



PUNJAB STATE AGRICULTURAL POLICY

By
Agricultural Policy Formulation Committee

Punjab State Farmers' and Farm Workers' Commission
Government of Punjab
2023



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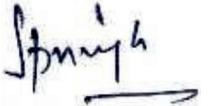
PREFACE

Agriculture plays an important role in socio-economic and inclusive development of Punjab. Though the productivity of state's agriculture is higher, but at present, it is passing through a phase of economic and ecological crisis due to rising costs of inputs, market uncertainties and intensive agriculture model being pursued that lowered the farm returns along with degradation of natural resources and loss of biodiversity. To address these challenges, the Government of Punjab constituted a committee to formulate Punjab State Agricultural Policy. Formulation of the policy addressing all the issues was a daunting task, however, committee made rigorous efforts to accomplish this assignment. This policy document has been prepared after exhaustive deliberations; through several rounds of meetings and interactions with the experts of various fields; visits to many institutions within and outside the country; and inviting suggestions through print media, Sarkar-Kisan Milnis and NRI Farmers' Conclave to ensure the formulation process, an inclusive one that considers diverse viewpoints to address genuine concerns of all the stakeholders.

The main emphasis of the policy is to increase the profitability of the farms by promoting healthier agriculture production, value addition and marketing systems in a cooperative mode with efficient utilization of natural resources while embracing biodiversity thus providing quality food for the society and raising the happiness index of the masses. This policy also focuses to address the issues of climate change and environmental pollution as related to agriculture for a cleaner and greener Punjab. The policy document has given due emphasis to the role and significance of farm workers, rural artisans and women in agriculture and their empowerment for improving their livelihood and status in society.

The concerted efforts made by all the committee members, especially by Dr. Gurkanwal Singh, have ensured to formulate a comprehensive agricultural policy for the Punjab state. The entire staff of Punjab State Farmers' and Farm Workers' Commission, especially Dr. Nikhil Ambish Mehta and Manavpreet Singh, have made tremendous contributions to prepare this policy framework. This policy document addresses the burning issues of the agrarian economy of the state and guides for harnessing opportunities to promote healthier, profitable and globally competitive agriculture in the state, which can be replicated nationally and even globally.

October 13, 2023


Sukhpal Singh
Convener
Agricultural Policy Formulation Committee

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List of Abbreviations

AMRII	Agricultural Marketing Research and Intelligence Institute
ASCPP	Area Specific Crop Production Plans
BCM	Billion Cubic Meter
BHP	Brake Horsepower
CBG	Compressed Bio Gas
CETP	Combined Effluent Treatment Plants
CIBA	Central Institute of Brackish water Aquaculture
CNG	Compressed Natural Gas
CoE	Centre of Excellence
ENA	Extra Neutral Alcohol
ETP	Effluent Treatment Plant
ETT	Embryo Transfer Technology
FRP	Fair and Remunerative Price
GAP	Good Agricultural Practices
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IAMS	Innovative Agricultural Marketing Society
IFIS	Integrated Farming and Integrative Income Support
IFS	Integrated Farming System
IoT	Internet of Things
ISTA	International Seed Testing Association
IVF	In-vitro Fertilization
MAPs	Medicinal and Aromatic Plants
MPCS	Multi-Purpose Cooperative Societies
NAQUIM	National Aquifer Mapping and Management
NGA	Natural Growing Area
PACS	Primary Agricultural Cooperative Credit Societies
PADB	Punjab State Cooperative Agricultural Development Bank
PAGREXCO	Punjab Agri Export Corporation
PAIC	Punjab Agro Industries Corporation
PFS	Progressive Farmers' Society
PHPTC	Punjab Horticultural Postharvest Technology Centre
PSF	Price Stabilization Fund
PSFC	Punjab State Farmers' and Farm Workers' Commission
PSPCL	Punjab State Power Corporation Ltd.
PSSCA	Punjab State Seed Certification Authority
RAS	Recirculatory Aquaculture System
RRR	Repair Renovate and Rejuvenate
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedures
SPV	Special Purpose Vehicle
STP	Sewage Treatment Plants
TCD	Total Crushing Capacity per Day
TMR	Total Mixed Ration
TSS	Total Soluble Solids
UGPL	Under Ground Pipe Line

1. INTRODUCTION

VISION

TO CONTINUOUSLY IMPROVE THE LIVELIHOOD OF FARMERS, FARM WORKERS AND THOSE DEPENDENT ON AGRICULTURE BY MAKING FARMING HEALTHIER, PROFITABLE AND GLOBALLY COMPETITIVE, ASSURING DIGNITY TO WORK, COOPERATION, CONSERVING NATURAL RESOURCES AND MAINTAINING THE ECOLOGICAL BALANCE FOR FUTURE GENERATIONS

Bestowed with the natural diversity of seven seasons and fertile alluvial soils receiving flowing rich river waters of strength – Punjab has been unfolding its potential to feed the nation with its spirit to do good for all.

Located in the northwest of India, the state has a long bright history of diverse agricultural production and is recognized as the “Breadbasket of the Country”. It is producing 16 per cent of the nation’s wheat, 11 per cent of its rice, 3 per cent of its cotton, and 7 per cent of its milk despite occupying only 1.53 per cent of the country’s total geographical area. The state’s environment is ideal for agriculture owing to the abundance of water resources, fertile soil, and several agro-climatic zones with semi-arid to sub-humid climates. Punjab also receives adequate rain, especially during the monsoon season. The state’s forests, wetlands, and grasslands are home to a rich plant and animal biodiversity. Wheat, paddy, cotton, maize, sugarcane, fruits, and vegetables are the major crops being cultivated in the state. Foodgrain production has become an integral part of the agrarian economy and culture of Punjab since 1960s, indicating a reach well beyond its physical and demographic boundaries.

Farming is not merely an occupation; it is the passion and lifeline of Punjabi farmers. For generations, they have nurtured the vibrant diversity of their land, realising their intrinsic connection with nature and the cosmos. Farmers, rooted in this sacred profession's creative production process of the distant past, have consistently provided high-quality, well-balanced food to humans and maintained biodiversity while harmonizing with nature.

1.1 Good Old of the Distant Past

In times past, Punjab’s agriculture was in a natural mode, utilizing local resources and the accumulated wisdom passed down throughout generations of farmers. As a self-contained village economy, the populace met most of their food, clothing, shelter, and other needs locally, with exceptions limited to salt and a few spices. The crop and animal produce were of exceptional quality, striking balance between optimal yields as per their varietal and

genetic potential, and the availability of quality production factors in each ecological context. Soil health was maintained through crop rotation, green manuring, farmyard manure, and the deliberate fallowing of land to allow soil microflora and other natural forces to enhance its productive capacity.

Farmers practiced synchronous, mutually beneficial groupings of crops, utilizing mixed and boundary cropping to maximize output from limited land resources. These practices skilfully leveraged each crop group's distinct root-top requirements and mutual benefits. A prime example was the cultivation of nitrogen-fixing leguminous crops like Bengal gram, wheat, and boundary *sarson*, which provided protein, healthful oil, and a staple cereal from the same plot during the same season. This model, by exemplifying both quality and diversity, played a pivotal role in nurturing a more prosperous and healthier agricultural landscape.

The division of labour and teamwork within the village economy strengthened the community's self-sufficiency and unity. The cultural and agricultural practices manifested in the mental and physical strength of the population, resulted in strong immune systems and longer lifespans. It had been their synthesized collective wisdom, which developed not only a healthier and more practical agriculture science but a holistic science that evolved slowly through the age-long practices of the farming generations.

1.2 Traditional Agricultural Practices of Punjab

Punjab was endowed with good old agricultural practices up to the early 1960s. The unique aspect of Punjab agriculture before the Green Revolution was subsistence farming i.e. the production of diverse agriculture produce for use by the household and local community. Farmers cultivated crops based on regional demands and the suitability of the land, with little emphasis on market-driven output. Indigenous seeds were widely utilized, complemented by the organic application of farmyard manure. Farming techniques predominantly relied on manual labour, with human and animal power being the primary energy sources. Animal power found applications in various facets of agriculture, including fieldwork, irrigation systems, oil extraction units (known as '*kohlu*'), and local transportation. Agriculture was fundamentally labour-intensive, with active involvement of entire family being the norm which exemplified the community's commitment to agricultural endeavours.

The community-based system was deeply ingrained, encompassing agricultural production, primary processing, and marketing. At the local level, the prevailing barter system seamlessly facilitated the exchange of commodities. Storage facilities for grains, animal feed, seeds, and agricultural inputs were common at the household and village levels, and within

the broader community.

A hallmark of this agricultural sector was its rich biodiversity, which yielded diverse foods and crops. Crop rotation and mixed cropping techniques were commonly employed, effectively leading to the conservation of soil fertility and other vital natural resources. Farmers primarily relied on surface water from canals, rainfall and wells for irrigation and other water conservation practices, thereby maintaining ecological balance.

Despite these favourable conditions, the agricultural sector grappled with the vagaries of weather, exploitative moneylending system, and unfair market practices. Likewise, inadequate road and transportation networks, limited access to formal credit systems, and a lack of marketing opportunities compounded these challenges. Over the time, crop failures, increasing reliance on market economy and declining farm profitability contributed to the deteriorating socio-economic conditions of the peasant community.

1.3 Green Revolution Era

Punjab had accomplished the land reforms, especially consolidation of land holding in the years following national independence. The rural economy with diverse agriculture, based on on-farm produced inputs had been generating quality food with high dietary value to fulfil nutritional and other needs of rural families. In this context, the Green Revolution strategy initiated a series of measures to increase productivity and agricultural production in Punjab to meet the nation's food security needs. It became imperative for the state to frame new policy measures for developing institutional setups and making massive investments in the agricultural sector. The main targets of the state spending included developing a robust irrigation structure, link road networks, well-organized market yards and rural electrification. It was accompanied by extending the cooperative credit framework and increasing funding for agricultural research and extension services.

With the advancements in agricultural research, High Yielding Varieties (HYVs) were introduced, which, coupled with technological interventions, particularly in the case of wheat and paddy crops, led to enhanced productivity. Since then, a paddy-wheat cropping system has dominated in Punjab agriculture, and the state has contributed significantly to India's production share. The area under wheat and paddy increased from 16.08 and 2.85 lakh ha in 1966-67 to 35.1 and 31.6 lakh ha in 2022-23, respectively. During the same period, the production of wheat and paddy increased from 24.5 and 5.07 lakh tonnes to 165.6 and 205.2 lakh tonnes, respectively.

The nation's achievement of foodgrain self-sufficiency provided political stability and the growth of other associated economic sectors. The state's agricultural growth received further impetus from modern agricultural research and extension initiatives. A combination of policies that supported the wheat-paddy cropping system brought all these facets of agricultural development together, ensuring a minimum support price (MSP) and guaranteed procurement by government agencies. As a result, an increase in area was witnessed under wheat and paddy along with a gradual but persistent drop in area under crops like maize, *jowar*, *bajra*, guar, pulses, oilseeds, *desi* cotton, etc.

The state's contribution of foodgrains to the central pool increased until the 1980s and declined thereafter. The contribution of rice to the central pool increased from 7.4 per cent in 1967-68 to 59.7 per cent in 1979-80, which later declined to 21.2 per cent in 2021-22. Similarly, the contribution of wheat to the central pool increased from 59.1 per cent in 1967-68 to 73 per cent in 1979-80, which declined to 51.3 per cent in 2021-22. Furthermore, the share of agriculture sector in the GSDP/GSVA is decreasing as shown in the Table 1.1.

Table 1.1: Gross State Domestic Product (GSDP)/ Gross State Value Added (GSVA) from agriculture at factor cost (at current prices) in Punjab

Year	Crops	Livestock	Crops & livestock	State Total (Rs. crore)
1960-61	219 (44.6)	43 (8.8)	262 (53.4)	491
1970-71	715 (43.5)	275 (16.7)	990 (60.2)	1644
1980-81	1696 (33.8)	725 (14.4)	2421 (48.2)	5025
1990-91	6116 (32.4)	2115 (11.2)	8231 (43.6)	18883
2000-01	18571 (24.9)	7698 (10.3)	26269 (35.2)	74710
2010-11	44573 (19.7)	18715 (8.3)	63288 (28.0)	226204
2015-16	59364 (16.8)	32112 (9.1)	91476 (25.9)	353155
2020-21	82770 (16.9)	55603 (11.4)	138373 (28.3)	489348

Source: Statistical abstract of Punjab and www.indiastat.com

Note: 2015-16 and 2020-21 figures are in GSVA

Figures in parentheses are percentage of the GSDP/GSVA

During the initial phase of Green Revolution, mechanization increased the cropping intensity which generated more employment opportunities in the farm sector. However, after some time it reduced human labour employment due to declining profitability and increased the cost of cultivation due to increasing farm equipment cost and under-utilisation of machinery as a result the farm incomes further declined.

Table 1.2: Debt position of farmers in Punjab

Year	Institutional Debt (Rs./Crore)	Non- institutional Debt (Rs./Crore)	Total Debt (Rs./Crore)	Total Debt as percentage of Gross State Domestic Product (GSDP) of Agriculture	Source
1997	2654	3047	5701	26	Shergill, H.S. (1998)
2002-03	4139	5747	9886	36.5	Singh, Sukhpal and M.S. Toor (2005)
2005-06	13047	8017	21064	62	Singh, Sukhpal, et al. (2008)
2007-08	15407	14987	30394	67.5	Shergill, H.S. (2010)
2009-10	19995	12555	32250	52	Singh, Sukhpal, T.K. Dhaliwal (2011)
2022-23	73673	-	-	-	NABARD (2023)

Table 1.3: Year-wise distribution of farmer and farm labourer suicides in six districts of Punjab

Year	Farmers Suicides (Number)	Agriculture Labourers Suicides (Number)	Total
2000	543 (61.22)	344 (38.78)	887 (100)
2001	522 (63.43)	301 (36.57)	823 (100)
2002	511 (61.27)	323 (38.73)	834 (100)
2003	528 (60.07)	351 (39.93)	879 (100)
2004	511(61.02)	324 (38.80)	835 (100)
2005	481 (60.81)	310 (39.19)	791 (100)
2006	445 (51.62)	417 (48.38)	862 (100)
2007	567 (59.43)	387 (40.57)	954 (100)
2008	630 (55.70)	501 (44.30)	1131 (100)
2009	496 (51.51)	467 (48.49)	963 (100)
2010	550 (53.04)	487 (46.96)	1037 (100)
2011	530 (52.89)	472 (47.11)	1002 (100)
2012	483 (53.08)	427 (46.92)	910 (100)
2013	494 (52.11)	454 (47.89)	948 (100)
2014	474 (53.38)	414 (46.62)	888 (100)
2015	537 (57.37)	399 (42.63)	936 (100)
2016	288 (55.60)	230 (44.40)	518 (100)
2017	308 (50.14)	303 (49.59)	611 (100)
2018	395 (50.19)	392 (49.81)	787 (100)
Total	9291 (55.99)	7303 (44.01)	16594 (100)

Source: Singh, Sukhpal et al. (2020)

Figures in parenthesis are percentages

The state's agriculture, in general, and small farming, in particular, has become less lucrative over the years due to the rising costs of cultivation and non-remunerative sale prices of crops. Without alternate sources of income, basic requirements such as high costs for healthcare, education, and cooking gas strain rural families' finances. Farmers and farm workers have to rely mainly on loans from institutional and non-institutional sources to make ends meet. As a result, farmers are forced to accept exploitative informal lending at an exorbitant interest rate. This vicious cycle of availing expensive loans to continue farming in the hope of improving their financial situation and repaying previous loans with high accrued interest burdens push them into the debt trap. Additionally, women often fall victims to the exploitative interest rates of private lenders, especially microfinance companies. Debt is increasing on exponential rate as shown in Table 1.2. In this situation of distress, the number of suicides committed by farmers and farm workers since last two decades is a serious concern (Table 1.3). Both farmers and farm workers have become victims of suicide at an almost proportionate rate, highlighting the severity of the distress faced by the agricultural community. Moreover, the proportion of suicide of women among agricultural labourers is higher than that of farmers.

1.4 Scope of the Agricultural Policy

“Agriculture is defined as the art and science of raising plants and rearing animals and other bio-life by humans for their needs.”

The agricultural policy is designed for farmers, farm workers and other stakeholders. Broadly, this policy is aimed to address the livelihood and socio-economic well-being of any person actively engaged in the activity of producing primary agricultural commodities, which includes all cultivators, farm workers, sharecroppers, and tenants engaged in various farming-related occupations such as growing crops, poultry, livestock, fisheries, beekeeping, mushrooms and agro-forestry, etc. The activities performed by artisans i.e. iron smiths, carpenters and a host of other skilled professions also come under the scope of agricultural policy.

1.5 Objectives of Agricultural Policy

The intensive agriculture model of the Green Revolution era, being pursued to meet the food security needs of India, has long been unfolding its inherent consequences affecting Punjab's socio-economic fabric along with agro-eco and human health concerns. It has necessitated urgent policy interventions to address these concerns and challenges for a change for good of all.

With a view to this background the policy is designed to focus on the following primary objectives:

- i. To promote healthier agricultural production, value addition and marketing systems in a cooperative mode for a globally competitive agriculture.
- ii. To enhance farm profitability and improve earnings of rural masses.
- iii. To generate attractive and productive employment opportunities in farm sector and rural areas for the rural masses.
- iv. To conserve natural resources and promote biodiversity to secure and develop the productive potential of agro-ecology.
- v. To raise the happiness index of the stakeholders with holistic development of agriculture and ensuring due rewards of their generated value in the state.

1.6 Methodology

The formulation of Punjab State Agricultural Policy involved a meticulous and comprehensive methodology to ensure inclusivity and incorporate various stakeholders' valuable insights and perspectives. To facilitate a well-rounded approach, the Punjab government set up a committee of 11 members (with Chairperson of Punjab State Farmers' and Farm Workers' Commission (PSFC) as the Convener of this committee), specifically for the formulation of agriculture policy of the state. It consisted of experts, policymakers, economists, representatives of progressive farmers, research institutes, and agricultural departments, along with other relevant stakeholders. The committee members actively engaged in discussions, deliberations, and collaborative decision-making to ensure a policy formulation process that is inclusive and representative of diverse viewpoints. An overview of the methodology adopted, which encompassed multiple steps such as stakeholder participation, review of existing policies and literature, discussions with various departments related to agriculture and allied activities, and field visits to progressive farms within the state, indicate towards elaborate efforts, basis and direction of the policy framework.

