buffalo like Murrah and Neeli Ravi and cattle such as Sahiwal, Tharparker and Hariana.

	• Bull mother farms should be established on priority for producing elite breeding bulls in public/private sector. Well-known NGOs, already involved in livestock developmental activities, should be involved for this and given due incentives. • Availability of quality semen, elite breeding males in livestock species (cattle, buffalo, sheep, goat, pig, horse), chicks, poultry feed need to be provided to the farmers. AI coverage in cows and buffalos should be doubled during the current Five Year Plan.
• **Reproductive management** Delayed maturity and first calving, longer inter calving period, repeat breeding, silent heat, infertility, early embryonic mortality, abortions, low semen quality and conception rates in AI are some of the reasons responsible for not achieving desired productivity in buffalos and cows in Haryana.	**A. Research:** • Developing techniques for production of disease free hygienic quality sexed semen for use in buffalos and Sahiwal cows. • Reducing early embryonic losses in buffalos. • Researches should be undertaken by LUVAS in collaboration with CIRB, Hisar on reproductive problems in buffalos including the causes and detection of silent heat. • Diagnosing early pregnancy in cows and buffalos by developing appropriate techniques, such as early pregnancy protein technique. • Developing better stabilizers for effective freezing and thawing of buffalo bull semen for use in AI. **B. Development:** • AI coverage in buffalos should be increased from the present 50% to 90% in the current Five Year Plan. There is need to improve the conception rate from AI in buffalos and cattle by using appropriate technique for detecting optimum time of oestrous for insemination.
• **Livestock management and product development/ value addition/use of bio-manure** If the family labour input for less than 5 dairy animals kept by small holder farmers is accounted for, the price farmers get for milk they produce is not remunerative unless full use is made of the produce for value addition including bio-gas and vermi-compost and other	**A. Research:** • A school of Post-Harvest Management should be established under the Veterinary University for education and research in this area. • It is the need of the hour to enhance productivity in buffalos, cows, sheep, goats and pigs by improving shelter and other management practices by conducting specific research suiting to local agro-ecological conditions. • Research on value addition of milk and dairy products for health, like cholesterol free ghee, Mozzarella cheese, whey proteins, CLA, Omega III fatty acids and A2 milk need to be pursued. • Developing new designer products from milk, poultry eggs, meat, dung, urine and other animal waste.

value added products from dung, urine and other waste (agarbatti, soap, vermiwash etc) from animal sheds. Good feeding practices (GFP) and GMP play an important role in enhancing livestock production by reducing the risk of biotic and abiotic stress to the animals.	**B. Development:** • The State should establish state of the art referral Laboratory at LUVAS, Hisar for SPS certification in respect of pathogens, mycotoxins; residues of antibiotics, pesticides, preservatives, heavy metals, etc. • The Institute of Veterinary Biologicals, Hisar should be strengthened for having self-sufficiency in production of diagnostics and vaccines. PPR and Brucella vaccines should be made available in adequate quantities to take full advantage of the mass immunization program with 100% assistance from GOI. • Milk processing should be raised from 27% at present to 50% during the 12th plan period. Farmers' SHGs and producer companies should be provided incentives for developing cold chain, Fat and SNF estimation facilities and linkage with market. • The Veterinary University at Hisar should develop a food technology park/cafeteria for training of students and for much needed technology transfer to the stakeholders. • Farmers/SHGs should be given incentives for keeping records in respect of milk production, vaccinations, reproductive performance, etc. • For increasing the productivity and production of high biological value protein of animal origin, sheep and goat farming should be promoted in semi-arid districts, while in districts with good rain fall, fish farming deserves due consideration under Integrated Farming System (IFS). Major focus should be on poultry for eggs and broiler including backyard poultry for landless and small holder farmers. • Diversification in poultry in terms of emu, turkey, quail and backyard poultry could be promoted. • Value addition of milk and meat, in terms of new products following HACCP, improved keeping quality, long shelf life, and nutritional value in the form of health food/designer foods and beverages etc. should be undertaken for more income to the farmers. • Programs should be initiated for production of bio manure, biogas, pesticides/insecticides from bovine dung and urine for promotion of organic farming and urine distillate etc for medicinal purposes by creating necessary infrastructure. Biogas plants should be made an integral part of medium and large scale dairies.