The committee was designed to create a policy framework that accurately reflected the needs and aspirations of the agricultural sector in Punjab. By actively engaging stakeholders representing diverse backgrounds, including farmers, researchers, agricultural experts, policymakers, and representatives from farmers' unions, farm workers' unions and growers' associations, the formulation process sought to foster a collaborative and inclusive approach. The committee thoroughly examined and analysed existing policies and relevant literature about agricultural development. Previous attempts at formulation of agricultural policies of

Punjab by the Punjab State Farmers' and Farm Workers' Commission (PSFC) were also taken into consideration. The drafts of the Agricultural Policy of Punjab, PSFC (2013), Punjab State Farmers' Policy, PSFC (2018) and "Making Punjab's Agriculture Healthier, Profitable and Globally Competitive", Agriculture Technocrats Action Committee, Punjab (2005), were studied and taken into consideration. Subsequently, the committee reviewed the agricultural policy drafts of other states of India, including the agricultural policies of Odisha, Rajasthan, Haryana, Tamil Nadu, Andhra Pradesh, and Maharashtra. Some national policies were also considered, including the National Policy for Farmers (2007) and the National Geospatial Policy of India (2023). Additionally, numerous studies related to the state's agricultural questions were undertaken by the committee, such as various Diversification Reports (1986 and 2002) of the Government of Punjab (Johl Committee Reports) conducted throughout the twilight phase of agricultural production growth of the state. Contemporary documents released by the Punjab government, such as Punjab Vision Document-2047, were also considered. This literature review served as a foundation for a comprehensive understanding of the current agricultural landscape, challenges faced, and potential opportunities for growth and development of the sector. The methodology strongly emphasised engaging key stakeholders, including farmers, Department of Agriculture and other line departments, and Non-Resident Indian (NRI) farmers. Meetings were held with various farmers' associations to understand their viewpoints, demands, and concerns. Furthermore, the methodology included seeking suggestions and feedback from farmers across the entire state. Recognising the importance of grassroots perspectives, efforts were made to solicit farmers' inputs from various regions of Punjab.

The Punjab government placed numerous advertisements in the newspapers to invite suggestions from farmers and other sections of the society regarding the formulation of agricultural policy. The response of the people of the state was overwhelming as the committee received more than one lakh suggestions regarding the agriculture sector of Punjab from farmers, farmers' unions, and other stakeholders (Annexure I). All those suggestions were then synthesised and incorporated into the policy. Additionally, the State government arranged two farmer-government meetings, namely *Sarkar-Kisan Milni-I* and *Sarkar Kisan Milni-II*, where tens of thousands of farmers participated and provided written suggestions for policy formulation. A special focus was given to incorporating the experiences and expertise of NRI farmers who bring unique perspectives and practices from their agricultural experiences abroad. For this purpose, various steps were taken. The Convener of the committee conducted

meetings with multiple scholars, farmer groups and eminent scientists in California, USA. The Punjab government held NRI Farmers' Conclave, and the committee held discussions with NRI farmers at PSFC. Similarly, meetings were held with representatives of various associations of farmers, horticulture and estate representatives, beekeepers, and livestock (dairy, poultry, piggery, and fishery) farmers, and progressive and organic farmers. A brainstorming session was held at Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, with scientists and experts nationwide to discuss livestock economics and marketing. Farmer unions and farm worker unions gave valuable suggestions and presented alternative models of agriculture in the state, which were deeply analysed and embodied in the policy framework.

The committee conducted frequent meetings with Agriculture and line departments for including their views regarding agriculture sector in the policy formulation. Meetings with more than 25 departments related to agriculture and allied activities were held at the office of PSFC over months to gather insights and perspectives from experts in the field. All the departments were given opportunities to discuss obstacles in the development of agriculture and were asked to provide a blueprint for the betterment of their departments and, subsequently, the whole agriculture sector of Punjab. The suggestions and insights provided by these departments were incorporated into the policy. This participatory approach was aimed to include the insights and recommendations of those directly involved in agricultural practices, allowing their voices to shape the policy. In addition to stakeholder engagement and literature review, the methodology included field visits to progressive farms across the state. The committee visited various progressive farms, small-scale value addition units, Centres of Excellence (CoE), various estates, farmer groups, FPOs, Integrated Farming System (IFS) models, and organic farms all over the state (Annexure II & III). These visits allowed for direct observations and interactions with the farmers who had achieved noteworthy success in their agricultural practices. By studying their methods, techniques, and experiences, valuable insights were gained, which helped shape the policy document.

The amalgamation of these key elements, stakeholder participation, policy and literature review, and field visits ensured a comprehensive and well-rounded approach to developing the Punjab State Agricultural Policy. This methodology aimed to generate a policy framework that addresses the pressing challenges, harnesses the opportunities, and promotes healthier, profitable, and globally competitive agriculture in the Punjab state.

Punjab State Agricultural Policy

The scope of agricultural policy is wider which requires a longer time span to analyse the various dimensions of the economy but keeping in view the on-going agrarian crisis and pressing needs of the state, the present policy has been formulated in less than a year. Thus, some limitations might be present despite the maximum efforts of the committee to fulfil this challenging task.

State's Holy Task

Though there has been significant increases in productivity and production in all the segments of agriculture i.e. foodgrains, livestock, horticulture and others yet continuous deterioration in the economic conditions and ecological health has been witnessed. The farmers and farm workers are living in a state of increasing debt and distress which forces them to commit suicides. Simultaneously, the state of natural resources, especially water and soil, is also worsening.

The harsh realities in the background facts are clearly indicative of the emerging grave dangers and impending disaster, in case, the existing perpetuated structural bias against agriculture sector continues. It is not only a question of just sustaining the now over-chemicalized and stagnated agriculture which is suicidal for the farmer and a health hazard for the society as a whole, but the crisis has deeper implications. It is a question of the state's survival, whereby, making Punjab's agriculture healthier, profitable and globally competitive as an energizer of its rural as well as overall economy and as supplier of healthier, nourishing food to society becomes the state's holy task. It needs to be appreciated that Punjab is blessed with the required potential to do so in the person of its developed human capital, i.e., world class scientists and extension experts, entrepreneurial farmers and a productive agro-climatic diversity with rich natural resources in place.

With the state's will, this holy task can be accomplished by establishing a system:

- i. That can help create per capita value from agriculture sector comparable to the other leading sectors of economy and assuring equitable transfer of such value within this sector and in exchange with other sectors.
- ii. That uses science in maximum cooperation with nature and fellow beings.

And it is possible!

The Policy

How to Make Punjab's Agriculture

Healthier, Profitable and Globally Competitive

Divorced from its natural habitat, a living being ceases to be itself. It ceases to unfold and fully express its unique potential and the persistence of such status endangers its existence.

Though immense scientific advances in the last century have liberated mankind from the age-old ignorance with tremendous progress, yet wrong application of science either unknowingly or for vested interests, has intruded the natural limits and balances, to the detriment of ecology and health of the living diversity. Health of Punjab's crisis ridden agriculture and its profitability needs to be seen in this perspective.

In this light, the following issues deserve serious consideration and so have been kept in view while writing this policy document for a healthier, profitable and globally competitive agriculture in Punjab:

- i. Rebuilding natural agricultural security mechanisms by maintaining natural eco-balance.
- ii. Rationalising terms of trade between agriculture sector and non-agriculture sectors.
- iii. Developing, acquiring, adopting and implementing the latest but most suitable eco-friendly and water-saving agricultural technologies.
- iv. Market research and intelligence, advance planning of production, value addition and marketing.
- v. Promoting cooperation in agriculture.
- vi. Creating productive employment opportunities by generating/adding higher value in the agricultural sector, while shifting a part of its population to other more profitable sectors within rural areas.
- vii. Natural risk/calamity management system vis-a-vis insurance.

The proposed mode of agricultural development is based on the practical experiences, innovations, and exposures of the domain experts, farmers, and other stakeholders in Punjab and abroad. It is embraced by theoretical knowledge of the leading agriculture world which has been tested through concrete practice in different forms. The ways, means and resources of putting this envisioned system into practice have been broadly assessed. It is believed that it is basically just re-channelising the state's resources, which with people's participation, is sure to lead to success.

2. MODE OF AGRICULTURAL DEVELOPMENT AND MARKETING

The importance and relevance of promoting an agriculture development system and management of its produce lies mainly in its impact on the socio-economic status of the stakeholders, human health and the ecology. In this light, the choice of mode of agriculture development and marketing should have prime focus on the said concerns to build a healthier progressing society. Further, efficiency of such systems enhances the profitability of stakeholders thus generating productive employment opportunities to engage a part of the population as a high calibre workforce to contribute in the social development process and raising the quality of life while in unison with the nature.

2.1 Mode of Agricultural Development

The availability of quality food not only shapes the health of society, but is also vital for the existence of human race. Quality food cannot be substituted by items of consumerism. Herein lies the importance of diverse agriculture produce as an item of assured prime demand for each being and for society as a whole.

Unique intrinsic relations of plant and animal kingdoms with nature which nurture it most intelligently with a balance further enhances the importance of agriculture as a profession that compliments and supports nature's endeavours to produce balanced quality food for all, while also providing with livelihood support to a section of society.

In this light, quality food production factors, i.e., the ecology which includes the soil and its microflora, water, sunlight etc. and the human resource which is most essential for agriculture as a profession - the farmer, farm worker and agriculture expert- should have been respected and duly rewarded by the civilized society. However, on the contrary, all of these became victim of the anti-agriculture and anti-rural bias of the vested interests and the governing regimes of the times.

It is in this background that this subject, i.e., the mode of agricultural development needs to be addressed with a view to the following:

- i. Balanced quality food
- ii. Profitability of the prime stakeholders: The farmers and the farm workers
- iii. Agro-ecology and the natural resources
- iv. Productive employment generation
- v. Dignity of labour and work culture

- vi. Mutual trust – Cooperation
- vii. Contribution to rural and State's economy
- viii. Happiness index of the stakeholders

The ongoing intensive agriculture model, which is presently pursued as a modern mode of agricultural production with a policy-price push, is a highly resource intensive and a distorting system. It is promoting crops against their natural habitat requiring heavy chemical inputs resulting in low quality produce with higher costs. This intensive model affects people's health and farmers' profitability leading to debt, depression and suicides.

In the past, farmers were allured for higher productivity to feed the nation, compromising the quality of produce, thus breaking nature's limits and balances with the support of narrow and fragmented application of science. Such increases in productivity with chemical supported intensive agriculture model, which were divorced from holistic science context, squeezed and polluted the natural resources. Higher productivity increased supplies of produce in the market leading to price falls owing to absence of advance planning of production as per market demand.

In a nutshell, it has become a disastrous economy for the farmer, health hazard for the people who perpetually remain in queues for the hospitals and death knell for biodiversity and ecosystem. This state of affairs is unfortunately a boon for the exploiters.

Assessing its widespread adverse effects which have shaken the foundations of healthy living, we have no choice but to shift towards growing crops in their Natural Growing Areas (NGA). NGA provide us with cost free natural factors, which promote quality production with minimal input use. Within NGA, maximum on-farm inputs and minimum off-farm quality input use are needed, making the produce globally competitive and profitable in an eco-friendly mode.

2.1.1 Developing Natural Growing Areas (NGA)

Every crop has its own specific requirements with respect to climate, soil, water and other productivity and quality promoting factors. Punjab's diversity, possessing variations with respect to these factors provide vast potential for different kinds and varieties of crops, fruit plants and other alternatives to be grown in different regions, zones and pockets. The natural potential of such regions, zones and pockets which suits specific crop kinds and varieties needs to be tapped in a planned and systematic way. In the emerging competitive post-WTO liberal regime, such planning and execution assumes increased importance,

because in its natural habitat the specific crop gives best performance in terms of quality and productivity with the support of cost free natural factors. Furthermore, highly valued organic agriculture/horticulture produce of a specific crop, which is not only a good commerce but a more healthful diet can best be promoted in its respective NGA in maximum co-operation with nature, because it will require least protection due to absence or less prevalence of odd factors, thereby reducing production costs.

These NGA should be the focus of research, extension, market off-take, processing development activities and should be the state's priority areas of the specific crops for their promotion as per crop requirement. The existing practice of enforced farming against the natural habitat of a specific crop not only adds to production costs, but also gives poor quality with lower yields. Wheat and paddy grown against their natural habitat in the *Kandi* region is one of the glaring examples of poor yield and low quality where better alternative crops could be grown. During 2021-22, the average wheat yield obtained in the NGA- Kotkapura block (Faridkot) was maximum (4767 kg/ha), whereas in *Kandi* area, which is not NGA of wheat, the average wheat yield in Talwara block (Hoshiarpur) was minimum (2667 kg/ha). Similarly, the average paddy yield in NGA-Dhuri block (Sangrur) was maximum (8149 kg/ha) whereas in *Kandi* area, the paddy yield in Hajipur block (Hoshiarpur), which is not NGA of paddy, was the lowest (4739 kg/ha) in the same time period.

Existing area under enforced crops will have to be replaced, preferably by high value crops of which the replaced area forms the NGA. Over the time, most of the NGA for existing crops have already been demarcated and are in the records of Agriculture and Horticulture Departments. The remaining areas can be meticulously assessed by these departments from agro-climatic data, interaction with agriculture scientists and sharing the experiences of farmers.

A profitability index of each crop/crop rotation amongst the group of crops in the NGA along with its export potential needs to be prepared. This will enable extension experts of the area to assess the suitability of each crop or crop combinations with respect to the status of each farming family. It is because of the fact that the most profitable crop of the NGA may not be so for every farming family due to status of its assets, family labour force or other reasons. Next alternative profitable crop/group of crops may be more suitable for such farming families.

For value addition to the raw agriculture/horticulture produce, the processing industry will become viable in these NGA because of availability of required quantum of good quality

low cost raw produce with minimal transportation costs. It will energise the rural economies by providing productive employment and check the migration of local intellect and population to urban centres, thus reducing pressure on cities.

Market infrastructure with cold chain facilities will be developed in NGA to attract buyers from abroad who will contact the farmers at these markets – cold storage/storage centres for purchase of safely preserved produce. The farmer will be in a far better bargaining position than that of the existing system.

2.1.2 Area Specific Specialized Research and Extension

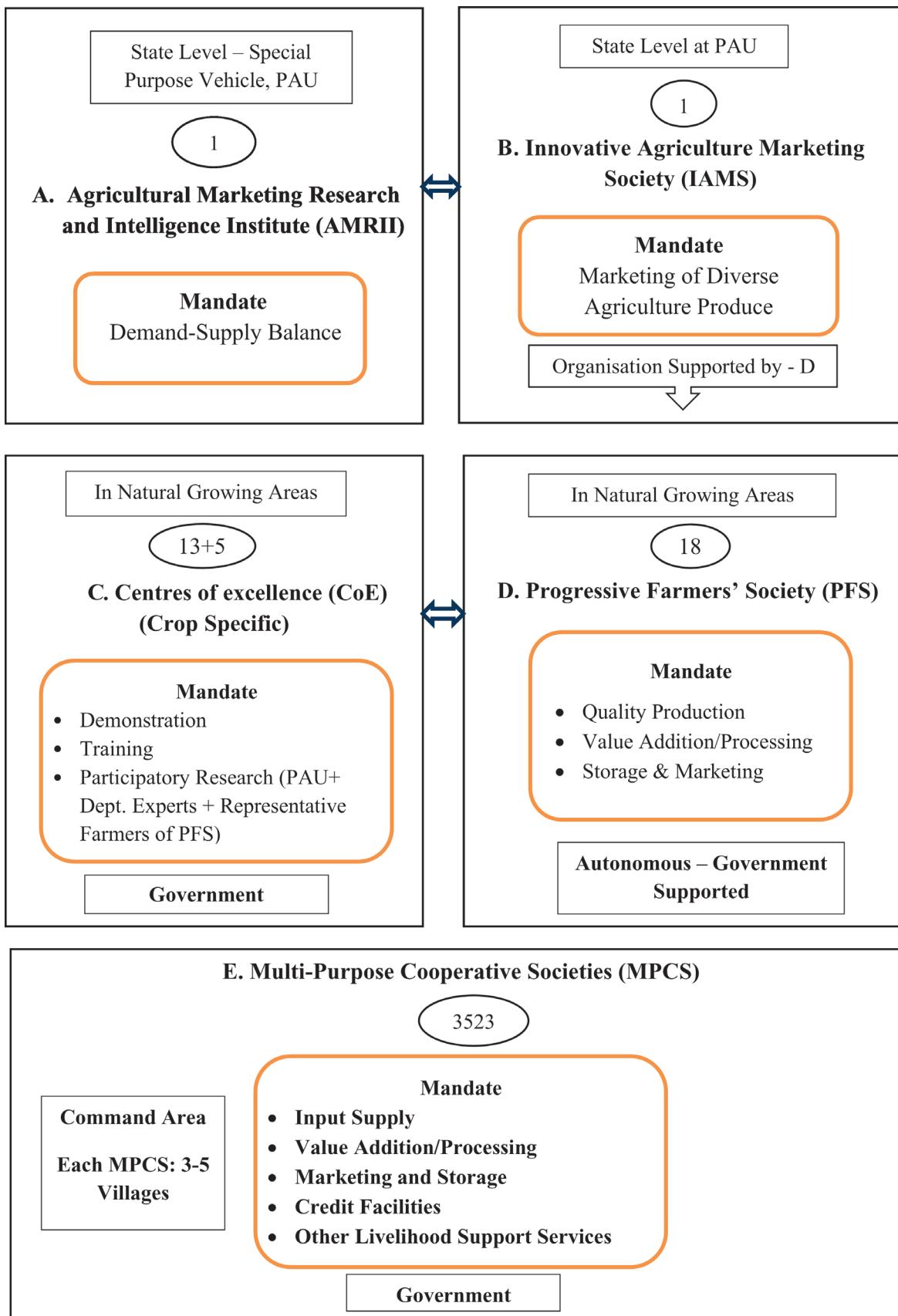
Punjab's agro-ecological diversity offers varied sets of agricultural production factors as an opportunity and a necessity for selecting crops and undertaking research and extension on area specific basis in their respective natural habitats, i.e., NGA to make agriculture/horticulture produce globally competitive. The existing system of carrying out research in one specific area and applying its results/recommendations in a generalized form in other areas possessing different sets of agriculture production factors has not only added to the production costs, but also produced poor quality with lower yields. Also, the era of generalization in agriculture has ended, whereby crop production and marketing requires specialised research and extension pool efforts.

2.1.3 Formation of Professional Committees

To fulfil such requirements, it must be understood that in addition to the government's will, the most vital input in the agriculture/horticulture production process is the human resource where the scientist, extension expert and farmer are the three most essential elements. For every dominant crop/crops of the NGA, there should be a professional committee comprising the regional extension expert of the crop (Nodal officer field), the regional scientist of the crop, representatives of the farmers growing the crop and market experts of the proposed Progressive Farmers' Society (PFS).

This committee should meet every month or as per requirements to discuss the problems of the said crop in every respect. Being based at the grassroot level, this area-specific and crop-specific professional committee with a better understanding of the local area and the market pulse will be more capable of sorting out and focusing the research and development priorities of the specific crop as per domestic and global market demands. The tuning of such research and extension efforts with market and crop development requirements will make it more need-based. The outcome of the research, that is, the developed technology will be demonstrated at the respective Centre of Excellence (CoE) of the crop in the NGA and disseminated by the regional extension expert with the help of his team of extension experts and Progressive Farmers' Society (PFS) to every farmer in the NGA.