• **Livestock health protection** The livestock in the State is under constant threat from existing, emerging, and exotic diseases, like Avian influenza, swine influenza, equine influenza, foot and mouth disease, PPR, HS, Brucellosis, Blue Tongue, IBD, Chicken infectious anaemia, Swine fever, etc., requiring constant vigil and preparedness for effective surveillance, monitoring, development and production of vaccines, diagnostics for timely control, prevention and eradication to maximise the production and profitability.	**A. Research:** • Need to strengthen the epidemiological research for disease surveillance, monitoring and forecasting. • Development of Pen-size diagnostics / kits and vaccines for major diseases of livestock and poultry. **B. Development:** • Mobile veterinary polyclinics be provided in each district. • Regional disease diagnostic laboratories should be established at Rohtak, Sonipat and Ambala, besides the existing disease investigation laboratories. • Adequate check posts and quarantine stations should be established at inter-state borders for preventing the entry of livestock and poultry diseases through migrating or trade of transboundry or imported animals. • Traceability of all animals should be a long term target by applying electronic chips to monitor movement of animals between States, disease surveillance and to promote the export of livestock and livestock products. • Veterinary services need to be strengthened further so as to provide one veterinary officer for every 3000 cattle units as per OIE norms. Presently, there is only one veterinarian for each 9000 cattle units in the State. • The Teaching Veterinary Clinics at Hisar be strengthened further. • The existing departments of Veterinary Epidemiology and Economics be upgraded into a "School of Veterinary Epidemiology and Economics" under the setup of Veterinary University at Hisar. • There should be a State level Disease Diagnostic Laboratory (SDDL) with three regional labs to have a thorough epidemiology and surveillance mandate for disease control programs and monitoring of diseases. • The FMD vaccination program should be extended to other diseases like PPR, Brucellosis, HS, Swine fever, Fowl pox, IBD etc. to minimize heavy economic losses in livestock and poultry.

• **Veterinary public health** To achieve "One Health" concept of WHO/FAO, Veterinary Public Health plays important role in the control of zoonotic diseases in humans as nearly 60% diseases in man are contracted from animals. Food borne diseases can also be reduced considerably by ensuring food safety through protection of animal health. Thus, control of animal diseases not only helps in enhancing livestock production, it also provides nutritional and food security for human beings.	**A. Research:** • Development of rapid and sensitive diagnostic tests for detection of pathogens, toxins and residues of antibiotics, preservatives and heavy metals in food of animal origin should be in place in the State. • There is need for developing bio-remedial methods and techniques for monitoring, surveillance and containment of zoonotic diseases and food poisoning. **B. Development:** • Veterinary Public Health units should be established in each district along with the existing veterinary hospitals to look after veterinary Public Health related issues. • For better delivery of veterinary services at farmers' door steps, training of "Pashu Mitras"/SHGs at village level by involving women, unemployed youth, along with strengthening of infrastructure in veterinary hospitals/ dispensaries is needed quickly. • Need for development of HACCP protocols for various livestock products, readymade feeds and concentrates, mineral mixtures, etc. is recognized. • Disease investigation labs should be strengthened along with delegation of more powers to the DIOs.
• **Climate change impact on fodder, Feed, breeds, livestock health and production** Climate change due to rising temperature and emissions of greenhouse gasses poses real threat to livestock health, productivity, production and biodiversity. It requires urgent attention for evolving technologies and best practices for adoption and mitigation strategies to combat adverse impact of climate change.	**A. Research:** • Need to study the effect of biotic and abiotic stress (humidity, temperature) on animal health, physiology, production, reproduction and behaviour. • Development of cost effective feeds and innovative feeding practices with less emission of methane in ruminants, identification and characterization of breeds with low emission of methane will be a welcome step for further research to mitigate impact of climate change on livestock. • Need to identify/develop fodder crops / cultivars with tolerance to different stresses (drought, temperature etc) and better response to high CO_2 concentration due to climate change. **B. Development:** • For maximum hybrid vigour utilization, production of F1 progeny in buffalo and other livestock species through cloning be promoted.

6. FISHERIES

Issues	Suggestions
• **Culture of carps and quality fish seed** In this region, carps are the main stay of fresh water aquaculture. However, availability of quality seed is constraint.	**A. Research:** • The farmers are invariably getting either low quality seed or under size weak seed. While certain studies contribute this to inbreeding depression, this issue requires further investigation. Meanwhile, efforts have to be made to replace the existing brood stock from the hatcheries in the State. This has to be done by procuring natural carp seed from various riverine resources both within and outside the State and their maintenance up to maturation for subsequent breeding programs. **B. Development:** • Policy and legal instruments shall be put in place with mandatory provisions for registration of all the fish seed producers (hatcheries, seed rearers/growers), feed manufacturers and suppliers / traders as well as certification of the seed and feed quality.
• **Fish nutrition/aqua feed** Fish requires very high dietary protein content (30-60%). This raises the cost of fish production, which has to be made more affordable.	**A. Research:** • To address the shortage of good quality fish feed and to develop sustainable eco-friendly technology, following investigations need more attention: • Development of cost effective, eco-friendly aqua feeds. Innovative feeding with low excretion of ammonia and release of phosphates. • Studying the nutritional aspects of locally available cheaper ingredients and formulation of nutritionally balanced feeds for various fish species. • Studying the mineral requirements of fish. • Study the role of probiotics in fish feeds. • Study the role of single cell protein in aqua feeds. • Testing the efficiency of locally formulated feeds for different species. • Studying the importance of periphyton supported aquaculture. **B. Development:** • To promote and provide incentives to those who produce and supply good quality fish feeds/meals, especially using local products at reasonable costs.

• **Diversification of aquaculture** • Fresh water aquaculture • Brackish water aquaculture • Reproduction/Breeding	**A. Research:** **a) Fresh water** In order to provide more profitable options for farmers, species diversification is essential. R&D initiatives be strengthened to take up field based research programs. Haryana has very limited resources of fresh water. Hence following research activities need to be undertaken: • Culture of air breathing species • Breeding of air breathing species • Air breathing species require very little water in comparison to the culture of carps. Hence, efforts be made to develop culture technology of fish species like: Clarias batrachus and Heteropneustes fossilis etc. • Efforts be also made to develop hatchery technology to breed the air breathing fish species. • Since these fish grow rather slowly, biotechnological tools be employed to enhance their growth • Seed production technology, captive breeding/maturation of Scampi and Pangasiaus pangasiaus, Hypophthalmichthus molitrix for seed production; and refinement of captive maturation breeding are specific areas to be pursued further. **b) Brackish water aquaculture** Haryana has considerable untapped resources (more than 60 %) of underground saline water. These waters are neither fit for agriculture nor for industrial use. At the same time, these waters could be utilized for promoting brackish water aquaculture. Since many marine fish species like *Shrimp,Chanos chanos, Mugil cephales, Etroplus suratensis etc*. can be cultured and grown in brackish waters (>5 ppt), as they can be grown profitably under saline and brackish water. Hence, their seed has to be brought from coastal areas and tested induly. • Research issues must address the feasibility of producing these seed locally. • There is certain need to study the breeding possibilities of the brackish water culturable fish species through induced breeding technique / captive breeding / maturation **c) Recirculating aquaculture systems (RAS)** Given the limitation of land and water resources in the State, RAS can be a viable option for growing high value fishes. On the R&D side, developing a cost effective indigenous version of RAS as against importing the complete systems shall be given priority. Similarly, developing nutritious and cost-effective feeds for such promising species be given adequate attention.

• **Capacity development in fisheries**	**B. Development:** • Establishment of a College of Fisheries under the Haryana Veterinary & Animal Sciences University is essentially needed. As of now, there is neither a Department of Fisheries nor a college of Fishery in the University for strengthening fishery sector in the State. • Establishment of an effective extension system to tackle the day to day problems of farmers and transfer technical knowledge to fish farms. • The following needs to be ensured: 1. Progressive farmers to help in imparting training to interested farmers. 2. To encourage entrepreneurship for linking fish farmers to markets. 3. Promoting aqua feed manufacturers and to ensure required incentives and rewards.

7. BEE KEEPING

Issues	Suggestions
• **Bee Keeping, honey products and bee by- products**	**A. Research:** • SAU should start systematic studies on bee multiplication, and bee breeding. • Artificial queen bee insemination technique and mating in the isolated yards should be researched. • There is also a need to improve the pedigree to obtain robust colony. • Control of bee diseases is another important researchable issue, as at present no systematic efforts are being made in this direction. • Pollination efficiency of different bee species in pollination of different crops • Pollination studies should be conducted in each of the beekeeping areas. • Technology may be developed to maintain bee colonies economically during lean period. **B. Development:** • For increasing production/productivity of agricultural crops and also for providing employment opportunities to many marginal and small farmers, • Multiplication of bee colony is the need of the hour. • The job may be entrusted to entomology department, CCS HAU, Hisar. • Government should provide more incentives to bee farmers in the form of bank loans or more subsidies on bee hives. If possible Govt. agencies may help the bee farmers in the migration of colonies wherever needed for pollination of crops. • A systematic training program on all aspects of bee keeping/ bee breeding, honey extraction and obtaining other by products (bee's wax, bee venom, propolis etc.) be initiated at important locations where well established apiaries are available. • Bee parks for honey bees where farmers can keep their bee colonies temporarily during honey flow season as well as during lean/dearth period may be made available. • Availability of genetically superior queens for increased honey production should be ensured. • Lack of Infrastructure at the grass roots and national level for beekeeping and availability of trained field workers in beekeeping at the village level is the major constraint.

	• Poor quality control for the production of honey and lack of proper pricing policy for honey and those engaged in packaging, processing and storage of honey are serious constraints to be addressed. • Scientific methods of extraction of honey from wild colonies be evolved and promoted, particularly in forest ecosystem. • Disease prevention, control and analysis are the major constraint for the development of beekeeping in India. We need to have regional and also central bee disease analysis laboratories. A registration process of apiaries should be in place to certify and declare the apiaries as disease free for migration. Similarly such apiaries should only be allowed to sell queens and bees all over India. • Sufficient financial help from government and lending institutions for the development of beekeeping should be provided. • There is no control on the use of pesticides by farmers leading to death of bee colonies in field locations. This problem should be addressed on priority basis. • Efforts should be conducted for developing bee vector technology for the management of insect and fungal pests of field crops. • There is an urgent need for perfect coordination between all agencies engaged in promotion of beekeeping. • For training future beekeepers Farmer Field School approach may be adopted. • Finally country needs a full-fledged Bee Research and Training Institute with network arrangements with existing stake holders.

8. MARKETING

Marketing is as important as production. It is the market where prices are determined and the fate of farmer's produce and ultimately his income is decided. Strengthening of market infrastructure and needed reforms in the Agricultural Produce Markets Act (APMC) can help farmers get better returns, especially in case of perishable commodities. Marketing system should, therefore, be made more efficient and be seen as pro-farmer and pro-consumer.