**Institutes of Farm Sector Excellence
(In Cooperative Mode)**



Keeping in view the area and importance of the specific crop in the state, more number of such committees will be formed headed by the State-Level Nodal Professional Committee of the specific crop comprising nodal extension expert, nodal scientist, representative of proposed Agricultural Marketing Research and Intelligence Institute (AMRII), representatives of proposed Innovative Agricultural Marketing Society (IAMS), farmer representatives and consumer representative. The state level Nodal Professional Committee will be responsible for devising ways and means to make the specific crop profitable and execution of the approved plans with government support. The Apex Committee, comprising the concerned Minister as Chairperson, a representative of the Department of Finance, or if so required, representative of any other concerned Department and the Director of Agriculture/Horticulture, will finalise the proposals put forward by the state level Nodal Professional Committee and shall be responsible for the required government support in every respect.

2.2 Marketing

2.2.1 Non-Perishables

Agricultural marketing has great potential to contribute towards the growth and expansion of our economy, since economic development leads to the creation of advanced and efficient marketing systems. The main goal of developing a network of efficient physical markets is to ensure that farmers receive a fair price by fostering an environment in which supply and demand forces may operate fairly, regulating market practices, and achieving transparency in transactions. The Punjab state has a vast marketing infrastructure including accessible network of principal markets and sub-yards for non-perishable crops such as foodgrains, oilseeds, cotton, etc. Although, the existing regulated market infrastructure is sufficient for the procurement of non-perishable crops, but this market system is unable to cater the procurement requirements for the perishable crops, like fruits, vegetables and other produce.

A major feature of the agricultural markets of Punjab is the presence of commission agents, commonly known as ‘*arhtiyas*’. These middlemen, who emerged from petty shopkeepers and merchants, have played a significant historic role in Punjab’s agricultural landscape, both with positive and negative implications. The commission agent is the most dominant person in the agricultural marketing system. They are the link between sellers (farmers) and buyers (consumers, wholesalers, agencies). On the positive side, they have been instrumental in providing crucial financial support to farmers, especially during times of need. They extend farm inputs and credit to the farmers, and facilitate the sale of agricultural produce in the market. However, the historic negative aspect has been the potential exploitation

of farmers by commission agents. High interest rates on credit, supply of spurious farm inputs, high commission charges, and a lack of transparency in pricing mechanisms and transactions have often led to farmers receiving lower returns for their produce. Despite having a minor role in marketing of crops, particularly MSP crops, such as wheat and paddy, these agents have been successful in raising their commission over the years (Annexure IV). To eliminate the stronghold of commission agents and other inefficiencies of agricultural markets, the state needs alternative marketing systems along with transparency in the pricing system, strong checks on malpractices, real-time price discovery and dissemination, digitalization of the process, etc.

2.2.2 Perishables

In all the basic sectors of the economy, namely the Primary (raw material), Secondary (finished goods), and Tertiary (service sector), the producer himself fixes the price of his raw and finished product before putting it for sale in the market. However, it is only the farm segment in the primary sector where the price of farmers' produce is "discovered" in the market by the forces that appear alien to the producer.

It is a fact that the price discovery of farmers' field-generated value in the form of diverse agriculture produce is the most vital operation in the modern market. This operation is conducted and controlled by the agents of price discovery – the middlemen. These registered commission agents and their regular group of retailers and traders jointly settle and fix the lowest possible price of farmers' produce without any real competitive bid. The only exception is wheat, paddy and sugarcane, where price is fixed by the Government of India and is operative; however, it always remains under question for its genuineness. Further, this discovered price for the farmer is again translated into a self-exaggerated high price called the retail price for the consumer. Usually, the difference between the discovered price for the farmers and the retail price of the consumer is much higher, though with some overhead costs. This method of the price discovery system leads to exploitation of the farmers, resulting in their distress.

With a view to the above-mentioned scenario, the main market related problems/uncertainties faced by the farmers are as follows:

- i. There is no expert agency to ensure demand-supply balance leading to market gluts and artificial scarcities and finally, unbridled price fluctuations.
- ii. Farmer is a production expert and cannot individually perform the specialized functions of marketing efficiently in the modern market in addition to his production-related engagements and other issues.

- iii. For the majority of diversification crops/alternatives, genuine price or even the bottom threshold price of the farmers' produce is not fixed by the state. This gives freedom to the middlemen/agents of price discovery to offer the lowest price to the farmers' produce to promote their own economic interests.
- iv. There is no relation between the discovered price of the farmers' produce and the retail price set by the retailer himself. Further, there is no retail price cap fixed by the state, which makes it free for all agencies to exploit both the farmers and consumers.
- v. Formal bidding is done at about 4 AM in the morning, whereas, the farmers being engaged in harvesting, packing and other works throughout the day cannot afford to participate so early in the bidding process. It gives liberty to the agents of price discovery to settle the lowest prices. And in the absence of farmer, there is nobody in the market to watch his genuine interests or to supervise and ensure fair bidding.
- vi. At the fag end of the season, the hard-pressed farmer has the urgency of getting returns of his produce to reinvest in the next crop, to repay debt and to support his family. Actually, he neither has bargaining power in the market nor is able to hold back his produce even if a low price is offered by the middleman in the market.
- vii. Low-quality produce gets a price even lower than what it deserves in the market. As in the liberal regime, best-quality imported produce competes with the local low-quality produce because the field production of such produce lacks the advice of domain extension experts as well as uncertainties of other quality production factors.
- viii. Due to the lack of real competitive bidding for the crops of diversification, the traders/ middlemen are able to settle the lowest price discovery (price-settlement) of farmers' produce.

An efficient market for diversified crops can play an integral role in helping Punjab state to move away from its reliance on the wheat-paddy dominated cropping pattern. Being primarily dependent on the provision of MSP, the requirements of the wheat-paddy crop cycle have also shaped the market infrastructure. Therefore, diversification-driven marketing may face a variety of challenges, including glut situations, transportation and storage issues, lack of market access and linkages, financial and technical obstacles, price fluctuations, etc. Similarly, the lack of a monitoring system, lack of suitable marketing infrastructure, intermediary pressure and unfair bidding are other concerns which lead to exploitation of the farmers and affect revenue of the government.

Such situations demand urgent action to reform the agricultural marketing by providing efficient market intelligence with enhanced infrastructure and market information accessibility for all crops.

2.3 Market Research and Intelligence, and Advance Planning of Production

Marketing in the liberalized WTO-era is the most sensitive and planned business. And with Punjab's agriculture becoming more and more commercial, it is the market which is to determine not only the status of the state's economy, but also the fate and respect of every farmer in the eyes of the nation and international community. However, in the present situation the knowledge of what to produce profitably at one's farm unit and for what market, is neither the capability nor the expertise of Punjab's 11 lakh farming families. This fact alone, among others, necessitates advance planning of agricultural production in Punjab by the experts.

Though "planned economy" and "free play of market forces" systems have opposing elements, yet, what is required is synthesis of these two systems with restricted market forces to act as an indicator of changing social demand patterns, which would help in advance planning of agricultural production. Giving more weightage to the free play of market forces paradigm not only lead to the exploitation of producer farmers and the consumers to the benefit of middlemen, but also results in inefficient use of natural resources and social efforts. It is tantamount to undermining the importance of planning which is essential for an efficient and just social development process.

Although, the social food needs are generally reflected in the market through the comparative price/profitability status of different kinds of agri-produce, yet, the food needs of a part of social strata with lower purchasing power cannot be assessed from the market. The buffer food stock needs and the food requirements of this stratum, to be assessed by the advance planning experts also form the market demand, as the state is to fulfil its responsibility of providing minimum required food support to every needy through Public Distribution System (PDS) by ensuring required purchases by offering MSP. It is generally observed that market glut reduces the profitability of the producer and scarcity leaves the people hungry, even if they have the purchasing power. Hence, agricultural production has to be oriented as per market demand which either already exists or is created. It assumes more importance in the case of high-value perishables which cannot be stored for long to wait for the emerging demand. It necessitates that assessment of existing, developing market demand by surveying of domestic and export markets and creation of new demand, be done regularly quite in advance every year in terms of quantum, quality, time of supply and competitors including potential competitors of the specific produce. This process has to be closely coordinated with the extension experts of the Agriculture/Horticulture Departments so that tuning of the

extension efforts as per market demand requirements be expedited. Such planning can bring the farmer as producer, the expert and the market in a single line, thereby, ensuring minimal market risks and more profits for the quality produce of the farmers.

2.4 Agricultural Marketing Research and Intelligence Institute (AMRII)

To achieve demand-supply balance in agriculture, the state requires a strong Agricultural Marketing Research and Intelligence Institute (AMRII), which should be established at PAU, Ludhiana as a special purpose vehicle (SPV). It will be both, the “global market eye” of the crop-specific farmers’ associations in NGAs and, the “heart” of state Departments of Agriculture, Horticulture, Animal Husbandry and PAU. It will pump in and exchange market development information, giving the global and domestic market pulse regularly in advance to these extension and crop research organisations to enable them tune their extension, research and advance planning of agriculture and horticulture production activities accordingly. It will also co-ordinate with the GOI's import/export agencies so that the latter's decision regarding the import/export of agricultural produce may not go against the Punjab's production process.

Mandate
Demand-Supply Balance

This working model of advance planning based on market research and intelligence will maintain the equilibrium of the market by adapting the production potential to the absorption capability of the market. Such adaptation will neither affect the agriculture producers and their standard of living, nor will harm their production efficiency and profitability. With this system, the farming community will not be left at the mercy of the dictates of the market forces. It will, to a larger extent, erode the basis of existing conditions which led to distress amongst the farming community.

The union government is importing edible oils and pulses worth thousands of crores of rupees every year, which is a big drain on National Forex Reserves. However, for making purchases of domestic produce of these crops, the state agencies hesitate and are not as active as in the case of wheat and paddy. Consequently, private agencies exploit the farmers and the consumers in the market, ultimately affecting the profitability and area expansion under these low water-requiring crops. These crops could be made profitable in their respective NGA and should be promoted by ensuring their guaranteed purchases at Fair and Remunerative Price (FRP) along with their disposal mainly through strengthened Public Distribution System (PDS) outlets at the grassroot level.

2.5 Innovative Agricultural Marketing Society (IAMS)

After harvesting, sorting and packing the farm produce and engaging labour late in the evening, the farmer is expected to come to the market early in the morning with his field-generated value - the capsicum, cauliflower, onions or potato for a price discovery of his produce. For this produce, the buyer generally offers an unexpectedly lower price to the farmer which sometimes does not cover even the production, harvesting, packing and transportation costs. However, at the same time, the retailers/traders after receiving the produce may sell it at a far higher price to the consumer. In this way, both the farmer and consumer are at loss. As there is no bottom price for the farmer's produce and there is no end cap for the skyrocketing retail price set by the retailer, this system siphons off in a day or so, the major share of the consumer rupee and farmers' season-long generated value. The existing unfair system needs to be changed due to the following reasons:

Mandate
Marketing of Diverse Agriculture Produce

- i. Practice shows that in the post-WTO regime of the liberalised era, the exploitative tendencies of the middlemen buyers with their retailer groups have been strengthened with their higher profit margin wishes in the absence of a mechanism to rationalize the price discovery by the governing regimes. Both the farmer and the consumer are at loss in the existing market mechanism.
- ii. It needs to be made clear that in the globalized era, the division of labour has led to specialization of each aspect of the product/entity, while production and marketing being two broadly different aspects of any agricultural produce, require different types of expertise to deal with each one.
- iii. Marketing in this competitive era is a whole time job requiring an understanding of the nature of the produce/product to be marketed, collecting consumer-specific local, distant and global demands, market assessments, connecting with the stakeholders, dealing with logistics and ensuring supplies to the consumer's satisfaction along with advertising the strength of one's product. All these activities have to be conducted more efficiently in a cost effective manner to make the produce globally competitive.
- iv. Individual farmers in a nuclear family with agricultural production engagements and responsibility of supporting the family - educating the children, dealing with the family health problems, social obligations, etc. - cannot perform the specialized function of marketing, in addition to agricultural production, with such excellence as a specialized marketing body can do. The small volume of his produce too is a problem. Thousands of such farming families

individually suffer although their collective produce could be marketed successfully by the specialized marketing body that will play on volumes for each farming family's benefit. Presently, the farmer is suffering individually losing day-by-day in the existing system which has a structural bias against him leading to distress and mass exodus of Punjab's energetic productive human resources.

In this background, it is proposed to form an organization in the embodiment of the 'Innovative Agricultural Marketing Society' (IAMS) which will be manned by domain marketing and subject experts having the mandate to profitably market the diverse produce of the farmer members of the proposed PFS in the NGA. It will be the apex marketing agency represented and supported by all these societies established in the NGA of respective crops of diversification.

Having knowledge of the strength of each part and aspect of the specific agri-produce/value-added product, these professionally qualified marketing experts will assess in advance the consumer preferences and their demand quantum and timing, while at the same time making it a seller's market in liaison with the proposed AMRII for demand dominated supply releases, thus, tilting the balance in favour of producer seller rather than middlemen.

Such institutional interventions with a collaborative design that operate in the cooperative framework of a large number of farmers in respective crop-specific groups i.e. the PFS in their NGA have the potential to offset, in a major way, the demerits of small fragmented farms.

As these crop-specific PFS will be closely linked to the CoE in respective NGA, the farmer members of the society will have the latest technical advice and training at these centres. Latest machinery and equipment on rent-hire, quality inputs at lesser costs, microbial consortiums for soil improvement, leaf and soil testing facilities, value addition, packaging, storage-cold chain, marketing, credit, etc. will be available improving their economies of scale with strong bargaining power and capacity to hold back his produce. It will mostly reduce his production and marketing-related uncertainties.

With all such support at minimal costs in the NGA, his quality produce will enhance his profitability with the support of the apex marketing society i.e. IAMS. The farmer will get an identity to be with a strong supportive organization while retaining the economic integrity and legal independence of his farm unit. In the social set up, the farmer will be able to walk with pride and high self-esteem.

2.6 Centres of Excellence (CoE)

To compete globally, there is an urgent need to provide state-of-the-art world-class facilities in the NGA of respective diversification crops or crops of the state's priority for an end-to-end support to the farmers, thus reducing uncertainties for a healthier and profitable agriculture with better control over their destiny.

- | | |
|----------------|---|
| Mandate | <ul style="list-style-type: none"> • Demonstration • Training • Participatory Research (PAU + Dept. Experts + Representative Farmers of PFS) |
|----------------|---|

In this background, every NGA of a specific crop or group of crops should have a CoE under respective line departments, which is to serve as a lighthouse of knowledge regarding the latest quality production, processing and innovative marketing technologies in an eco-friendly way.

The CoE needs to have a direct liaison with the AMRII, IAMS and PFS for tuning production as per market demand. Most suitable amongst the developed and acquired technologies will be demonstrated live at this centre along with intensive practical training of the farmers, the farm workers and the professional domain experts to enrich and update their knowledge. Weather status and leaf and soil test facilities will also be provided to the farmers. Under the guidance of PAU scientists, participatory research with domain field experts and PFS farmers will also be conducted to quickly demonstrate and transfer the technologies to the field.

It will have a hi-tech complex with a farmers' training hall equipped with audio-visual-IT aids and a comparative display system along with other required infrastructure. Such latest hi-tech services from this complex in the local area will have a unified impact/impression upon the minds of the farmers, thereby helping in maximizing technology adoption in the fields and enhancing the profitability of the farmers.

A total of 13 such CoE need to be established in respective NGA of those crops which have the potential for higher profitability and diversification. Five CoEs have already been established in the Punjab state.

Table 2.1: Centres of Excellence (CoE) and Progressive Farmers' Societies (PFS)

Sr. No	Crop Specific CoE	Area proposed	Remarks	Progressive Farmers' Societies
1	CoE for <i>Basmati</i> Crop	Gurdaspur	Should be established	Should be formed
2	CoE for Pulses	<i>Malwa</i>	"	"
3	CoE for Oilseed Crops	<i>Malwa</i>	"	"
4	CoE for Cotton	<i>Malwa</i>	"	"
5	CoE for Sugarcane	<i>Doaba-Bhogpur</i>	"	"
6	CoE for Maize Crop	Garhshankar (Hoshiarpur)	"	"
7	CoE for Organic Farming	Ladhowal (Ludhiana)	"	"
8	CoE for Beekeeping	Khanaura (Hoshiarpur) Dept. of Horticulture, Punjab	"	"
9	CoE for Food Processing & Value Addition	PAU* (IIT-Ropar Supported/Adopted)	"	"
10	CoE for Dairy Development	Kapurthala, Dept. of Dairy Development, Punjab	"	"
11	CoE for Machinery & Equipment	PAU, Ludhiana*	"	"
12	CoE for Integrated Farming and Integrative Income Support	PAU, Ludhiana*	"	"
13	CoE for Small Ruminants	<i>Malwa</i> , (GADVASU)*	"	"
14	CoE for Vegetables	Kartarpur, Jalandhar	Already established	"
15	CoE for Citrus Fruits	Khanaura, Hoshiarpur	"	Already formed
16	CoE for Potato	Dhogri, Jalandhar	"	Should be formed
17	CoE for Floriculture	Doraha, Ludhiana	"	"
18	CoE for Onion	Kheri, Sangrur	Already in progress	"

*Similar set up of PAU and GADVASU as per given organisational flowchart

Note: To establish the state-of-the-art-institutes, budgetary support of Rs.12 crore for each CoE should be provided as one-time grant-in-aid. Similarly, for infrastructural and operational support, Rs. 7 crore be provided to each PFS as one-time grant-in-aid.

Organizational flow chart of Centre of Excellence

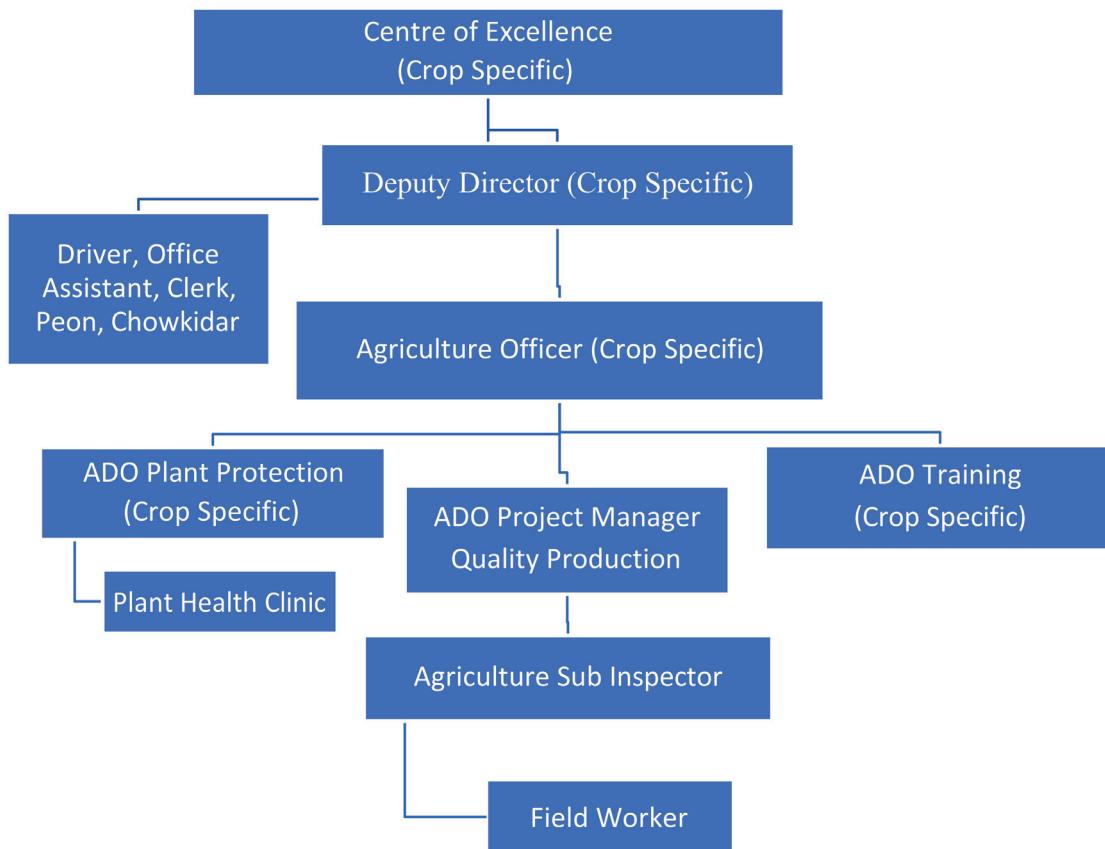


Table 2.2: Details of the Posts at CoE

Description	No. of Posts
Deputy Director (Crop Specific)	1
Agriculture Officer/Asst. Director Horticulture (Crop Specific)	1
ADO/HDO as Project Manager Quality Production	1
ADO/HDO Plant Protection (Crop Specific)	1
ADO Training (Crop Specific)	1
Agriculture Sub Inspector	1
Lab Incharge	1
Office Clerk	1
Office Assistant	1
Driver	2
Chowkidar	1
Field Worker	2
Peon	1
Total	15

2.7 Progressive Farmers' Societies (PFS)

Farmers of Punjab grapple with a multitude of complex issues and challenges that deeply impact their agricultural livelihoods. These issues include a heavy burden of debt resulting from unfair terms of trade, high interest loans, increasing production costs, and market volatility. Likewise, small fragmented holdings along with requirement of large sized modern machinery for cultivation compound these problems, while market price fluctuations and limited access to credit and lack of quality inputs add to their economic instability. Modern agricultural machinery often proves economically unviable for small landholders necessitating revision of the economies of scale to make agriculture profitable for small farmers. Without access to value addition, processing, storage, and marketing, the farmer is unable to unlock full potential of his agricultural products, limiting his economic opportunities and growth potential. Given the present situation of farmers, in general, and small peasants, in particular, operating in individualistic and self-centred mode, the proposed Progressive Farmers' Societies can help to address their issues through cooperative mode in a humanistic spirit.

Mandate

- Quality production
- Value addition/Processing
- Storage and Marketing

How the Society can Deliver

- i. Provision of supporting professional services and facilities from common sources having co-operative mode will help the farmers' families and their decentralized production system to cut on costs and enhance the profit margins with guarantees. These services include providing technical know-how, machinery equipment on rent hire, farm inputs, cold chain and processing and value addition facilities, credit, marketing, group and health insurance support, etc.
- ii. It will help neutralize the constraints of fragmented small holdings in a major way. Also, it will raise their volume of marketable surplus and thus economies of scale, along with power of scale, while keeping the legal independence and economic integrity of the small farms intact (for reasons of diversity and entrepreneurship development of each family farm unit). This proposed registered society has to be nurtured as a socio-economic advisory and supportive entity in such a way so as to retain and maintain the following basics during its formative and operational process and prevent it from becoming an authoritative kingdom of a few commanding the others:
 - a) Democratic management principles
 - b) Economic efficiency

- c) Ethical discipline
- d) Social justice
- iii. It is a move towards a collective economy in agriculture while encouraging natural diversity in all forms. Liaising with AMRII for advance planning of production and marketing support of IAMS, this framework has vast potential to resist monopolies that stand against peoples'/ farmers' welfare.
- iv. It is a synthesis of co-operative planning and farmers' freedom wherein the latter reposes its faith in its larger groups/PFS as a shock absorber avoiding cyclic fluctuations in prices relieving the consumers too with a fair purchase price.
- v. It needs to be recognized that the probability of such co-operation is maximum in the activities, where most of the interests of the farmers are in unison. Single crop-specific activities, ranging from acquiring technical know-how regarding the particular crop to input management, production and marketing, etc. forms the basis of farmers' cooperation through such farmers' crop specific societies.
- vi. The large volume of inputs to be purchased/managed for the farmers of a particular crop by the crop-specific farmers' association will increase their bargaining power vis-a-vis selling companies. The same logic applies to the marketable produce of the specific crop. In case the input purchase volumes are bigger, companies supply direct good quality materials at discounts which enhance the profit margin of the farmers. Similarly, the farmers' associations can bargain the supply price of specific agri-produce with a far stronger position with the buyers. Future contracts of specified quantum and quality of produce are easier through those associations.

In this light, it is proposed that to empower the farmers to contribute to their wellbeing, crop specific farmers' societies, i.e., PFS (Crop Specific) be promoted in the respective NGA of those crops which have the potential of higher profitability and diversification. The mandate of this society will be to promote quality production, productivity, processing and marketing of produce of the member farmers to enhance their profitability in co-ordination with AMRII and IAMS which will be the apex marketing body of the PFS. The list of recommended PFS is provided in Table 2.1.

Progressive Farmers' Society (PFS)

It should be a government assisted registered and autonomous body.

Table 2.3: Composition of PFS

Description	No.
Agriculture Development Officer Field/(Crop-specific Nodal Officer) as Chairman	1
Executive Members (Crop-specific progressive farmers)	15
Nodal Scientist (Crop-specific)/ regional (from PAU)	1
Marketing Expert (Crop specific) (MBA & B.Sc. Agriculture)	1
Manager Cooperative Bank/PADB	1
Secretary MPCS (As Nodal Secretary representing MPCS)	1

Table 2.4: Staff required for the PFS for the management of farm inputs, machinery equipment and marketing services (through outsourcing-placement agency)

Description	No.
Manager of Society	1
Office Clerk	1
Office Assistant	1
Peon	1
Chowkidar	1
Driver	1

Note: PFS should be allotted 2 to 5 acres land as per the nature of crop/alternative for establishing society infrastructure, machinery equipment for rent hire and quality production trials.

Main Tasks

The PFS shall undertake following tasks:

- i. Quality production, seed production with Good Agricultural Practices (GAP) and in organic mode
- ii. Processing and value addition
- iii. Storage, marketing, and future trading

Facilities

The PFS shall have following facilities:

- i. Providing expertise
- ii. Finance–Linked to cooperative societies/PADB at lesser interest rate
- iii. Equipments on rent hire/production related bio-materials
- iv. Infrastructure–Office, seminar hall, processing packaging systems, value addition
- v. Storage–Silos/Cocoon with 5-100 ton capacity as per requirement

2.8 Multi-Purpose Cooperative Societies (MPCS)

The present village with its distressed peasantry, the farm workers and other sections has been allured to follow the self-centred individualistic ways and means to manage their agriculture production, marketing and other operations. It leads to high input costs, lower price discovery of farm produce and inefficient and under-utilization of resources with lower profitability and higher indebtedness.

To offset these constraints, it is of utmost necessity to promote cooperative institutional framework at grassroot level as MPCS in a group of 3-5 villages for economies of scale to facilitate the peasantry, farm workers and other sections. While retaining the legal independence and economic integrity of their diverse production units in respective NGA, it will utilize the pooled common resources for production, processing, and marketing.

Mandate

- Input supply
- Value addition/Processing
- Storage and Marketing
- Credit facilities
- Other Livelihood Support Services

These MPCS having 500-600 families of farmers, farm workers and other sections would be supported with many facilities for cost efficiency, and productive employment generation in rurality. It has a potential to have gains and bargains of the common larger pool of inputs, quality produce, storage and processing systems.

The range of facilities to be promoted in community mode as per the cropping pattern and other requirements of the MPCS command area and its activities falling in the respective NGA are given as under:

- i. Market outlets for perishables and non-perishables with insulated cold rooms to sell the farmers' diverse produce of the MPCS command area with self-price discovery for self-consumption of this community, while the surplus produce going to the cities through MPCS marketing vehicles with quality certification and transparency identity code.
- ii. Diverse processing value addition equipments like oil extraction, flour mills, processing and packing of pulses and spices; fruits, vegetables and sugarcane processing/juice vends; honey, mushroom and milk processing units.
- iii. Latest efficient machinery equipments on custom hire basis as service providing system.
- iv. Quality inputs like certified seeds, fertilizers, pesticides, bio-inputs at bargained prices preferably from producer suppliers.

- v. Solar-supported small cold stores, pack houses, small silos/cocoons for storing farm produce during glut periods with stock loan provision and disposing in lean periods to earn higher values.
- vi. *Gobar* gas plants with direct biogas connectivity to kitchens. Such *gobar* gas plants to be supported by one or two incentivized micro dairies in MPCS command areas for production and supply of quality milk within one hour of milking to the 500-600 families. The surplus milk to be processed at MPCS with common facilities.
- vii. Provision of cheap credit from cooperative banks/Punjab State Cooperative Agricultural Development Bank (PADB) and 24 hour credit facility for emergent situations.
- viii. Sewage treatment plant to treat and use waste water for agro-forestry plantations.
- ix. Diesel/petrol pumps as nearest fuel sources for the provision of additional farm inputs to farmers.
- x. Skill development facilities to generate employment, poverty alleviation, enhancing entrepreneurship and global competitiveness.
- xi. Recreation, cultural and sports centres along with other required/need based provision for promotion of physical and mental status of rural communities.

2.9 Institutional Work Linkages

Crop specific CoE and PFS shall be organically linked and shall meet atleast once every month or as required to learn how to produce quality at minimal costs. These organizations will have close coordination with the AMRII, IAMS and MPCS for tuning the production as per market demand and to market the produce profitably in domestic and global markets.

Having knowledge of the preferences of the consumer buyers and then helping at the grassroot level in developing the required unique intrigues/characters of the specific produce/product as its attractive marketing features to earn/dictate higher market prices, the local market expert of the PFS will be an active co-coordinative value addition personnel to shape the produce as per consumer demand.

2.10 Institutional Framework and Agriculture Development

The proposed multistage co-ordination of co-operative institutional frameworks shall form the most cost efficient and profitable arrangement for quality agricultural production, value addition and marketing with self-price discovery at grassroot level in the respective NGA.

Utilizing the unique potential of each in the division of labour with all-round guaranteed support in a community mode, this arrangement will not only deliver the required diverse quality products, but also improve the happiness index of both the producers and consumers. It will check the depressive tendencies, thus, arresting the alienation process for better contribution to the agricultural and rural development process.

2.11 Governing Body

The Governing body is proposed to efficiently coordinate the operations of these “Institutes of Farm Sector Excellence”. The proposed committee will be headed by Vice-Chancellor, Punjab Agricultural University, Ludhiana as Chairman and Director of Agriculture as member secretary. The Vice-Chancellor of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana and Director Horticulture, Director Dairy Development will be members of the body. One member each from Cooperation, Agricultural Marketing Research and Intelligence Institute, Innovative Agricultural Marketing Society, and Secretary of Multi-Purpose Cooperative Society will also be members of the body. Similarly, five representatives from Centres of Excellence and five farmers from Progressive Farmers’ Societies will be members of the body. These members of CoE and PFS should be rotated after three years for better representation from amongst their respective organisations. This governing body will coordinate the functioning of these institutes of Farm Sector Excellence as per their respective mandates to make the state’s agriculture healthier, profitable and globally competitive. However, head of each Institute of Farm Sector Excellence shall be responsible to maintain the required discipline to fulfil the mandated tasks of respective organisations.

Policy Recommendations

1. **Establish Institutes of Farm Sector Excellence:** Develop Natural Growing Areas (NGA) and establish Institutes of Farm Sector Excellence as detailed from section 2.1.1 to 2.11.
2. **Establish Price Stabilization Fund:** A Price Stabilization Fund (PSF) should be established by the state government to the tune of Rs. 1000 crore with an equal share of the Union government to protect the farmers against price fluctuations for all crops (including bee products and milk) where procurement at MSP is not operative. Public institutes like Markfed, Punjab State Warehousing Corporation, Punjab Agro, Milkfed, and Punjab Mandi Board should intervene to stabilize prices during the glut period, individually or jointly, as per their respective domain.
3. **Value Addition and Marketing by Cooperatives:** a) The public sector organizations - Markfed, Punjab Mandi Board Milkfed (Verka) and Punjab Agro Industries Corporation

(PAIC) with their collective strength and marketing acumen should jointly market the processed agriculture products of Punjab, retaining their product identity but under the common brand of “Punjab Foods” or similar brands in common/joint outlets in domestic and global markets to be a force to reckon with. Similarly, nutraceuticals, phytochemicals, gluten and other valuables should be extracted and marketed by these cooperatives. However, with the mandate to be in service of Punjab’s farmers, these organizations should share a part of the earned value back to the farmers.

b) State agencies like Markfed, PAIC, Milkfed should come forward with fair price support for large-scale processing, storage and marketing of basmati, oilseeds, pulses, other crops of diversification and livestock/bee products as a regular feature to help farmers to diversify by paying back a part of earned value to the farmers. In case of perishables, state agencies like Markfed should intervene itself or in coordination with PAIC with fair price support to stabilise the prices during glut period with the Price Stabilisation Fund (PSF) with advance planning by disposal of the produce either through fresh export or storage or processing.

c) The Punjab Agri Export Corporation (PAGREXCO) should be strengthened with sufficient domain experts to facilitate the export of farm produce through seaports and by air to get higher returns for the farmers.

d) Regular assessment of these public sector organisations should be done with the participation of governing body to evaluate their progress.

4. Establish State Agricultural Costs and Prices Commission: A State Agricultural Costs and Prices Commission should be established to provide cost and return estimates for all crops, dairy products and eggs so that remunerative prices can be given to the farmers. These estimates may also be used for fixation of compensation/relief, credit limits and other related issues. For the betterment of farm sector, it is significant that a legal guarantee of procurement at MSP should be established. For crop diversification in the state, a comparative returns pattern should also be taken into consideration while fixing the prices of non-MSP crops, so that farmers can shift their cropping pattern from wheat-paddy to alternative crops.

At this juncture, the Punjab government should hold a dialogue with the Union government for establishing a legal guarantee of procurement of MSP crops cultivated within the state. Atleast the MSP of all crops should be fixed as per recommendations (GOI, 2006) of the National Commission on Farmers ($C_2 + 50\%$) (Swaminathan Report). However, C_2 should be based on (GOI, 2015) (Ramesh Chand Committee Report), which includes the following additional costs (i) head of the farm households should be considered as a skilled

worker rather than a manual worker as is prevalent; (ii) interest on working capital should be accounted for the whole season in contrast to the prevalent practice of estimating it for half season; (iii) actual land rent to be accounted without any ceiling rate; and (iv) engendering post-harvest costs like cleaning, grading, drying, packaging, marketing and transportation costs. As per this criterion, the MSP for wheat, during 2020-21, should have been 45 per cent higher (Rs 2787/q) than the MSP (1925/q) given by the Government of India. (Annexure V). To ensure the long-term sustainability and prosperity of the farm sector, it's crucial to develop marketing infrastructure and strategies that deliver Fair and Remunerative Prices (FRP) to farmers for all their produce.

- 5. Subsidized Transportation for Perishables:** To avoid the glut of perishables during peak production periods in Punjab, the government should subsidize transportation charges for inland haulage, by road & rail and ocean freight & air cargo for distant domestic markets and export along with cold chain linkage facilities from field to destination.
- 6. Trade with Pakistan and West Asian Countries:** Although Indo-Pak trade through Kandla port (Gujarat) remains operative, but this facility is not available for the Punjab state with respect to Attari-Wahga border. The farmers of Punjab and all neighbouring states i.e. Himachal Pradesh, Jammu and Kashmir, Ladakh, Haryana, Rajasthan will benefit significantly if the land route through Attari-Wagah border is opened up for trade between India and Pakistan & West Asian countries. The Punjab government should hold dialogue with the Union government to end this discrimination.
- 7. Wood Market:** To promote agroforestry, a timber market is urgently required; Dasuya Hoshiarpur Road can be an ideal location for this market. The government should also develop four-five modern timber markets with the latest infrastructure for sawmills, drying, and seasoning so that farmers or their organisations may utilise these facilities to create value-added products.
- 8. Provision of Market Outlets to Farmers:**
 - a)** Establish Multi-Purpose Cooperative Societies (MPCS) to facilitate the marketing of agricultural produce from villages served by these societies. These societies should open outlets and also establish channels for direct home delivery of fresh products like sugarcane juice, *kinnow* juice, etc. and freshly cooked diverse food items. Additionally, they should market processed products by opening mega stores in neighbouring towns and cities.
 - b)** The Department of Agriculture and Farmers' Welfare should open "Kisan Huts" at district headquarters or other potential areas of produce in order to provide monetary benefits to both

farmers and consumers by reducing the number of intermediaries. Similarly, the government should provide market yards/required infrastructure to the group of farmers for selling their produce/products in towns/cities.

9. **Improve Agri-Markets:** The entire crop produce should be recorded and accounted for by using latest technologies like CCTV, and electronic devices, which will help enhance market efficiency, transparency and government revenue.
10. **Develop Zirakpur/Mohali as Market Hub:** With a view to Chandigarh-Jaipur corridor having connectivity with Kandla port, Zirakpur/Mohali market hub should be developed to market fruits and vegetables of Punjab, J&K, Ladakh, Himachal Pradesh, Haryana and others to reduce the transportation expenses by avoiding long route through Delhi. It will open up the export opportunities to Afghanistan, Russia and other countries through Chabahar port of Iran.
11. **Ensure Fair Bidding:** Punjab Mandi board should ensure fair bidding for perishables in the market. Commencing bidding as early as 4 AM proves inconvenient for farmers, leading to their absence during the bidding process due to inconvenient timings and other challenges. Ensuring fair bidding for all farmers' produce requires implementing a suitable time schedule across the state.
12. **Rationalize Wholesale-Retail Pricing :** Rationalize the relation between price of the farmer's produce in the wholesale market and the retail price set by retailers for the consumers to check inflation and exploitation of both the farmers and the consumers.

3. ECO-SYSTEM AND CLIMATE CHANGE

Mode of development globally pursued in the past has largely contributed to greenhouse gas emissions leading to climate change. This phenomenon has severely affected the agricultural production of the world. The impact of climate change has led to numerous tribulations for agriculture such as rising temperature, longer summers, droughts and erratic rainfall, all of which have negative impact on agriculture sector. In the recent years, effect of climate change is also being witnessed in Punjab agriculture, where sudden increase in temperature at terminal stage of wheat and mustard has resulted in significant yield reduction. Rice-based intensive agriculture has brought in many problems like groundwater depletion, air pollution due to crop residue burning, loss of biodiversity, emerging biotic stresses, drainage-related challenges, etc. Besides drawing heavily on the energy budget of the state, increased groundwater extraction for irrigation has a large carbon footprint as well.