Issues	Suggestions
• **Linking farmers to market** Agriculture is the only enterprise where prices are determined by others than the producer. Also it has a long chain of middlemen which need to be examined to ensure and explore efficient ways and means of marketing.	**A. Research:** • The present system of linking farmers to markets through a long chain of middlemen needs scientific investigation in order to explore options which can increase its efficiency. • The other available options like contract farming, cooperative marketing, farmers company and direct selling to retail chains and super markets etc. need in depth investigation for arriving at workable options. **B. Development:** • In developed countries, cities invariably have market place designated as "Farmers' Market" where a farmer can directly sell his produce to the consumers. Similar provisions are to be made. • Training to be provided to the farmers for producing commodities and preparing products as per market demands, including their exports. • Linking villages with mass media and market information centers through ICT and SMS service.
• **Development of private and SHG markets** Presently agricultural produce markets working under Agricultural Produce Markets Act are the only platform for sale of farmers produce. Provision for development of private/ SHG markets will lead to competition and also improve marketing efficiency.	**A. Research:** • The concept of regulated market has served the farming community in a big way. However, these markets have not been able to cope up with the fast changing economic scenario. It is being argued that other markets like private markets, etc. can serve better than the existing regulated markets. These options need to be scientifically investigated. **B. Development:** • Need for the development of private/ SHG markets to create healthy competition in the best interest of the farmers and consumers. Government help through policy intervention, incentives and encouragement will accelerate the pace of development of these markets.

• **Market forecasting** Market forecasting should be on effective way to help farmers in taking right decision in planning production and sale of their produce.	**A. Research:** • In order to provide information about likely changes in the marketing scenario, there is an urgent need to establish market information research centers for collecting relevant information and intelligence information technology. **B. Development:** • The forecasted information will be useful to the farmers in crop planning decisions if provided at appropriate time. As such, villages need to be linked with nearest market information centers through latest information technology and SMS services.
• **Strengthening of processing facilities** Inadequate processing and value addition facilities are the major impediments in realizing better prices by the farmers.	**A. Research:** • The State has a number of agro-processing units. However, there is need to develop multi-commodities, multi-products processing units catering to the needs of different commodities nearer to the producing areas as well as to minimize the cost of processing and to provide year round employment to the workers. This aspect will need more research. **B. Development:** • Establishment of primary processing agro-industries be encouraged in production areas and these be exempted from tax. • Government help in establishing forward linkages in initial stage is vital for the success of SHG/farmers Company.
• **Marketing charges** It is a general perception that marketing charges are high. There has been significant increase in the market arrivals since the time when charges were fixed. Also the mode of operation of the services for which charges are levied has changed making it more efficient. The marketing charges being levied in neighboring State should also be taken in to consideration.	**Development:** • Marketing of crops is done mostly through middlemen / commission agents. The marketing charges were fixed long back. Rates of commission charged by the *Arthiyas* and other marketing agents keeping in view the increased volume of business are high and need proper solution. Also marketing charges to be fixed keeping in view the charges being paid by the farmers of adjoining States.

• **Exposure to foreign markets** Real life exposure helps in building confidence and fasten the pace of adoption	**Development:** • Progressive farmers be provided proper exposure to foreign markets with adequate training on quality standards, proper grading, packaging and marketing intelligence for export of agricultural produce.
• **Strengthening of cold chain facilities** Inadequate cold chain facility is one of the major factors responsible for post harvest losses particularly in fruits and vegetables.	**Development:** • Post harvest losses in agricultural commodities are high on account of perishability, seasonal nature of production and lack of proper air-conditioned storage facilities. Moreover, demand for processed and off season food is also increasing fast with improvement in income level and increased participation of women in mainstream economic activities. It calls for increased emphasis on creation of conditioned storage facilities for raw and processed products nearer to the production and consuming areas.
• **Tie-up arrangements for marketing** Advanced tie-up arrangement helps in quick disposal and better prices for the produce require priority attention.	**A. Research:** • To search out the strong and weak links of different types of marketing arrangements available for different commodities and to select best option for a particular product is a researchable issue. **B. Development:** • Tie-up arrangements for marketing of horticulture, fishery and dairy produce are not in place at present, same needs be taken up on priority in the State.
• **Pledged storage facility** Pledged storage help in avoiding distress sale and regulating supply as per market demand, thereby, better price for the produce.	**A. Research:** • Examine the crop wise and district wise requirements of pledged storage facility in the State and its financial requirement. **B. Development:** • Distress sale is a common phenomenon for the farmers to meet their pressing cash requirements. Thus, there is an urgent need to strengthen pledged storage facilities at nominal rates in the villages/ cluster of villages with provision of negotiable receipt. Also farmers need to be informed about existing warehousing facilities available in the State.
• **Contract farming** Contract farming is an important means of transfer of technology, minimizing price risk and linking farmers to market.	**A. Research:** • Need for development of standard proforma including every aspect of contract farming is essential for signing the workable contract for effective implementation with a provision for penalty when there is violation of contract.

	B. Development: • Contract farming is an important means of linking farmers to the market and safeguarding them from wide fluctuations in prices. Contract farmer cultivates specific crop/ variety under the strict supervision and management of contractor. The inputs used in the production process are also provided by the contracting firm. Despite following every directive, the contracting firm makes deductions in the quantity supplied in the guise of quality of the product delivered. This process needs to be improved and effective checks are to be put in place.
• **Kisan Bazaar** Kisan bazaar has emerged as an important means to the farmers in realizing better prices for their produce. It is a system of direct sale where producer and consumer come in direct contact at a specified place and time and transaction takes place. It also requires less infrastructural facilities.	**A. Research:** • To study the advantages of Kisan Bazaar over existing system of marketing. **B. Development:** • Kisan Bazaars under different nomenclature are working efficiently in different parts of the country like Raitu Bazaar in Andhra Pradesh providing big relief to the farmers from exploitative practices of the middlemen in the main markets. These markets bring producers and consumers in direct contact thus eliminating intermediaries. There is a need to develop Kisan Bazaar within the State with proper infrastructural facilities for marketing and storage. It will help farmers in getting better returns for their perishable products including dairy, poultry and fishery products.
• **Branding of agri-products**	**Development:** • Haryana can regain its agricultural growth trajectory by promoting innovations and inventiveness in this sector. The competition for the development of class products can be created by assuring intellectual property rights and incentives to inventors. CCSHAU and other research institutions should have a mission to create unique products including value added and processed products which meet international standards. Branding of such products (with registered trademark and logo) including organic products, bio-tech products, rice, baby corn, mushrooms, bio-fertilizers, honey, vegetables, fruits etc would attract stakeholders from inside and outside the country. HSSDC has popularized crop seeds under brand name “HARYANA BEEJ”. Such efforts will help farmers, agro-industry and entrepreneurs for competing effectively in the market for enhanced income. This will have far reaching impact on production and productivity of agriculture in general and crops in particular in the State.

• **Economics of new crops and crop production practices** In order to shift some areas from cropping system like Rice-Wheat and Cotton-Wheat which are more water and other input intensive, efforts are being made to shift some area under less water requiring crops. Economic analysis of such new crops/cropping systems will help in smooth transition from water intensive to less water requiring crops/ cropping systems.	**Research:** • To examine the economics of new crops/ production practices like, DSR vis-a-vis puddle rice and winter maize. • To work out the inputs requirement of crops/ production practices contemplated to put in comparison to existing crops and production practices.
• **Economic analysis of cropping/farming systems** Farming systems approach has emerged as most important system to make farming profitable and sustainable. Economic analysis will help the farmers to make right choice.	**A. Research:** • To workout the comparative economics of different cropping/ farming systems adopted at farmers' level and to suggest most beneficial systems/enterprises. **B. Development:** • Creation of required facilities for procurement of inputs and disposal of output and training facilities to cope with the changing technological and socio-economic environment will be desirable.

9. TRANSFER OF TECHNOLOGY AND FARM ADVISORY SERVICES

There is lack of adequate knowledge of modern agricultural technologies and need based trainings on different issues pertaining to NRM, IPM, dairy, fishery and poultry, bee keeping, productivity enhancement and farming systems.

Issues	Suggestions
• **Yield gaps between research stations/FLD's and farmers field and lack of knowledge about modern agriculture technologies and environment**	**A. Research:** • Need to search and research the major constraints which are holding back the attainment of higher yields of different crops on farmers' fields. These constraints may be related to NRM, poor quality, imbalanced and untimely delivery of inputs, socio-economic problems etc. The real constraint could be found out by closely working of scientists of RRSs and KVKs in a farmer participatory mode and suggesting desired interventions following bottom-up approach to convince them more effectively for sustaining higher productivity on their farms. KVKs should also play the role of an ATIC. • Such programs should be operated by adopting some selected villages in each district following holistic approach of full package of technological interventions, and conveying desired message through field days /other means in the entire district. **B. Development:** • The existing yield gap to a large extent could be bridged by strengthening knowledge base of the farmers. Progressive farmers and social workers in the villages be given short term training in agriculture to teach young farmers about the important issues related to kitchen gardening, IPM, NRM etc. Services of retired agricultural experts and NGOs could be utilized for strengthening extension activities • Establishment of Agri-clinics having specialists drawn from different disciplines of agricultural science. • Diploma course for input suppliers and training to the existing input dealers from time to time to update their knowledge base as they the closest extension agents to reach quickly the farmers.
• **Technology for small farmers**	**Development:** • There is an urgent need to provide technological support to small and marginal farmers which account for 65% of the

	total farming families. These farmers need remunerative farming and cropping systems for which they require low cost machines, tools and feasible technologies. Hence, a State Mission on "Mechanization of Small Farms" must be launched. Research programs should receive due focus on micro-management of resources including crop residue management and refinement of technologies to help small farmers. • Strengthening of input delivery mechanism for ensuring quality inputs in adequate quantity, at affordable prices and at right time/place. (A policy to make agricultural graduates dealers of agricultural input needs to be brought in place. This will improve efficiency and effectiveness of technology transfer).
• **Technology for women farmers**	**Development:** • Women in Haryana are major work force in agriculture as they are involved in each and every activity of farming. They have relatively little exposure to new technologies. Their skill improvement would have direct impact on technology adoption and for enhancing agricultural production and productivity.
• **Development of viable decision support system (DSS) and technology transfer**	**A. Research:** • The research on the development of viable Decision Support System (DSS) is critical in revamping agriculture production in Haryana. The data bank will help in risk management by accurate planning, forecasting and early warning. The information generation system for natural resources, new diseases and pests, market fluctuations and demands need to be strengthened at block level for micro-planning. **B. Development:** • Technology transfer system needs to be modernized based on ICT. Provision of incentives and awards to farmers and extension workers for faster adoption/transfer of the technology should be made. Extension and training programs for input suppliers for updating their knowledge need to be introduced.