The state needs better strategies to mitigate the adverse effects of climate change on the agriculture of Punjab, along with an all-round approach for the conservation of fastly depleting natural resources. A healthier agriculture approach should seek to utilize natural resources in such a way that farmers can regenerate their productive capacity and minimize harmful impacts on ecosystems. It should focus on building healthy soil, preventing erosion, managing water wisely, minimizing air and water pollution, promoting biodiversity, and increasing resilience to extreme weather.

The influence of agriculture and allied activities on ecology of the state has been profound. On one hand, certain adverse effects such as air pollution in peak harvesting seasons, groundwater depletion, pesticide residue in food chain, loss of biodiversity due to mono-cropping, and greenhouse gas emissions are observed. Conversely, the positive impacts of farming on ecology significantly outweigh the negative ones. The agriculture sector plays a crucial role in enhancing carbon sequestration, acting as a vital absorber of CO₂ emissions and serving as an effective carbon sink. Furthermore, it contributes positively to air, soil and water quality, promotes stability in food and livestock production, and preserves the resource base for future generations. Notwithstanding these positive contributions, it is important to acknowledge that there exists substantial room for improvement within the agricultural sector. Concerted efforts from both farmers and government are required for enhancing its positive impacts on ecology while mitigating the negative repercussions.

Policy Recommendations

- 1. Pollution Check Regulations:** The Punjab Pollution Control Board (PPCB) should effectively

monitor, promote, and enforce clean energy sources. It should work on improving industrial emission controls, strengthen vehicle emission standards, waste management and recycling, afforestation and green spaces, along with water pollution control and air quality monitoring.

2. **Carbon Credit Rewards:** Agro-forestry, horticultural plantations and other crops are good carbon sinks. By implementing Good Agricultural Practices and water-saving technologies, carbon credit gains can be further enhanced. The state should designate PAU as a nodal agency to ensure that the farmers are rewarded with carbon credit gains for their contribution to carbon sequestration.
3. **Promote Solar System:** To fulfil the energy requirements of agriculture, industry and domestic & office establishments, the clean green solar energy systems should be supported on large scale.
4. **Upgrade Testing Laboratories:** Mapping of the soil and water health of the state should be undertaken to take remedial measures with precision.
 - a) Mobile soil and water testing labs are required to be set up in the state. The hi-tech labs for the testing of soil, water, seed, and chemical (pesticide/fertilizer) operated under the Department of Agriculture should be strengthened and upgraded. All testing facilities should be made available to the farmers at nominal charges.
 - b) Soil health cards should be prepared for every farmer in the state so that balanced use of inorganic and organic fertilizers can be ensured. The Soil Health Index of every farm should be made available on the official site of the Department of Agriculture and Farmers' Welfare.
5. **Screening for Climate Resilient Germplasm:** Climate change is now a serious threat to crop productivity. Therefore, the reorientation of crop breeding programmes in terms of genetic and genomics as well as trait profiling and screening strategy of germplasm are urgently required.
6. **Conservation Agricultural Practices:** a) Emphasis should be placed on promoting--natural and regenerative agricultural practices, land restoration to improve productivity, soil health, nutritional value of food produced, and reduction in greenhouse gas emissions in agriculture. The issue of crop residue should be addressed largely through *in-situ* management.
b) The government should ensure that existing crop residue management machines are operated at their maximum capacity.
c) Plants that create imbalances in eco-systems should be replaced with beneficial green cover foliage. This will increase the diversity of local flora and fauna, which is essential for the biodiversity and conservation of endangered local species.

- d)** Effective monitoring by the government is urgently required to check the illegal mining of agricultural lands.
7. **Promotion of Area under Forests and Wetlands:** Promoting forest cover and wetland conservation in Punjab is need of the hour. A well-coordinated approach that combines afforestation, community participation, and sustainable forest management practices can contribute to the expansion and protection of forests in the state.
8. **Awareness Campaign:** A mass awareness campaign should be launched regarding the conservation and judicious use of natural resources, along with the prevention of air and water pollution.

4. LAND

The Punjab state has a total geographical area of 50.3 lakh ha, out of which 41.27 lakh ha (82%) is under cultivation. The cropping intensity of Punjab is 189.7 per cent. Area under forests in the state is 4.87 per cent against the national average of 21.7 per cent. In contrast, the land put to non-agricultural use in the state has been steadily increasing, rising from 6.8 per cent of the total geographical area in 1990-91 to 10.2 per cent in 2021-22. Despite the paramount importance of land in agricultural production, the land area under agriculture is shrinking day-by-day due to the rapid urbanization, road networks and other non-agricultural purposes. The average size of operational land holding in the state declined from 3.77 ha in 2010-11 to 3.62 ha in 2015-16 wherein the hierachal subdivisions from generation to generation also become a major contributing factor. Moreover, the prevailing farm technologies are not the best fit for small farms, consequently affecting the economies of scale.

While farming on owned land remains predominant in Punjab, the land leasing market has been steadily gaining ground in this sector. As per estimates of NSSO (2012-13), more than 24 per cent of the cultivated area in Punjab is under tenancy. It is believed that long-term tenancy and land-leasing arrangements would lead to optimum utilization of land and investment. In this context, it is imperative to address issues related to the land lease market, land tenancy laws, and other land-related matters to ensure that farming becomes a profitable occupation.

One of the primary challenges faced by rural Punjab is land disputes. Out-dated land records, unclear titles and existing land laws have driven many individuals towards court cases to seek justice. As a result, it breaks fraternity, kinship, and social harmony and weakens the economic position of the people. Addressing these challenges requires a wide-ranging policy intervention which involves legal and social reforms, community engagement, and other effective measures.

Policy Recommendations

- Tenancy Law Reforms:** In Punjab, land tenancy laws need to be looked upon. Currently, land leasing in the state is done verbally on an yearly basis popularly known as *theka* (contract system). Under this system, tenancy agreements are not formally recorded in the name of the actual cultivators due to landowners' fears that such registration may grant tenants certain rights, preventing eviction. This practice is operating against the tenant cultivators as the unregistered tenants cannot claim the *Kharaba* (compensation) in case of crop failure due to

natural calamities and are deprived of the facility of crop insurance. Also, these unregistered tenants cannot become effective members of any cooperative credit society, and therefore, are not eligible to avail credit and purchase farm inputs from societies. Similarly, due to mechanization and migration, the system of reverse tenancy is prevalent in the state as small and marginal farmers lease out land to large farmers. Likewise, Non-Resident Indians (NRI) lease out their land to other farmers. Many a times, there are disputes among tenants and landowners due to unregistered lease of land. Therefore, the tenancy laws need to be reformed to protect the interests of both the tenant and landowner. The rental income from leased land should be exempted from income tax, as income derived from agriculture is currently exempted.

2. **Land Records:** For ensuring transparent and efficient land transactions and averting land disputes, data regarding land ownership should be digitized and updated in a time-bound fashion. Land ownership passbooks linked with *Aadhaar* cards should be issued to land owners. Every transaction of sale and purchase of land should be entered and updated in the passbooks. Similarly, transactions related to loans and lease/mortgage of land should be recorded in the passbook.
3. **Panchayati Land:** a) *Panchayati* land should be clearly identified in a time-bound manner and village-wise information should be put on a government website, for transparency and to check illegal encroachments.
b) Each cooperative society should be allocated atleast one acre of suitable *Panchayati*/ government land in order to make societies able to avail benefits of various central schemes such as setting up cold stores, petrol pumps, warehousing, etc.
4. **Punjab Land Revenue Act Reform:** The Punjab Land Revenue Act, 1887 needs to be suitably amended for speedy settlement of land division cases. The *takseem* process needs to be simplified and executed within a stipulated period of inheritance.
5. **Land Administration Reforms:** a) Outdated title registration rules of pre-independence era continue to be in force. Sale-purchase and transfer agreements should be recorded in simple language and *Vasika Navees* (document writers) and mediators should be replaced with government employees. The applications/documentation preparation and other formalities should be completed by the government employees. To check corruption, *Suvida* Centres or digital facilities should be provided for ensuring transparency in the transactions. Timelines and rates of all services should be displayed outside the office and proper receipt should be

issued to the clients. Clients should directly submit/handover documents to the registration officers without intermediaries.

b) Due to considerable volume of land transactions and unfilled administrative positions, the administrative employees are experiencing a heavy workload. In order to facilitate farmers, streamline land ownership procedures, alleviate the workload, and improve transaction efficiency, it is imperative to fill vacant positions, particularly those of *patwaris*.

6. **Transfer of Agriculture Tubewell Power Connections:** Tubewell power connections are registered in the name of land owner. With the sale/purchase and transfer of land, the ownership of tubewell power connections should also be transferred as per the ownership of land.
7. **Land Demarcation:** The entire agricultural land of the state should be clearly demarcated using latest technologies such as cadastral mapping through remote sensing.
8. **Dissemination of Information:** The revenue department should actively educate the public on matters related to land transactions, individuals' legal rights, demarcation procedures, and other aspects of land administration to increase awareness and reduce corruption.

5. CROP SECTOR

The importance of Punjab's crop sector lies in its contribution to national food bowl making it self-sufficient along with political stability, enriching state's economy and providing productive employment to masses.

Its crop diversity, though with foodgrain i.e. wheat-paddy dominance, promoted to feed the nation along with virus-free seed potato, *kinnow* mandarin as health capsule are amongst some of its star attractions.

However, paddy, in the wheat-paddy monoculture of Intensive Agriculture Model has adversely affected the states' ecology deteriorating its soil and microflora, underground water status, air quality and bio-diversity making the system unsustainable and unhealthier for the society. It needs a change to restore states' ecology and strengthen its economy for improving the happiness index of all the stakeholders.

In this background, it needs to be emphasized that natural endowments of Punjab has the potential to grow diverse crops of hot market demand in its NGAs with better quality at minimal costs to make it globally competitive and profitable. It just needs a price-policy push to promote this sector for diversification as per state's emerging needs with required support as detailed here as under:

5.1 Quality Seed

Seed is the basic input in agriculture. The impact of investment in research can only be realized, if farmers have better access to high quality seed of the improved varieties at reasonable costs, near to their production sites. The seed of recommended varieties for a particular region must be true to its type and have the potential to germinate and perform under field conditions to harness maximum potential. The Punjab's annual requirement of wheat, paddy and potato seed is 35, 5.7 and 46 lakh quintals, respectively. Similarly, seed of more than 50 field crops and vegetables is required in the state. Moreover, seed demand of other states and countries needs to be captured by assuring certified quality seed supply which requires focus to promote seed industry in the state.

Policy Recommendations

- 1. Develop Seed Hubs:** Develop Punjab as "Seed Hub" by developing seed village clusters in the state. The clusters can be made as per suitable ecology for seed production of selected crops e.g. potato in *Doaba* region; wheat and paddy in Ludhiana, Sangrur, Barnala and Moga; pea in Patiala and Fatehgarh Sahib; *Basmati* in Gurdaspur, Tarn Taran and Amritsar; onion

and garlic in Bathinda and Mansa; radish in Gurdaspur.

2. **Facilitate Seed Producers:** The seed producing organizations, groups and individuals in each cluster should be provided with all technical know-how for quality seed production, grading, storage, marketing and traceability set-ups not only to cater the state needs, but also to enter in markets of other states and countries.
3. **Enforce Seed Act:** The enforcement of the Seed Act, 1966 should be ensured for production and distribution of the quality seed.
4. **Promote Recommended Varieties:** Only recommended and adapted varieties should be promoted for saving natural resources and checking the spread of insect-pests and diseases in the state.

5.2 Wheat and Paddy

Wheat and paddy occupies central position in food security of the country. In Punjab, wheat is grown on 35.1 lakh ha with 165.6 lakh tonnes production and paddy on 31.6 lakh ha with 205.2 lakh tonnes production (2022-23) (Annexure VI). The average productivity of wheat-rice system in the state is 11.5 tonnes/ha. Paddy occupies over 75 per cent share of total cropped area during the *kharif* season. Punjab is consistently contributing a major share of foodgrains in the central pool, i.e. 21.2 per cent of rice and 51.3 per cent of wheat during 2021-22.

The wheat and paddy combination ensures stable income and complements food security needs of the country. However, in this crop cycle, paddy is becoming a predominant cause of underground water depletion at very fast rate. The natural resources like soil, air and biodiversity are also being affected due to its cultivation.

Policy Recommendations

1. **Focus on Trait Specific Varieties:** In wheat, trait specific, and nutraceutically rich varieties like PBW 1 *Chapati*, PBW RS1, WHD 943 have been developed for consumer specific markets. Processing for its value-added products should be supported at MPCS.
2. **Enhance Nutrition with Biofortified Wheat:** To combat micronutrient deficiency, promote biofortified wheat varieties like PBW 1Zn and PBW Zn2 through public distribution system and mid-day meal at the subsidized rate. Similarly, resistant starch variety PBW RS1 needs support for promotion and marketing to tap the demand of diabetic patients at the national level.

3. **Organic Wheat Production, Value Addition and Marketing:** The organic wheat production segment needs attention to meet the consumers' demand for safe and healthy food. The combination of organic and trait specific products of wheat can fetch more premium in the market, which should be promoted through MPCS.
4. **Enhance Synergy between Researchers and Stakeholders:** Wheat grain quality-related breeding, processing, and marketing research needs to be done, for having the synergy between public agricultural universities and the grassroot farmers' organizations.
5. **Storage at MPCS:** Develop Multi-Purpose Cooperative Societies for storage of wheat in silos/cocoons at the village level. The holding of wheat for two or more months will add value and avoid peak period glut.
6. **Promote Short Duration Paddy Varieties:** Encourage short duration paddy varieties such as PR 126 by procuring at a bonus price, while long-duration varieties of paddy should be completely banned in the state.
7. **Incentivize Use of Water-Efficient Technologies:** Better quality and yield of paddy can be obtained with 30-40 per cent less irrigation water compared to puddling system using different water saving technologies like - alternate wetting and drying without puddling, drip irrigation systems and others. It improves soil health, percolation of water and leads to lesser methane emissions, therefore new technologies should be incentivized and research and extension should focus on these alternatives, however puddling should be discouraged and banned in a phased manner.
8. **Enforce Water Preservation Act:** The government should ensure compliance of the Punjab Preservation of Subsoil Water Act, 2009 and early transplanting of the paddy should be avoided.
9. **Restrict Paddy Cultivation on *Panchayati* Land:** *Panchayati* land should not be leased out for cultivating the paddy crop.
10. **Incentivize Paddy Straw Management Technologies:** Technology base for managing the paddy straw in environment-friendly way is sufficiently large and its adoption needs to be incentivized through the financial support.

5.3 Diversification in Agriculture

Crop diversification is imperative, both from economic and ecological viewpoints. Hence, the government should facilitate the preparation of Area Specific Crop Production Plans (ASCPP) based on harmonizing natural endowments and market demand. It should be

ensured that all investments and efforts of various departments are in-sync with diversification goals. To make the diversification efforts successful, crops other than paddy need urgent attention. The block-wise planning of diversified crops is required as per ASCPP, considering the yield potential and niche area of the alternative crops. To raise the living standard, farmers should be encouraged to diversify from mainstream agriculture to horticulture, beekeeping, fish farming, mushroom cultivation, etc. by making such alternatives profitable. It should be promoted by forming Crop Specific Farmers' Societies/Multi-Purpose Cooperative Societies (MPCS).

5.3.1 Basmati

Basmati plays a significant role in diversification plan, particularly in the northern states of the country. However, *Basmati* export is becoming challenging due to strict norms for pesticide residues. Therefore, to promote this crop, it is imperative to meet the minimum pesticide residue standards set by the European Union and other importing countries by strengthening the extension system. Implementation of the recommended measures will facilitate the growth and export of *Basmati* from the state.

Policy Recommendations

- 1. Establish CoE and PFS:** **a)** Establish a Centre of Excellence (CoE) for *Basmati* in its NGA in district Gurdaspur for demonstration of latest technologies, training and participatory research with its stakeholders.
b) Form PFS (*Basmati*) along with CoE (*Basmati*) as an autonomous registered body to promote quality production, value addition, processing and storage, and marketing. It should help to lead the Basmati farmers having liaison with the institutes of farm sector excellence.
- 2. Adopt Good Agricultural Practices:** Shift *Basmati* rice production to Good Agricultural Practices (GAP), or organic cultivation. As per new National Export Policy, organic produce does not attract restrictions such as minimum export price, quota cappings, etc. Higher value can offset freight costs, and two crop system optimises use of infrastructural and other facilities. The produce would also not encounter pesticide residue issues. Expansion of organic certification and setting up of traceability mechanisms would be a pre-requisite to this shift. Organic *Basmati* crop can be rotated with organic wheat crop (preferably of specialty traits) as there is high demand for local organic wheat.
- 3. Explore Domestic Market:** Explore domestic market with the aim to expand consumer base in the growing middle-class segment. Creation of a high quality, affordable brand for regular use in North-western Indian households is required for sustaining greater acreage under

Basmati crop.

4. **Price Stabilization Fund:** Markfed should intervene with Price Stabilization Fund in the situation of price distress of *Basmati*.
5. **Strengthen Quality Control Laboratory:** Strengthen the Quality Control Laboratory (QCL) of Punjab Horticultural Post-harvest Technology Centre (PHPTC) in PAU, Ludhiana with capacity to detect low levels of pesticide residues (as stipulated by importing country regulations) to meet the standards of foreign markets.
6. **Provide High Quality Seed:** Provide good quality and disease free seed of recommended varieties (like *Pusa Basmati 1121*, *Pusa Basmati 1509*, *Punjab Basmati-7*) in the state.
7. **Ensure Procurement:** Ensure hassle-free procurement of *Basmati* at profitable price (having gross returns more than paddy) in the designated markets.

5.3.2 Cotton

Cotton is the second most important crop after paddy during *kharif* season in Punjab with localized cultivation in South-western districts. Its area ranged from 4 to 6 lakh ha for most of the years, with maximum 7.58 lakh ha during 1988-89. However, in the recent past, there was a drastic fall in the area as during 2022-23 as the area under cotton was only 2.4 lakh ha (Annexure VI). This is mainly attributed to increased vulnerability of the crop to insects-pests and diseases due to surrounding puddled area having high humidity, low quality seed and inputs and crop price fluctuations. Further, the canal water/power supply uncertainties and high labour cost have also led to reduction in crop area and its sustainability.

Policy Recommendations

1. **Establish CoE and PFS:** **a)** Establish a Centre of Excellence (CoE) for cotton in its NGA in *Malwa* region for demonstration of latest technologies, training and participatory research with its stakeholders.
b) Form Progressive Farmers' Society (Cotton) along with CoE (Cotton) as an autonomous registered body to promote quality production, value addition, processing, storage and marketing and to lead the cotton farmers by having liaison with the institutes of farm sector excellence.
2. **Timely Canal Water Supply:** In cotton belt, ensure canal water availability from mid-April onwards for timely sowing before 15th May.
3. **Discourage Paddy in Cotton Areas:** Discourage paddy cultivation and incentivize cotton in the defined cotton zones of South-western districts. The entire block having large area under

one crop will develop suitable ecology for better performance and pest management in cotton. Transplanting of paddy and cotton simultaneously in same blocks enhances the humidity and creates conducive conditions for perpetuation of cotton pests.

4. **Promote Micro-irrigation:** Promote and support micro-irrigation for cotton-wheat rotation in conjunction with solar pumps and water storage structures on the individual farms.
5. **Ensure Quality Seed Supply:** Provide quality seed of recommended varieties at subsidized price to the farmers.
6. **Provide Extension Services:** Provide intensive extension advisory for cotton crop with advance planning covering all aspects regarding land preparations, quality inputs, quality produce, harvesting and efficient marketing.
7. **Ensure Price Stability:** Market intervention by the state government and Cotton Corporation of India to provide fair price for cotton to avoid losses to farmers in the event of fall in prices.
8. **Strengthen Cotton Research:** Strengthen research on development of varieties having genetic resistance to American bollworm, pink bollworm, whitefly and cotton leaf curl virus to lower the pesticide use, enhance productivity and sustainability of the crop. Similarly, to reduce the labour-intensiveness, develop varieties suitable for mechanical picking of cotton.

5.3.3 Maize

The *kharif* maize is cultivated in the districts of Hoshiarpur, SBS Nagar, Rupnagar, and Pathankot, whereas, the spring crop is mainly grown in Jalandhar, Kapurthala, Ludhiana, Moga, SBS Nagar, and Hoshiarpur. At present, maize is cultivated on more than 2.0 lakh ha area predominantly during spring season, owing to high productivity in this season. Kharif maize occupied 5.77 lakh ha area in 1975-76, which was comparable with paddy (5.67 lakh ha) and cotton (5.80 lakh ha). In Punjab, maize grain used by the feed, starch and other processing industry requires about 5.0 lakh ha land to produce the required quantity, but it is largely coming from the other states, mainly Bihar. So, this competitive potential can be tapped by lowering the production cost and increasing the productivity. Its potential as fodder, silage, sweet corn, baby corn, popcorn and ethanol production can also be tapped.

Policy Recommendations

1. **Establish CoE and PFS:** **a)** Establish a Centre of Excellence (CoE) for Maize in Garhshankar, district Hoshiarpur in its NGA for demonstration of latest technologies, training and participatory research with its stakeholders.
b) Form Progressive Farmers' Society (Maize) along with CoE (Maize) as an autonomous

registered body to promote quality production, value addition; processing, storage, marketing and to lead the maize farmers having liaison with the institutes of farm sector excellence.

2. **Incentivize Maize Cultivation:** Develop mechanism to remunerate maize production for the area shifted from paddy. Though water saving is the prime objective, but anticipation in terms of electricity subsidy can also be counted. The traditional maize growing blocks showing rapid underground water depletion should be targeted for area expansion under maize.
3. **Strengthen Maize Supply Chain:** The maize agro-industry needs to be facilitated and encouraged to source their material from Punjab itself. Presently, a large quantum of maize is being brought into the state from Bihar, Maharashtra, Karnataka, Gujarat and Rajasthan for production of cattle and poultry feed, starch and processed foods. However, grain moisture of the local produce is a major issue with the private procurement agencies. For this, maize dryer of appropriate scale are needed to be set up in the market channels/MPCS for drying the grains on fee for service mode.
4. **Use of Maize in Animal Feed:** There is a need to implement norms for feed quality to ensure the use of nutritionally better maize grain in the manufacturing process rather than any other grain.
5. **Modernize Maize Processing Facilities:** State-of-the-art maize processing units need to come up in the state. The mega food park being set up at Phagwara (which will have a major maize processing facility capable of handling 600 tonnes/day) should be supported to ensure the procurement of maize from its vicinity by removing the bottleneck with respect to its viability.
6. **Promote various Segments of Maize:** The area under baby corn, sweet corn and popcorn can be increased by developing processing units, cold chain facilities and developing linkages with national and international markets.
7. **Subsidize Machinery:** Machinery like bed planter/pneumatic planter for proper germination and optimum plant stand, power sprayers for efficient weed control and dehusker-cum-sheller for shelling of grains need to be subsidized/provided at MPCS for rent hire.
8. **Promote Drip Irrigation:** Promote drip irrigation for general cultivation of maize, as well as mandatorily for the spring maize to improve its quality and save water.
9. **Early Harvesting of Spring Maize:** Spring maize grown for grain and silage making must be harvested in end April with a regulatory provision for saving water and breaking the fall armyworm cycle.

10. Establish Marketing and Processing Infrastructure: The five blocks of district Hoshiarpur cultivating maize on a large scale, should be treated as a zone and the government should develop maize marketing and drier facilities at the local level, food processing plants, and ethanol plants. The ethanol production from whole maize grains should also be allowed, since at present, its provision is only from the cut-grains.

5.3.4 Sugarcane

Sugarcane is a unique agro-industrial crop with a hundred per cent processable biomass production, thus having the potential to add and earn value to energize the rural economy of the state. Its hardiness and harsh weather tolerance makes it less risky in the face of weather disruptions due to increasing global warming, the Al Nino, the La Nina and the power and canal water uncertainties.

This sweet segment of agriculture has diverse value addition options like healthier fresh juice, jaggery (*Gur, Shakkar*), white crystal sugar in different forms, and utility of its by-products for co-generation, distillery for ethanol or ENA (Liquor), bio-CNG, nutritional compost and mulch materials, etc. This exhibits its higher income earning potential as a valuable diversification crop. Further, its productive potential of 80–150 tonnes/ha in its NGA in Punjab makes it a big carbon sink that qualifies it as a good case of earning carbon credits for the farmers to enhance their profitability.

Also, with a view to the water use efficiency per acre, the sugarcane crop with the support of water-saving technologies, like drip, trench, bed and mulch systems with added advantage of percolation, fairs better than the wheat-paddy combined. Sugarcane consumes only 9000 m³/ha water compared to 19750 m³/ha water in case of wheat-paddy combined.

But despite its agro-climatic suitability and importance in enriching the rural economy along with eco-gains, the area under sugarcane has rapidly declined during the past two and a half decades. The reasons for this decline in area and production need to be assessed for taking remedial measures to rejuvenate the state's sugarcane industry.

During the liberalization, the sugarcane development scheme of the State Department of Agriculture was discontinued in 1993, by the state withdrawing an effective extension advisory from the farmers and weakening the regulatory cover which checked the exploitative tendencies of the vested interests in sugar mills. Further, the Sugarcane Research Station (SRS), Jalandhar, which was established as a sub-station of SRS, Risalewala (now in Pakistan) in 1934 and upgraded as Sugarcane Research Station in 1947, was shifted outside sugarcane NGA to Ladhawal (Ludhiana) in 2002, thus affecting the sugarcane research adversely. With

weakened research, extension and regulatory cover, the area and production of sugarcane declined yielding space to water-guzzling paddy, and consequently, the sugar mills with the shortage of cane became unviable. As a result, out of 22 sugar mills in the state, six mills were closed owing to facing difficulties in making timely payments to the farmers. Later in 2012, Sugarcane Research Station was again shifted to Kapurthala in its NGA as a Regional Research Station, but without the required budgetary support and scientists' strength.

Table 5.1: Sugarcane production and sugar mills in Punjab

Year	Area (Lakh ha)	Production (Lakh Tones)	Sugar Mills (No.)	Cane crushed (Lakh Ton)	Remarks
1996-97	1.73	94.84	22	69.21	In 1993, the extension scheme was discontinued
2005-06	0.85	52.41	19	36.76	In 2002, Sugarcane Research Station Jalandhar was shifted
2009-10	0.61	40.56	15	21.12	Weakened research, extension and regulatory cover, decreased area, production and the cane crushed
2020-21	0.89	74.87	16	60.66	-

Source: Department of Agriculture and Farmers' Welfare

With this scenario, the existing operative 16 sugar mills with a total crushing capacity per day (TCD) of 58800 tonnes and having 90000 ha area under sugarcane can run only for 100-110 days in a year instead of 180 days required for their economic viability. Under such conditions, the issue of making timely payments to the farmers by the sugar mills will continue to concern the state and the owners with increasing distress among the farmers.

However, given the developed sugarcane production technologies, water-saving techniques and by-product management systems, Punjab has the potential to develop a vibrant sugar industry to energize the rural economy while replacing areas from under paddy in its growing regions.

Policy Recommendations

1. **Establish CoE:** **a)** Establish a Centre of Excellence (CoE) for sugarcane in its NGA at Bhogpur in Jalandhar district for demonstration of latest technologies, training and participatory research with its stakeholders.
- b)** Form Progressive Farmers' Society (Sugarcane) along with CoE (Sugarcane) as an autonomous registered body to promote quality production, value addition, processing,

storage, marketing and to lead the sugarcane farmers having liaison with the institutes of farm sector excellence.

2. **Ensure Timely Payment:** Once the raw sugarcane is delivered after weighment in the sugar mills, the farmer is entitled for payment, which should be paid online on the same day. In the case of delay, it should be paid with interest and penalty as decided by the competent authority.
3. **Extension Umbrella and Regulatory Functions:** The sugarcane development scheme of the State Department of Agriculture, which was discontinued in the 1990s, should immediately be revived. This will help implement the latest production and water-efficient technologies at the grassroot level participatory research with PAU Ludhiana and efficient performance of regulatory functions to check farmers' exploitation.
4. **Strengthen Research to Compete Globally:** Strengthen the Sugarcane Research Station at Regional Research Station (PAU) Kapurthala with bio-control, tissue culture labs and for crop physiology- modelling studies with required scientists – supporting staff and budgetary support. It will help Punjab's sugarcane industry to compete globally.
5. **Strengthen, Modernize and Revive Cooperative Sugar mills:**
 - a) Cooperative sugar mills should be strengthened by:
 - i. Increasing their crushing capacity (Annexure VII) to get the benefit of the economies of scale
 - ii. Appending by-product management and value-addition units
 - a. Distillery for ethanol production or ENA (Liquor)
 - b. Co-generation
 - c. Bio-CNG
 - iii. Creating new posts of required technical manpower and their recruitment
 - b) Modernize decades old sugar mills by replacing the old with new machinery, and equipments for higher efficiency to compete globally.
 - c) Revive the wound-up/closed cooperative sugar mills to increase the area under sugarcane and replace paddy, and to energize the rural economy.
 - d) A new sugar mill complex should be established in Sangrur district. This complex should be equipped with state-of-the art technologies and should have crushing capacity of 7000 tons per day. Furthermore, this complex should undertake ethanol production, alcohol and other sugarcane processing related activities in order to replace paddy by promoting sugarcane farming in the area.

6. **Recruit Regular Experts:** Ensure recruitment of regular domain experts and supporting staff with due pay status, for the efficient running of cooperative sugar mills and maintain their required strength. Fix responsibility for any lapse on the part of accountable personnel.
7. **Irrigation Support:** **a)** Ensure power-canal water supply for need-based irrigation, especially during the Grand Growth Period and the critical times as per crop requirement in consultation with experts.
b) With intensive research and development, and focused extension cover, make sugarcane as the most water-efficient crop by using drip systems (sub-surface), trench, bio mulch, bed plantation, and other methods as per expert advice.
8. **Mechanize Sugarcane Cultivation:** Sugarcane is a labour-intensive crop. But due to scarcity and timely non-availability of skilled labour, sugarcane production and harvesting operations are delayed and cannot be performed with required efficiency. It affects operational quality and adds to higher costs. Latest technological developments offer suitable machinery equipments of higher efficiency and precision. With a view to these facts, Punjab's sugarcane production and harvesting operations should be fully mechanized. The required equipments (Annexure VIII) should be provided to the PFS/MPCS as a one-time support with a grant-in-aid.
9. **Promote Jaggery Production:** **a)** It has been observed that sugarcane processors, particularly most of the roadside sugarcane processors, produce and sell adulterated and low-quality jaggery. These processors are not only exploiting, but playing with the health of innocent consumers to get higher returns. Their cheap product affects the business of honest and genuine processors. Therefore, to check such malpractices and for ensuring quality jaggery production, training from PAU and registration of the entrepreneur processors by the Department of Agriculture should be made mandatory before starting the jaggery production unit.
b) A quality check of jaggery is required in the state to thwart the adulteration of the product. For this purpose, regular sampling, testing and traceability is required so that compliance with local and national food safety regulation could be ensured.
c) Efficient jaggery production equipments should be provided on subsidy to promote value addition/cottage industry in rural areas and for its domestic and export marketing to earn higher value.
10. **Bonding for Production:** Bonding of sugarcane crop should be undertaken in a timely and transparent manner.

- 11. Efficient Management of Cooperative Sugar Mills:**
 - a)** It should be ensured that the Board of Directors of sugar mills should have true elected representatives of cane suppliers, without any political influence, and maintaining supremacy of the elected board over nominated government officials to promote democratic principles in cooperative bodies.
 - b)** Frequent transfer of managerial/technical staff be avoided to enable the management to run the mills smoothly.
 - c)** Train and update the knowledge/skills of the technical/working staff as a regular feature to enhance their efficiency.

5.3.5 Pulses: *Moong, Mash, Arhar, Chickpea and others*

Pulses are traditional high value food, rich protein source and vital nutritional security complement to the food security provided by cereals. It is a well-established fact that pulse crops improve the soil fertility (by fixing 40-60 kg atmospheric nitrogen per ha), and save natural resources like water. According to the Indian Council of Medical Research, 52 g of pulses are recommended for daily intake by a vegetarian. The dietary need of pulses in Punjab is more than 5 lakh tonnes per annum. In the face of present productivity level of pulse crops at farmers' fields (about 1.0 tonne/ha), 5 lakh ha area can be covered under pulses to meet the consumption of the state. However, due to low productivity, price instability and lack of assured marketing, pulses are poor competitor of paddy.

Policy Recommendations

- 1. Establish CoE and PFS:**
 - a)** Establish a Centre of Excellence (CoE) for Pulses in its NGA in *Malwa* region for demonstration of latest technologies, training and participatory research with its stakeholders to enhance their profitability and make these viable.
 - b)** Form Progressive Farmers' Society (Pulses) along with CoE (Pulses) as an autonomous registered body to promote quality production, value addition, processing and storage, marketing and to lead the pulse farmers having liaison with the institutes of farm sector excellence.
- 2. Develop High-Yielding Varieties:** Develop high-yielding, short-duration, insect-pest and disease resistant varieties of pulses.
- 3. Ensure MSP:** Ensure MSP and assured procurement of the pulses with competitive prices.
- 4. Promote Niches:** Promote cultivation of pulses in respective niches and in areas showing fast downfall of groundwater by providing quality seed, other inputs and machinery at subsidised cost. The organic production can add value and make the pulses more competitive in the market.

5. **Integrate in Profitable Crop Rotations:** Integrate pulses in high yielding crop sequences (rather than relegating to the marginal lands/fields) to achieve high productivity per se and improve competitiveness of pulses-based crop rotations.
6. **Promote *Chholia*:** Promote chickpea as *Chholia* by using mechanical harvester for de-podding followed by freezing to tap distant markets similar to frozen pea.
7. **Encourage MPCS:** Encourage and facilitate primary processing (cleaning, grading and packaging), storage and retailing through MPCS. The cooperatives should be supported to explore the state and national level markets for making pan India presence.

5.3.6 Oilseeds: Mustard, Groundnut, Sunflower

India is importing about 16.47 million tonnes of edible oil (2022-23) by spending huge money to bridge the demand-supply gap. This demand is increasing day-by-day, but acreage under oilseeds is decreasing due to lack of procurement stability and incentives by the government. Lack of price support makes oilseeds uncompetitive in comparison to the wheat, in spite of lower cultivation cost and other advantages of less water and input requirements.

Mustard, groundnut, sunflower and linseed grow well and fit in different cropping systems of the state. Among them, rapeseed-mustard is representing one-third of oilseeds. The oils of groundnut, sunflower and linseed are of premium quality.

Sunflower occupied more than 1.0 lakh ha area during 1990s, which shrunk to 1300 ha in the state during 2021-22. Similarly, the area under groundnut was 1.74 lakh ha during 1971, which declined to merely 1700 ha during 2023 (Annexure VI). The *kharif* groundnut harvested in September-October followed by winter season has geographical advantage of aflatoxin free production in the state. Therefore, it is possible to convert this feature into a marketing advantage. Besides oil, kernels of groundnut are used at large as snacks and in confectionary industry.

Policy Recommendation

1. **Establish CoE and PFS:** **a)** Establish a CoE for oilseeds in its NGA in *Malwa* for demonstration of latest technologies, training and participatory research with its stakeholders.
b) Form PFS (Oilseeds) along with CoE (Oilseeds) as an autonomous registered body to promote quality production, value addition, processing and storage, marketing and to lead the oilseeds farmers having liaison with the institutes of farm sector excellence.
2. **Promote *Kachi-Ghani* Oil Extraction:** MPCS must be supported to set up small scale units to start *Kachi Ghani* oil extraction of *sarson* due to high preference of the consumer. The

oil extracted through solvent extraction units leads to loss of natural aroma and antioxidants along with hazardous effects of chemicals used in treatment.

3. **Promote Groundnut to Meet Local Demand:** The estimated demand of groundnut is 4.5 tonnes/day within the state, which can sustain an increased area under groundnut. Local and neighbouring state markets should be tapped to extend area in existing and old niches of the state.
4. **Support Crop Rotations for Diversification:** Mustard-cotton and maize-potato- groundnut/ sunflower rotations fit well in crop rotation and the entire cropping system needs to be supported.
5. **Provide Machinery through MPCS:** Appropriate farm machinery through MPCS custom hiring mechanism needs to be ensured for timely operations, cost cutting, and economic viability of the oilseed crops.
6. **Promote Confectionary Groundnut:** Focus should be laid on confectionary type varieties of groundnut to harness the market trends.

5.3.7 Millets and Other Minor Crops

The Food and Agriculture Organisation (FAO) declared 2023 as ‘International Year of Millets’ due to their significance as healthy food. These small seeded grains are rich in protein, vitamins, iron, minerals and fibre. In India, *Kutki* (Little Millet), *Swank* (barnyard millet), *Kangni* (foxtail/ Italian millet), *Kodra* (*Kodo* millet), *Jowar* (sorghum), *Bajra* (pearl millet), *Ragi* (finger millet), *Barri* (*Proso* or common millet), are commonly grown millets. In Punjab, these crops were commonly grown with predominance of *bajra* in Pre-Green Revolution period. These short duration crops grown during summer and *kharif* seasons can withstand variations in moisture and temperature. Large number of medicinal and aromatic plants are available under subtropical conditions of Punjab, but a few like turmeric, mentha, celery, fenugreek, fennel, dilseed, coriander seed, *aloe vera*, lemon grass, citronella, basil, *currey patta*, *moringa*, *desi gulab* have potential of commercial cultivation in the state.

Policy Recommendations

1. **Develop High Yielding Varieties:** Develop high yielding and better-quality varieties of millet, medicinal and aromatic plants having commercial importance for cultivation in the state.
2. **Establish Value-Added Processing Units at MPCS:** Establish small-scale processing units at MPCS for preparation of value-added products.

3. **Promote Grain Guar Cultivation:** Promote cultivation of grain *guar* in water deficit areas of South-western districts of the state.
4. **Hemp Cultivation as Fiber Crop:** The hemp cultivation as a fibre crop should be explored for *kharif* season in Punjab.
5. **Explore Medicinal Poppy Cultivation:** Poppy cultivation may be promoted for medicinal use in the state. The state government may hold dialogue with the Union government to permit this cultivation.
6. **Encourage Green Manuring:** Green manuring is need of the hour for improving the soil health, which can be encouraged by providing seed at subsidized rate.