• **Inadequate facilities of soil, water, milk, egg, meat testing in remote areas**	**Development:** • There should be adequate mobile and stationary laboratory facilities for testing milk, dairy products and meat, fertility status of soils and water quality in different parts of Haryana. • Every farmer should be provided separate passbook for soil health and animal health with detailed entry of physical, chemical and biological status of the soil of his holdings and its recheck at regular interval.
• **Lack of adequate knowledge and drudgery to women farmers in agriculture**	**A. Research:** • Need to modify/multiply and distribute the small farm implements and tools developed by several Institutes and SAUs which are women friendly to carry out various agriculture operations. Also to test their relative efficiency. **B. Development:** • Need based training and adequate knowledge of technological packages of different production systems at the doorsteps of women farmers should be provided by SAUs and State departments of agriculture.
• **Lack of information on IT mode and need to update package of practices published by the university**	**Development:** • There is a need to train the staff on IT and operation of electronic media in the Directorate of Extension Education & State Departments of Agriculture, Animal Husbandry, High Tech Horticulture and Fisheries. The Directorate of Extension should come out with package of practices of different production systems (Crop Production system, Horticulture, Animal Sciences, Fisheries, Poultry etc.) in IT mode in local language to help the different stakeholders. The package of practices need to be updated regularly. • The m_Krishi Tata mobile phone based IT messages are proving very helpful to farmers in conveying their field problems along with photos of diseases etc and getting desired feedback immediately from the scientists to help them. • ICT based extension services at farmers' door, human resource and entrepreneurship development at all levels, market intelligence and linkages; use of biotechnology tools for improving livestock health, nutrition, reproduction and productivity; proper insurance cover to all milk animals, strict quarantine measures, residue analysis, breed registration and traceability.

• **Development of Krishi Vikas Kendra in each block to help the farmers**	**Development:** • KVKs must also play the role of ATIC. • Need to develop the Krishi Vikas Kendra in each block, by strengthening the existing infra-structure facilities of Veterinary Hospitals to provide office accommodation to agriculture officials for facilitating the agriculture technology/advise delivery system (covering all aspects of agriculture, horticulture, animal production) at one place.
• **Lack of farmers committees and lack of incentives to Kisan Clubs** Kisan Clubs could play crucial role in sustaining growth of agriculture in the State. However, there is lack of space and basic infra-structure facilities for running the activities of Kisan clubs effectively.	**Development:** • The Farmers Committee at Panchayat, Block and District level should be formed and their monthly meetings/ trainings should be organized by the Department of Agriculture /Horticulture /Animal Husbandry /Fisheries and Directorate of Extension Education CCS HAU, Hisar to help the farmers on burning issues and modernization of farming in Haryana. • Kisan clubs are emerging as an important social organization for helping in the spread and adoption of modern agricultural production technologies and creating awareness among the rural masses about good practices. These clubs are also creating awareness among farmers of their rights and benefits of government programs. Incentives for formation of Kisan clubs and providing minimum facilities for meetings and purchasing technical bulletins/CD will be a welcome step in this direction. In this regard following decisions as agreed upon by State Govt. need implementation without further loss of time: • The Establishment of Kisan Clubs in each sub-division of the State. • Providing office space for the clubs by the department of agriculture or HSAMB. • Provision of basic office furniture and farm journals by Department of Agriculture. • Further promoting the activities of Kisan Clubs for the formation of SHGs to develop agro service centres of CA based machines, quality seed production of improved varieties/hybrids and empowerment of rural youth and farm women.

• **Providing knowledge to the farmers**	**Development:** • Dedicated TV channel or Agriculture for effective knowledge sharing with farms be a priority of the State government. • Services like digital green or *e-chaupal* using smart phone by the farmers to have access to technical knowledge be made available on priority. • Institutionalizing farmers organizations and community groups is required to move towards farmer-led technology transfer. • Strengthening training institutions need to be among the top ranking strategy. For formalizing this initiative, launch of polytechnic agriculture education in the form of establishing Agriculture Training Institute on the lines of ITIs imparting vocational training to industrial workers.

SUGGESTIONS OF HARYANA KISAN AYOG TO STATE GOVERNMENT

Recently Haryana Kisan Ayog submitted following suggestions to Government of Haryana for consideration:

1. Farmers First:

- While implementing various agriculture development related schemes, including "The National Food Security Act," Farmers' Security First need to be ensured for overall prosperity to the farmers.

2. Easy Credit Availability:

- Availability of easy credit by public sector banks at 4% interest rate for all agricultural activities including horticulture/dairying/fisheries/agro-forestry need to be ensured to non-defaulting farmers.

3. Supply of Electricity:

- Uninterrupted supply of electricity for at least 8 hours daily for all agricultural activities/sectors, including dairying, poultry, fisheries, mushroom, honey bee, agro-processing, small scale rural based agro-industries etc., need to be made available, at domestic rates/rates applicable to agriculture (not commercial rates).