5.4 Horticulture Sector

Punjab, with its endowments, is placed on a gold mine of horticulture with a vast potential of 2-5 times of profitability enhancement - which can be achieved by adopting global standards of discipline and efficiency, coupled with application of global research advances as per Punjab's conditions in an eco-friendly way. Such objective opportunity in the state necessitates institutional interventions with a co-operative framework to check the monopolistic tendencies. In this context, these crops need to be considered and focused for developing a vibrant rural economy as an engine of universal growth in Punjab.

Horticulture with its diverse healthier options - the fruits, vegetables, flowers, spices & aromatics, mushrooms, beekeeping and sericulture, is a high value crown of agriculture sector having wealth of vitamins, minerals, nutraceuticals, antioxidants and fiber rich foods which are placed higher in the bio-food chain. Its vast income generation potential can be gauged from the fact that presently even under most uncertain production and market environment, it is contributing 15 per cent to the state's agricultural GDP from only 5.61 per cent of the gross cropped area while saving significant amount of water through water saving technologies.

Horticulture has unique positive and risky features which need to be assessed to initiate a policy thrust for making a dent in the state's degrading monoculture economy with high value-health promoting horticulture produce. The sector has a vast potential to contribute in a big way to enhance profitability, productive employment and eco-friendly diversity in the state.

Horticulture Crops/Alternatives

Potential

- i. High value, high productivity and 2-5 times higher profitability crops
- ii. High value generation potential from value addition/processing
- iii. High employment generation crops (500 person days/ha in horticulture against 200 person days/ha in traditional crops)
- iv. About 30 per cent saving of water with water saving technologies
- v. High nutritional/medicinal value (rich in vitamins, minerals, antioxidants, etc.)
- vi. Aesthetic landscape with recreational potential for rural Punjab
- vii. Orchards as high carbon neutralizing crops

Risks and Constraints

- 1. More risky crops**
 - a) Sensitive/Perishable nature:
 - i. More prone to climatic stress
 - ii. Lesser shelf life leads to more losses/wastage
 - iii. High storage costs
 - iv. Management intensive crops
 - b) Prone to high market price fluctuations:
 - i. Fair price not guaranteed as price discovery is in the hands of middlemen
 - ii. Absence of MSP and Price Stabilization Fund
- 2. Non-traditional crops:** Horticultural crops are non-traditional. Therefore, farmers are more dependent on frequent advice which is lacking due to non-availability of regular technical umbrella.
- 3. More capital intensive crops:** Horticulture crops are more capital intensive, therefore, the farmers especially small farmers require financial support for cultivation of these crops.
- 4. Long juvenile period of orchards:** Fruit bearing/earning starts after years of wait.

Policy Recommendations

A. Production Related

1. **Technical Advice:** **a)** Provide regular technical umbrella by deputing domain experts right in the field in sufficient numbers with mobility and assisting staff as per the emerging requirements.
b) Establish demo units at Centres of Excellence (CoE) and the government farm units in the respective NGA of the major crops of diversification.
c) To ensure timely advice to the farmers, exempt expert staff from non-technical and additional duties assigned by the district administration.
2. **Strengthen Research:** Research at PAU should be strengthened to lead the state in quality production at minimal costs as per the emerging field and global market requirements.
3. **Strengthening Quality Control in Line Departments:** Equip quality control units of the respective line departments with powers to exercise exclusive quality control functions with dependable regular legal support while making them immune to any interference but accountability for any lapse.
4. **Set up Irrigation Schedule Committee for Canal Water and Power Supply:** **a)** A State Level Irrigation Schedule Committee should be constituted under the headship of Financial Commissioner Development (FCD). This committee should include representatives from related line departments i.e. Agriculture, Horticulture, Irrigation and Power, Soil Conservation, Punjab State Power Corporation Ltd, Punjab Water Regulation and Development Authority, and farmer representatives. This committee can help in making advance planning to synchronize crop-specific requirements with canal water and power supply so that all critical crop stages for quality production can be covered.
b) Canal cleansing timings should be adjusted in a way that it does not harm diversification with horticulture crops.
c) District administration should focus on the implementation and working of finalised irrigation plans through line departments in coordination with water use associations, and making each one accountable for their designated tasks/responsibilities.
5. **Natural Calamities:** **a)** Management of weather uncertainties with expert advice to avoid/mitigate natural calamities losses with the support of weather forecast precision.
b) Create crop insurance fund and its interest should be utilized to compensate losses caused by natural calamities.

6. **Solar-Supported Drip:** Solar-supported drip systems should be promoted in horticulture crops for reducing costs, improving quality, boosting crop yields, conserving water, enhancing energy efficiency and reducing carbon emissions.

B. Post-Harvest Management

1. **Cold Chain:** Solar-grid supported cold chain with pre-cooling and ripening chamber facilities should be provided at crop-specific farmers' societies in the NGA in a cooperative mode and on-farm cold rooms for individual farmers for handling small produce. It will enhance profitability by avoiding glut situations during peak harvesting times.
2. **Reefer Transport:** Reefer transport facility should be provided to the Co-operative/Farmers' Societies to enhance the shelf life of the horticulture produce which can be hired on rent by the farmers.
3. **Value Addition and Processing:** To transfer the gains of value addition to the farmers, the latest global technologies/processing equipments should be run professionally in a cooperative mode in the NGA of respective groups of crops. Multi-purpose processing facilities should be provided to be MPCS/PFS. Such facilities should be solar supported and mandated to run in an eco-friendly way. This arrangement will check most of the uncertainties of the peak period market gluts of diverse horticultural produce, while at the same time, it will energize the rural economy of Punjab with significantly higher profits.

C. Marketing

1. **Price Fluctuations:** a) To check price fluctuations, the demand-supply equilibrium needs to be maintained. It requires establishing strong AMRII as an expert body to advise what should be produced, how much to produce and for which market to produce for advance production plans to balance supply as per market demand.
b) For a fair price discovery in the market, the Punjab Mandi Board should ensure a fair competitive bid in the market.
c) If the market price falls below a fair fixed rate for a crop, a Price Stabilization Fund created for this purpose should compensate the gap.
d) To check the exploitation of the consumer by the middleman, a fair end cap price should be fixed considering seller farmers' price of the produce.
2. **Payment Concerns:** Punjab Mandi Board should address the issue and ensure recovery of the sale proceeds of the seller farmers. The state government should tie-up with the Directorate of Revenue Intelligence of Government of India for ensuring recovery of farmers' sale proceeds in the distant markets.

5.4.1 Horticulture Farms and Nurseries

The horticulture farm and nurseries, both public and private, plays pivotal role in enhancing the quality of production and increasing yields in the horticulture sector of the state. Registration and regulation of nurseries is of utmost importance to maintain and ensure quality supply of plants to farmers.

Policy Recommendations

- 1. Establish Demo Centres:** The government farms and nurseries should be the Demo Centres of Excellence managed by domain experts with the assisting team of skilled and semi-skilled technical staff. These farms should exhibit the latest, but most suitable cost efficient, water saving and eco-friendly technologies relevant to the agro-climatic status of the region. These farm centres should also demonstrate the income supportive/productive, bio-fencing techniques to enrich the boundary landscape of the farmers.
- 2. Enforce Punjab Fruit Nurseries Act:** Strict enforcement of the Punjab Fruit Nurseries (Amendment) Act, 2021 is needed to ensure the availability of quality nursery plants.
- 3. Mandatory Registration for Horticulture Nurseries:** All the public and private plant nurseries should be registered/licensed under Punjab Horticulture Department and accredited by National Horticulture Board for the sale of certified horticulture plants in the state.

5.4.2 Fruits

Punjab's fruit culture, with an area of around one lakh hectare, is swiftly surging ahead with an area expansion growth of 36 per cent during last decade; despite the mentioned risks, constraints and major uncertainties that fettered its vastly unfolding potentials.

I. Citrus Fruit - *Kinnow*

Kinnow mandarin – The Golden Queen introduced from California in 1959 has enriched the cropping canvas of Punjab, diversifying in its NGA, dominating with more than 48 per cent of the state's fruit area with the strength of its productivity, nutrients rich fresh quality juice, longer shelf life and other marketing related traits. Its productive potential can be gauged from the fact that as against state's average productivity of 15 tonnes/ha in 2001, it realized maximum productivity of 132.25 tonnes/ha in farmers' field setting a global record. It could become possible only with the focused extension cover provided by the State Department of Horticulture in its Natural Growing Area, Abohar, showing the importance of expert advice.

Kinnow is rich in limonin glucoside which has vast value earning potential. The research findings of United States' Department of Agriculture (USDA) in 2015, revealed that limonin glucoside consumption is useful in prevention and treatment of liver cancer, diabetes, non-alcoholic fatty liver disease (NAFLD), cardiovascular disease and chronic kidney disease (Kelly, Darshan S. et al, 2015). With such medicinal, nutritional and longer shelf-life advantages of this attractive golden fruit, the following policy push shows the vast potential to enhance the profitability of the farmers with consequent expansion of area under this fruit for diversification.

Policy Recommendations

- A. Production Related**
 - 1. Strengthening Extension Services:** Ensure effective extension cover with mobility support for regular technical advice to the farmers in field by filling all the vacant posts and creating new posts to cover increased area.
 - 2. Enhance Plant Health through Pedigree Selection:** Ensure disease free healthier plants raised from elite mother plants of known pedigree.
 - 3. Optimize Canal Water and Power Supply:** Synchronize and ensure canal water/power supply as per the critical development needs of this sensitive crop to maintain the soil moisture status as per requirement.
 - 4. Promote Efficient Irrigation Systems:** Promote solar supported micro irrigation and water storage tanks to improve quality, save labour and water and reducing uncertainty of quality production factors.
- B. Post-Harvest Management Related**
 - 1. Upgrade *Kinnow* Value Addition Infrastructure:** **a)** For value addition and distant marketing of *kinnow*, outdated models of grading and waxing facilities at five Citrus Estates should be upgraded with latest efficient models of 5 tonnes/hr capacity along with packing lines.
b) For on-farm grading, waxing and packing by individual farmers such efficient models of 2 tonnes/hr capacity be promoted on subsidy to reduce the peak period glut by distant marketing and for earning higher profits.
 - 2. Promote Solar-Supported Cold Storage:** **a)** To utilize the 60-day long storage life of *kinnow*, there is a need to establish 1000 tonnes capacity solar supported cold store with separate chambers having temperature and relative humidity control in each of the five Citrus Estates. These models will help demonstrate the way of enhancing income by selling the product of

the society/farmer members in hot periods in local markets.

b) For individual farmers, on-farm solar supported cold storage of 10 to 100 tonnes capacity should be promoted.

C. Market Related

1. **Facilitate *Kinnow* Transport via Special Train Coaches:** To market one million tonnes of *kinnow* within two months (January-February) to lucrative distant market sites in India, special coaches/reefer boggies should be attached to passenger/freight trains from Punjab's production centres with subsidized freight.
2. **Reduce Transportation Costs for *Kinnow* Export:** Being a land locked state, Punjab is placed very far from the ports making it difficult to compete with Pakistan due to high transportation costs. Thus, to harness the vast export potential of *kinnow*, inland reefer haulage and ocean freight needs to be subsidized.
3. **Promote *Kinnow* through TV Campaigns:** **a)** Ensure aggressive health awareness TV advertisements exhibiting medicinal and nutritional gains of *kinnow* as a natural health capsule in different languages of the respective states and countries where it is to be marketed. It will make this attractive fruit in hot demand for the benefit of the consumers and all the stakeholders, along with enhancing its per capita consumption, reflecting back with its increased profitability for area expansion, and contributing to diversification.
b) It must be supported by facilitating distant marketing and export with required infrastructure and links to trustworthy buyers.
c) *Kinnow* should be promoted as a healthful nutritious food by including it into the mid-day meal programme.

D. Processing Related

1. **Promote Fresh *Kinnow* Juice:** Fresh juice of *kinnow*, which is rich in minerals, vitamins, carotene and medicinal limonin glucoside with excellent sugar-acid blend, should be extracted with the available equipment that do not crush its seed and peel, to avoid bitterness. Its direct marketing along with other seasonal fresh fruit juices and vegetable soups in all the villages and urban centres of the state, should be promoted by opening juice/soup vends.
2. **Value-Added Byproducts from *Kinnow* Waste:** After extracting juice the leftover peel, rag and seeds should be processed to make cosmetic, flavouring, pharma and other by-products to generate value from the so called waste of *kinnow* fruit.
3. **Harness Medicinal Properties of Limonin Glucoside:** Limonin glucoside with rich

medicinal properties is a very high value product in the global market and should be extracted from *kinnow* juice.

4. **Explore High-Value *Kinnow*-Based Liquor Products:** Recently, *kinnow* has been processed for formulating a high value liquor product GIN and is marketed with good success.

In this context, latest efficient citrus specific equipments should be appended to the two multi-purpose processing facilities of Punjab Agro at Hoshiarpur and Abohar. These facilities will harness the above mentioned processing potential of *kinnow* juice, peel, rag, seeds and the medicinal element limonin glucoside. However, a fair part of the earned value should reach the farmers to enhance their profitability and consequent area expansion - leading to diversification.

II. Pear

With its wide soil and climatic adaptability, pear has emerged as the fourth most important fruit of sub-tropical Punjab occupying 4692 ha area with productivity of 23.5 MT/ha and production of 110236 MT (Annexure IX). Its tree and fruit hardiness, regular bearing nature, high productivity, ease of processing and longer storage and shelf life has helped in its area expansion and marketing. Due to its longer life span of over a half-century, it has the potential to enrich the next generation as well. Although ‘*Pathar Nakh*’ and ‘*Punjab Nakh*’ varieties of pear have a commercial potential, but due to lack of effective extension services, the area under these varieties has been increasing at slow pace. Establishment of Pear Estate in its NGA in Amritsar-Tarn Taran region has played a pivotal role in its quality production and area expansion.

Policy Recommendations

1. **Provide Cold Store Facilities:** **a)** The pear fruit is typically harvested in July, yet the primary market demand for this fruit, especially in distant markets like West Bengal, Bihar, Assam, etc., arises during festival times, such as *Durga Puja*, which falls in October. As the fruits can be stored in cold store safely up to 3 months, a solar-supported cold storage facilities with separate chambers should be established at Pear Estate Amritsar with 1000 MT capacity for the farmer members of this society.
b) Cold stores up to 100 MT capacity should be supported for Multi-Purpose Cooperative Societies (MPCS) and as on-farm for individual farmers to check post-harvest losses and to expand marketing span. GOI’s 35 per cent subsidy should be clubbed with equal share of the state to strengthen the rural cold chain infrastructure. This will result in enhancement of profitability of the growers and increase the area under pear.

2. **Mechanize Pear Cultivation:** Latest machinery/equipment required for pear orchards should be supported and placed in the MPCS of the said area to be used on rent hire basis that can reduce the costs.
3. **Processing to add Value:** Processing of pear for paste and other products which are in hot demand should be ensured through PAIC and Markfed.
4. **Promote Drip System:** Drip system in pear saves 30-40 per cent water along with labour saving, reduced sprays and improvement in fruit quality. It should be supported with grid-linked solar system with dedicated funding to improve ecosystem and to enhance efficiency.
5. **Subsidize Freight:**
 - a) Exporting Punjab's one lakh metric tonnes pear produce is a necessity, so that small and marginal farmers can sell the fruit locally at a fair price without facing glut situations. Recurrent tax increases on oil have increased the transportation charges for distant marketing. So, to export pear from Punjab to Delhi and other distant markets, freight should be subsidized by 25 per cent and the distant market limit be reduced to 250 km instead of 500 km.
 - b) Special coaches/reefer bogies be attached to passenger/freight trains from Amritsar to West Bengal with subsidized freight to cut down transportation cost.
6. **Support during Juvenility:** In view of long juvenile period (5-6 years), financial support is needed for filler plantation during the pre-bearing period of pear.
7. **Strengthening of Nurseries:** Nurseries of PAU/Punjab government should be strengthened, and guidelines should be issued to supply 2 year-old plants to the farmers to cut down juvenile period.

III. Litchi

Litchi in Punjab with 3775 ha area leads India in productivity which touched 16.5 MT/ha in 2022-23 followed by Jharkhand with 15.7 MT/ha and a national average of 7.4 MT/ha (Annexure IX). With its commercial cultivation restricted by a narrow agro-climatic range, litchi has gained a grand success in fertile high humidity green regions of Pathankot, Gurdaspur and Hoshiarpur near the Ravi-Beas rivers by producing high-quality eye pleasing appearance of fruits with bright red colour.

With establishment of Litchi Estate in its NGA in Pathankot, its productivity, quality production and area expansions got a push despite its lower shelf life and perishable nature. Punjab litchi is in hot demand in metropolitan cities and Dubai markets. Another positive feature of Punjab's litchi is that it starts maturing from mid-June onwards when produce from other parts of country is usually finished.

Policy Recommendations

- 1. Provide Technical Support:** Quality production of litchi free of borer and splitting problems is a pre-requisite to fetch remunerative price in the market. To ensure such produce, a regular technical umbrella should be provided by filling all the vacant posts of the experts/Horticulture Development Officers (HDOs) and supporting staff.
- 2. Ensure Cold Chain and Subsidize Freight:** Quality litchi is in high demand in high purchasing power elite city markets like Mumbai and Dubai, but due to its perishable nature and shorter shelf life, cold chain support is required from field to Amritsar airport. Also, high air freight rates need to be neutralized. In this background, two reefer vans and 500 tonnes cold store of separate chambers with temperature and relative humidity (RH) controls should be established along with a pack house at Litchi Estate in Pathankot. Further, 20 per cent air freight subsidy should be given to litchi farmers.
- 3. Support during Juvenility:** In view of long juvenile period (5-6 years), financial support should be provided for filler plantation during the pre-bearing period of litchi.
- 4. Quality Planting Material:** Containerized 2 year old nursery plants should be made available (which is now lacking) and supplied to the farmers to cut down long juvenile period.

IV. Guava

Guava is one of the most important fruit crops of Punjab, next to *kinnar* mandarin. Being hardy in nature, it can be cultivated in a wide range of soil and climatic conditions and therefore, its plantation is well distributed throughout the state. It is relatively tolerant to salts, temporary flooding as well as drought conditions. Presently, guava occupies an area of 12769 ha with an annual production of 292872 MT and productivity of 22 tonnes/ha in the state. (Annexure IX).

Area under guava is increasing rapidly in Punjab due to its short juvenile period (2-3 years), amenable to double cropping (rainy and winter), suitable for high density planting and filler tree in long juvenile fruit crops (mango, litchi, etc.) and good processing potential. Excellent varieties having coloured peel (for table purposes) and coloured flesh (for processing) have been developed by PAU, Ludhiana and other institutes. Government of Punjab has established Guava Estate at Patiala to boost guava cultivation in the state.

Policy Recommendations

- 1. Establish Processing Units:** There is a good potential for preparation of processed products of guava such as juice, jam, jelly, cheese bars, nectar, ready to serve drinks, squash, and

powder. The processing of guava should be ensured through PAIC.