4. Addressing Concerns of Farmers:

- Haryana Kisan Ayog established on 15th July, 2010 need to be strengthened to address the concerns of farmers, including women and youth.

5. Provision of Insurance:

- Comprehensive and farmer friendly insurance schemes for crops, livestock, fisheries, poultry, mushroom, honey bee production etc. need to be initiated to cover the risk of all farmers.

6. Crop Diversification:

- Diversification of rice-wheat cropping system would be the key area of thrust in Haryana to save water. More emphasis on conservation agriculture to minimize production cost and promotion of high value low volume crops (Basmati rice, guar, soybean, maize, mushroom, straw berry, flowers etc.) need to be given and required incentives and policy support in this regard need to be put in place to ensure increased income and sustainability.

7. Small Farm Mechanization:

- Increased emphasis and subsidy on small farm mechanization, through a separate Mission at the State level need to be in place for resilience in agriculture with less dependence on farm labour.

8. Provide Market Intelligence:

- Linking villages with market intelligence centers to ensure for up-to-date price information is an urgent need. Weekly price forecast of agricultural commodities to farmers for proper marketing and decision making need to be ensured.

9. Capacity Building:

- Promote qualitative improvement and excellence in agricultural research and education. Reservation of 10 % seats for rural youth in agricultural education and special vocational training programs, including the farm women and youth, need to be organized.

10. Infra-structure Facilities:

- Establishment of rural agro-processing complexes with required infrastructure, including development for transport and cold chain etc need to be a priority.
- Creation of agricultural export zones for commodities with greater potential for export, and establishment of Kisan Bazars exclusively for farmers at appropriate places.
- Creation of fruits and vegetable collection centers in and around villages along with facilities for washing, cleaning, sorting, grading, packaging and storage.
- Establishment of accredited quality control laboratories, compatible to international standards, at appropriate places for agricultural inputs and outputs.
- Sub-surface drainage technology will be used to reclaim saline soils in a time bound manner with in 5 years and conjunctive use of brackish water in canal command areas need to be promoted.
- Ensuring support under MGNREGA and RKVY schemes for farm operations by small farm holders to improve farm infrastructure and land development.
- Higher subsidies will be provided on micro irrigation like sprinkler, drip and furrow irrigation systems for increased irrigation potential and higher water use efficiency. Also greater emphasis needs to be on conservation agriculture (CA) and laser land leveling.
- Provision for pledged storage facility near the villages to avoid distress sale.
- Subsidies on protected cultivation structures (green & poly houses) and extending the use of polyhouses for fish and azolla production.

11. Policy Related Initiatives:

- Incentives for formation of self-help groups and Producers Companies and provision of single window system for Government clearances.
- Doubling of horticulture area (from current 6 to 10 %) in the State in next five years.

- Strengthening of contract farming through elimination of required minimum deposit for the companies entering in contract farming arrangements.
- Develop proper policies for scientific use of natural resources such as land, water, solar energy and wind both at macro and micro levels.
- Special provision for pricing of organically produced products and incentives to the farmers for adopting organic farming practices need to be given.
- Long term policy and required incentives for retaining youth in agriculture need to be put in place.
- Doubling of inland fish production in the State through greater incentives and proper enabling environment for fish farmers.
- To help support some efficient Gaushalas in the State to take up genetic resource conservation and improvement of indigenous cattle breeds. Also State Livestock Mission needs to be given high priority with allocation of higher resources.

12. Modernization of Extension Services:

- To have a State level dedicated TV channel on agriculture.
- Strengthening of Kisan Clubs and promotion of farmer led innovations for large scale adoption through incentives and rewards need to be a high priority for which Agriculture Innovation Fund need to be increased to 10 crores.
- Creation of "Kisan Vikas Kendra" for knowledge dissemination/ extension services at the block level/ cluster of villages ensuring technical backstopping in all disciplines of agriculture as a single window approach.

IMPORTANT RECOMMENDATION OF THE AYOG ACCEPTED BY THE STATE GOVERNMENT

1. State agriculture policy adopted
2. Interest rate of agricultural loans reduced to 4%
3. Stamp duty on seeking agricultural loans waved off
4. Soil heath card issued to almost all farmers
5. Kisan Credit Card (KCC) issued to almost all farmers
6. “State Livestock Mission” has been launched
7. Water rates for fish pounds reduced considerably
8. Steps taken to reduce area under rice and to promote diversification in R-W system
9. Rolling plan for fodder seed production being prepared
10. APMC Act being amended to delink fruits and vegetables
11. Mandi fees exempted on vegetables and fruits
12. Pay scale to ADO revised

PUBLICATIONS OF HARYANA KISAN AYOG

A. (i) Reports Submitted to the Government (in Hindi and English)

1. Haryana State Agriculture Policy - approved by Government of Haryana
2. Working Group Report on Conservation Agriculture
3. Report on Policy Issues and Options Based on Interface with Farmers
4. Working Group Report on Fisheries Development in Haryana: Status, Prospects and Options
5. Working Group Report on Development of Horticulture in Haryana
6. Working Group Report on Development of Protected Cultivation in Haryana
7. Working Group Report on Natural Resource Management for Haryana
8. Working Group Report on Development of Animal Husbandry in Haryana
9. Working Group Report on Productivity Enhancement of Crops in Haryana
10. Working Group Report on Rainfed Area Development in Haryana
11. Working Group Report on Linking Farmers to Market in Haryana

(ii) Reports in Progress

1. Working Group Report on Post Harvest Technology and Value Addition in Haryana
2. Working Group Report on Promotion of Honey Bee Keeping in Haryana
3. Working Group Report on Agricultural Extension in Haryana

B. Proceedings

1. National Workshop on Farmer-Led Innovations
2. Stakeholders Workshop on Horticulture Development in Haryana
3. Prosperity through Diversification in Haryana
4. Opportunities for Youth in Agriculture

C. Newsletter- Quarterly published (in Hindi and English)

D. Farmers Assistance Booklet- Schemes related to farmers of Haryana (in Hindi)

E. Activities at A Glance (In Hindi and English)

F. Farm record and account (in Hindi)

G. Success Story of women farmers working on IPM in District Jind (in Hindi)

ABBREVIATIONS

AH&D	Animal Husbandry and Dairying
AI	Artificial Insemination
AICRP	All India Coordinated Research Project
APMC	Agricultural Produce Market Committee
ATER	Area Time Equivalent Ratio
CA	Conservation Agriculture
CCA	Canal Command Area
CCS HAU	Chaudhary Charan Singh Haryana Agricultural University
CFB	Corrugated Fiber Board Box
CIAE	Central Institute of Agricultural Engineering
CIRB	Central Institute for Research on Buffaloes
CLA	Conjugated Linoleic Acid
CRIDA	Central Research Institute for Dryland Agriculture
CSSRI	Central Soil Salinity Research Institute
CSWCRTI	Central Soil and Water Conservation Research and Training Institute
DIOs	Disease Investigation Officers
DLA	Dry Land Agriculture
DSK	Doodh Sangrah Kendras
DSR	Direct Seeded Rice
DSS	Decision Support System
ET	Evapotranspiration
ETT	Embryo Transfer Technology
FAO	Food and Agriculture Organization
FIRB	Furrow Irrigated Raised Bed
FMD	Foot and Mouth Disease
FYM	Farmyard Manure

GDP	Gross Domestic Product
GFP	Good Feeding Practices
GHG	Greenhouse Gas
GI	Geographical Indicator
GIS	Geographic Information Systems
GOI	Government of India
HACCP	Hazard Analysis and Critical Control Points
HARSAC	Haryana Space Applications Centre
HCN	Hydrogen Cyanide/Hydrocyanic Acid
HDP	High Density Planting
HKA	Haryana Kisan Ayog
HLRDC	Haryana Land Reclamation & Development Corporation LTD
HQ	Headquarters
HRD	Human Resource Development
HS	Hemorrhagic Septicemia
HSAMB	Haryana State Agricultural Marketing Board
HSSDC	Haryana State Seeds Development Corporation
HYV	High Yielding Varieties
IARI	Indian Agricultural Research Institute
IBD	Inflammatory Bowel Disease
ICAR	Indian Council of Agricultural Research
ICT	Information and Communications Technology
IFS	Integrated Farming System
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
KVKs	Krishi Vigyan Kendras

LER	Land Equivalent Ratio
LUVAS	Lala Lajpat Rai University of Veterinary & Animal Sciences
MAS	Marker Assisted Selection
MGNREGA	Mahatma Gandhi National Rural Employment Gurantee Act
NCR	National Capital Region
NDRI	National Dairy Research Institute
NGO	Non-governmental organization
NRM	Natural Resource Management
OIE	Office International Des Epizooties
PALCVD	Potato Apical Leaf Curl Viral Disease
PPR	Peste Des Petits Ruminants
R&D	Research Cum Development
RAS	Recirculating Aquaculture Systems
RRS	Regional Research Station
R-W	Rice-Wheat
SAUs	State Agricultural Universities
SDDL	State Level Disease Diagnostic Laboratory
SHC	Soil Health Card
SHGs	Self Help Groups
SNF	Solids-not-Fat
SPS	Sanitary and Phytosanitary
U.P.	Uttar Pradesh
UFI	Unique Farmer Identity
VHT	Vapour Heat Treatment
WG	Working Group
WHO	World Health Organization

TERMINOLOGY USED

Biochar: Biochar is a name for charcoal when it is used for particular purposes, especially as a soil amendment.

Brackish water: Brackish water is water that has more salinity than fresh water.

Brown manure: Manure prepared from animal waste is called brown manure and it is a good source of organic matter.

Industrial effluent: Industrial effluent is any wastewater generated by an industrial activity.

Off-barring machine: Off-barring machine is used for plowing or cultivating in a way that the soil is drawn away from the plants, usually in between the furrows for the purpose of killing the weeds.

Pisciculture: The breeding, rearing, and transplantation of fish by artificial means is called pisciculture, in other words, fish farming.

Relay cropping: In relay cropping, the second crop is started amidst the first crop before it has been harvested.

Staggered planting: Staggered planting is growing the same vegetable, but planting the seeds on different dates throughout the season so you can enjoy a longer period of fresh vegetables.

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