2. **Research on Organic Production:** There is a need to develop Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) modules requiring lesser use of fertilizers/pesticides and encouraging eco-friendly practices for residue and fruit fly free fruit production in guava.

V. Peach and Plum

Peach and Plum are temperate fruit crops but, their low chill varieties can be grown quite successfully in the sub-tropical climate as well. In Punjab, cultivation of low chill peach and plum has attained significance during the last few years due to many advantages like high productivity, regularity in bearing, precocity (starts bearing in 3rd year), early maturity (3rd week of April-mid May). Due to early maturity, growers get remunerative prices because of non-availability of other fruits at this time of the year. These fruits can also be planted as filler trees in crops like pear, litchi and mango orchards.

Owing to very short flowering to harvest phase (80-120 days) in comparison to other fruit crops especially *kinnar* mandarin (270-300 days), peach and plum crops involve lower production costs, which makes them a crop of choice for many growers.

Policy Recommendations

1. **Import of Germplasm:** There is an urgent need to import low chill varieties (having large fruit size, red over colour and better shelf life) and rootstocks (resistant to nematodes, waterlogging and replant problems) to diversify area under these fruit crops.
2. **Establish Processing Units:** Processed products of peach and plum are in great demand. Therefore, the processing of peach and plum should be ensured by PAIC. Development of cold chain facility will help in distant marketing of fruits.
3. **Disease Free Planting Material:** Life span of peach/plum plants is very short. There is need to strengthen nurseries of the state government and PAU for the production of nematode free nursery plants. Inter-state movement of nursery plants should be restricted to prevent infestation of soil borne pathogens and diseases, particularly nematodes.

5.4.3 Vegetables

I. Potato

Potato, as a staple food and a vegetable, is the most popular non-cereal crop of the world. India, with 2.2 million ha area and 53.38 million MT production, is the second largest producer of potato in the world after China, emerging as a hot market for quality seed potato.

With valuable traits of being a short duration crop and cultural flexibility, it fits well in the intensive cropping systems to deliver higher value to the farmers. In Punjab, potato is grown on more than 1.15 lakh ha area with production of 31.75 lakh MT and having 60 per cent share of seed, 38 per cent share for table crop and 2 per cent for processing purpose.

However, Punjab's unique advantage of having aphid-free window from October to December along with suitable agro-climatic conditions has to be tapped for earning higher income by changing the existing informal seed potato production to certified quality seed potato production with traceability.

It has become possible with the establishment of CoE for Potato in its NGA in Jalandhar in collaboration with the Netherlands, where tissue culture and aeroponics facilities were created with the support of Central Potato Research Institute (CPRI), Shimla resulting in production of virus free certified seed potato at a minimum ten times faster conversion rate than that of the old system.

With a view to the seed potato and ware potato demand of different states at different times, sufficient cold storage capacity of 23.50 Lakh MT against state's total potato production of 31.56 Lakh MT has already been created. Such storage facility can be used with Price Stabilization Fund intervention by the designate agency to avoid peak period gluts or over production gluts by restoring the control of the State Department of Horticulture over cold stores which was withdrawn earlier.

Policy Recommendations

- I. Enhancing Quality Seed Potato Production and Supply:**
 - a) Strengthen Punjab State Seed Certification Authority (PSSCA) and Horticulture Extension Umbrella:**
 - i. To ensure production of virus free certified quality seed potato through tissue culture based aeroponics and net house technologies.
 - ii. To supply such seed with transparency to the domestic and global buyers by ensuring block chain-traceability based certification that instils confidence in the stakeholders about its quality and origin.
 - iii. To ensure the use of geo-tagging scanner for tracking the details and location of the barcoded seed potato.
 - b) Areas free from diseases of quarantine importance should be identified in Punjab by the designate authority to ensure production of quality seed potato.**

2. **Mechanize Potato Production through MPCS:** Mechanize potato production, harvesting (with combine harvester) and post-harvest handling for precision, efficiency and reducing losses with latest quality equipments and machinery. For this, one time grant-in-aid should be given to MPCS and PFS in the production region(s) under the guidance of nodal team in liaison with the machinery equipment experts of PAU, Ludhiana.
3. **Enhanced Regulatory Monitoring for Cold Store Management:**
 - a) The State Department of Horticulture with regulatory powers/control should be entrusted to closely monitor Punjab's cold stores for their storage status, inflow-outflow details and temperature humidity status. Such standards are essential for certified seed potato, ware potato and other items to check disease spread and malpractices relating to mixing of different stages and qualities of seed and ware potato as it affects the growth of potato industry.
 - b) Separate cold stores/chambers should be marked for storing certified seed potato to avoid mixing of any kind and to check disease spread in the seed.
 - c) Strategic initiatives are required to upgrade the existing cold stores in Punjab, to enable those to be more cost effective, energy efficient, internationally competitive and improved suitability across multiple types of potato storage.
4. **Promote Export:** To promote export of ware and seed potato to European Union, Western Asia and other states of the country, proper phytosanitary measures for diseases like brown rot, ring rot, golden nematodes, etc. have to be ensured during production and even at borders of the Punjab. Also, to assess and study the demand-supply status of diverse agriculture produce by AMRII experts, strict monitoring of Punjab states' boundaries has to be ensured for inflow and outflow details of agriculture produce.
5. **Regulate Water Supply:**
 - a) Since potato requires irrigation with more precision, synchronized canal water and power supply schedules, as per critical growth stage demands of the crop in consultation with domain experts and potato farmer representatives, should be implemented with the administrative decision in the district production committee meeting.
 - b) Promote drip-fertigation with subsidy support as a water and fertilizer efficient technology that saves 30 per cent of these inputs and improves the quality of potato with better yields.
6. **Strengthen Research:** To cater demand of domestic and international markets, PAU needs to strengthen in-house research on potato to develop short duration, heat and frost tolerant, disease resistant and insect resistant varieties. Collaboration with national and international organizations like International Potato Centre (CIP) to strengthen the germplasm base of

potato is required. To improve the yield and quality of the potato, the experimentations on production, plant protection and post-harvest handling require key attention. The Punjab Tissue Culture based Seed Potato Act, 2020 may be amended to grow exotic varieties found suitable in Punjab.

7. **Promotion of NGA:** With long practice, the Natural Growing Areas (NGA) for seed potato production, processing and for ware potato production have already been demarcated by the State Department of Horticulture. These should be supported and promoted to make the produce of their respective ends to be of par excellence by utilizing the cost saving natural factors that favour their respective traits.
8. **Price Stabilization Fund:** In addition to other measures being taken to check the recurrent and cyclic market price falls of potato, a Price Stabilization Fund (PSF) should be created as a quick measure to stabilize the price. To utilize the long storage potential of potato and sufficient cold storage space availability in Punjab, a designate agency - Markfed/Punjab Mandi Board should intervene to stabilize prices with PFS. For such situation, advance planning should be made with market linkages to dispose-off the produce in an innovative and efficient way.
9. **Progressive Farmers' Society (Potato):** To empower the farmers to jointly contribute in their wellbeing, a PFS (Potato) should be promoted and registered as an autonomous body with the mandate to promote quality potato production, productivity, processing and marketing of produce of the member farmers. This can enhance their profitability in liaison with the CoE (Potato), AMRII and IAMS, which is the proposed apex marketing body of all PFS of diversification crops. PFS (Potato) should be provided two-acre operational space to accomplish its mandated tasks at the CoE (Potato), in Jalandhar district.

II. Pea

Pea is the second largest vegetable crop after potato in the state which witnessed increase in area from 20 to 45 thousand ha during 2013-14 to 2022-23. Combination of short duration varieties of pea and rice attracted the growers to grow three crops (rice-pea- wheat/ summer field and vegetable crops) in a year. Globally, frozen pea represents three-fourths of all frozen vegetables in the state. With the establishment of processing units like Pagro Foods Limited and CN Frozen, it is gaining ground in Punjab. The harvesting season of pea falls between December and March having 80 per cent area under early crop due to high economic returns. Higher manual picking cost of pods and fall in price during peak season of harvest make the pea cultivation less profitable.

Policy Recommendations

- 1. Expand Processing Infrastructure in Niche Areas:** Establish more processing plants with latest infrastructure in the state particularly in the niche areas (Amritsar and Hoshiarpur) of the crop.
- 2. Strengthen Research for Pea Harvesting and Varieties:** Strengthen research for development of in-house and affordable pea pod-harvester-cum-depoder and the matching mono-picking processable pea varieties.
- 3. Establish Pea Growers' Society:** Establish pea growers' society in pea growing areas/pea estate to strengthen mechanization, aggregation, processing and marketing of pea.

III. Onion and Garlic

Onion and garlic are important crops due to their high demand in local and exotic markets. Besides fresh use, these can also be processed in the form of paste, dehydrated flakes, powder, oil, vinegar, sauce and pickles, etc. Punjab has the advantage of high productivity of onion (23.3 t/ha) and garlic (11 t/ha) due to fertile soils, assured irrigation and geographic location (2022-23). Though, onion showed sizeable increase (35%) in production (1.83 to 2.46 lakh tonnes) during the last decade in the state, but still more than 70 per cent deficit (25 lakh tonnes) of Punjab and adjoining states needs to be plugged. Similarly, area and production of garlic has increased by more than 60 per cent during this period. Major factors limiting the area expansion under these crops are the labour cost and non-availability of the storage facilities in the state.

Policy Recommendations

- 1. Strengthen Storage and Processing Facilities:** Develop centralized gamma irradiation facilities (which can help prevent sprouting) along with appropriate controlled cold storage facilities to prevent post-harvest losses. There is possibility of modifying the existing potato cold storage by reducing the relative humidity and temperature of the cold chambers.
- 2. Expand Market Reach:** Devise system to tap Jammu & Kashmir and Himachal Pradesh markets, where geographical conditions do not favour for substantial in-house production.
- 3. Promote Mechanized Cultivation:** Support for the mechanized cultivation to lower the cost of onion and garlic cultivation is essential.
- 4. Processing through Markfed and PAIC:** Markfed and PAIC should develop processed and frozen products of onion and garlic.

5. **Promote Punjab as a Garlic Seed Hub:** Develop Punjab as national seed hub of garlic (to the tune of seed potato) by demarcating area along with seed certification and traceability system.
6. **Strengthen Research on Processing Varieties:** Strengthen research to develop varieties suitable for processing and exotic markets.

IV. Chilli

Chilli can be processed into powder, paste, pickle, sauce, soup, etc. Some products like capsaicin and oleoresin can be extracted from chilli. These products not only fetch higher value in the international market, but their export is also easier than the fresh produce. In Punjab, most of chilli produced is marketed as green fruit, but the demand of red ripe fruits for processing and dry for powder making is gradually increasing. It is a labour-intensive crop as red ripe chilli requires 6-7 pickings and the requirement of labour is much higher for green chilli fruit harvesting.

Policy Recommendations

1. **Develop Chilli Growers' Societies:** Develop chilli growers' societies in the niche areas like Ferozepur district for dry chilli; Fazilka and Hoshiarpur for red ripe; Sangrur and Patiala districts for green chilli production, storage and supply of produce as per market demand.
2. **Cold Storage for Chilli Grower Societies:** Chilli grower societies should be supported to establish cold storage facilities for staggered supply of fresh green as well as dry chilli to meet the staggered demand of fresh and processing industry.
3. **Utilize Grain Market Yards for Chilli Drying:** The grain market yards and sheds should be allowed to be used by the farmers for drying of red ripe fruit during the harvesting season (May to August).

V. Cauliflower and Cabbage

Cauliflower and cabbage are important vegetable crops after potato and pea with more than 34,000 ha area in the Punjab state (2022-23). Subtropical conditions along with cool winter are favourable for their cultivation in a broader window (more than 6 months) under different segments of temperature tolerance. During main crop harvest season, the prices fall due to glut, whereas, at the same time, it coincides with the snowfall period of countries in the northern hemisphere for export opportunities.

Policy Recommendation

1. **Strengthen Processing Units:** Strengthen processing units for both frozen and dried form

of cauliflower and cabbage to avoid seasonal glut and tapping domestic as well as export markets.

VII. Tomato

Tomato can be used fresh and processed into sauce, soup, paste, etc., which not only adds value, but also evade glut situation during summer months. It can be grown under open field and protected conditions. However, under Punjab conditions, short span of harvesting does not support the sustainability of processing industry. This labour intensive and highly perishable crop is severely vulnerable to whitefly-transmitted viruses during the rainy/*kharif* season.

Policy recommendation

1. **Enhance Research on Disease-Resistant Tomato Varieties:** Strengthen research on development of virus resistant, late and early blight resistant varieties suitable for cultivation under low tunnel/protected conditions in order to extend the tomato availability window. Focus should be laid on varieties having high Total Soluble Solids (TSS) and lycopene content for improving the viability of processing units.

VIII. Muskmelon and Watermelon

Muskmelon and watermelon are suitable for intensive cultivation in crop rotation of rice/maize-potato-muskmelon/watermelon and give high returns to the growers. However, short shelf life and seasonal glut adversely affect the prices of these crops.

Policy Recommendations

1. **Enhance Facilities in MPCS of Niche Areas:** Develop collection, storage and transportation facilities in the MPCS of its niche areas for serving the northern hilly, central and southern states of the country.
2. **Strengthen Research in Muskmelon and Seedless Watermelon Varieties:** Strengthen research for less explored segments like *Sharda*, honey dew and netted type in muskmelon and seed-less watermelon.

VIII. Carrot

Punjab has the geographic advantage to produce carrot of both Asiatic and European groups. It has short duration and long storage life. Its potential of juice, nutraceutical properties, fresh cut frozen forms need to be tapped. The area under this crop can be expanded as the required machinery for sowing, harvesting, washing and cleaning is available which helps in reducing the costs of cultivation and post-harvest handling of the produce.

Policy Recommendation

- 1. Cold Storage and Processing Facilities for Market Expansion:** Cold storage chambers should be set up for storage (1-2° C, 85-95% RH) to tap pan India fresh markets during lean season. Similarly, the processing units should be established for juice, frozen and fresh-cut forms.

IX. Turmeric

Turmeric is less prone to insect pests attack, hence has a scope for organic cultivation under state's conditions. It has a potential of value addition and employment generation through processing units on account of nutraceutical properties. However, its long duration (215-240 days), high seed rate (6-8 q/acre), lack of fully mechanized process and fluctuations in price restrict the expansion of area under crop.

Policy Recommendations

- 1. Development of Turmeric Varieties:** Introduction/development of varieties of turmeric having high curcumin content and early maturity to fit better in the cropping sequence is required.
- 2. Enhance Production, Processing, and Marketing through MPCS:** Strengthen production, aggregation, processing and marketing of the turmeric produce with the support of MPCS societies.

X. Okra, Bitter gourd, Hull-less Pumpkin and other Cucurbits

Okra, bitter gourd, bottle gourd, sponge gourd and pumpkins occupy sizeable area during summer and rainy seasons in the state. These vegetables can be easily grown and give high yield, but are highly perishable and prone to mosaic viruses also. Okra and bitter gourd are not only consumed by the locals, but are also in demand by the Indian diaspora living in the European and North-American countries. Therefore, these crops have export potential to these countries.

Hull-less pumpkin is a new cucurbitaceous crop in the country. Its seed does not develop testa and is directly consumed as snacks, in oil and bakery industry. It is a rich source of omega-6 fatty acids (32%) and oil (28%). Presently, its seed is being imported from China and United States of America (USA) and available in many cities. PAU *Magaz Kadoo-1*, the first hull-less seeded variety of pumpkin, has been developed and released by the PAU. Being a high value and low volume crop, it suits well in diversification and has the potential in domestic as well as export markets.

Policy Recommendations

1. **Research for High-Yield and Pest-Resistance:** Strengthen research for developing varieties having high yield and resistance to insect-pests to lower the pesticide use.
2. **Enhance Facilities through MPCS:** Strengthen the quality production, aggregation, processing and marketing with the support of MPCS facilities.
3. **Incentivize Cold Chain Facilities:** Incentivize cold chain facilitates for export through cargo to European countries.
4. **Crop Rotation in Potato-Growing Areas:** Potato growing areas can be focused with the rotation of hull-less pumpkin- paddy/maize/*moong* – potato/pea.

XI. Promote Fruit, Vegetable Nutrition and Herbal Kitchen Gardens

Producing organic fresh fruits, vegetables and herbs, rich in vitamins, minerals, antioxidants and fibre, in own kitchen garden is not only a nutritional and medicinal support to strengthen the immune system for quality life, but is a healthier reconnect of the new generation with nature and biodiversity. Nurturing this fruit, vegetable and herbal garden gives the family a refreshing opportunity to have a change from monotonous lifestyles. It is a cost saving practice of the family budget that also reduces market visits associated carbon emissions. Brochures for fruit, vegetable and herb growing and aftercare along with detailed health benefits of the produce have already been prepared by State Department of Horticulture and PAU, which should be promoted for multifaceted gains to the rural population.

Policy Recommendations

1. **Raising Awareness on Nutrition Gardens:** Horticulture extension functionaries along with the Punjab State School Education Board, Panchayats and the Horticulture Department should create awareness about the health benefits of nutrition gardens in the community. This network of institutions should help developing kitchen gardens in government schools to promote consumption of vegetables (potato and sweet potato), and fruits, and to provide a balanced diet to students in the mid-day meals.
2. **Promoting Urban Agriculture:** Promotion of nutrition-sensitive agriculture through home gardens/roof-top gardens is needed in urban area.
3. **Research on Bio-Fortified Varieties:** Promotion of bio-fortified crop varieties suitable for home gardening/pot culture for nutritional security.

5.4.4 Floriculture

Floriculture, which includes growing flowers and ornamental plants, has the potential to boost farmers' incomes and employment generation. The state's agro-climatic conditions are most suitable for quality seed production and to grow a variety of floral crops for domestic and global markets, both in open as well as protected conditions. During all the festivals and the wedding season, there is a great demand for flowers in majority of the markets. Urbanization has increased the market demand for ornamental and landscape plants in the state, which is now being met by importing these plants from other states.

Policy Recommendations

1. **Upgrading Seed Testing Facilities:** To export flower seeds from Punjab, the purity and germination test reports of flower seeds are pre-requisite. Such test facility is not available in Punjab, therefore, seed testing laboratory of State Department of Agriculture at PAU, Ludhiana should be updated for International Seed Testing Association (ISTA) based certification to test purity and germination of flower seeds.
2. **Importing Quality Planting Material:** Disease free quality planting material of zygophytes should be imported to expand area under high value floriculture plants.
3. **Enhance Flower Market Infrastructure:** There should be regularized floriculture market infrastructure with cold chain storage facility in flower growing areas. The transport facilities of reefer vans is necessary for efficient supply of cut flowers to nearby markets.
4. **Floriculture Production Model:** The cooperative flower production farming models linked with Centre of Excellence for Floriculture should be developed for production of flowers in the state.
 - a) Need to standardize mechanization in floriculture from sowing to harvest.
 - b) Encourage flower seed processing and storage infrastructure in the state.
5. **Upgrade Ornamental Nurseries:** The establishment of state-of-the-art nursery units and modernized nurseries should be encouraged for quality disease free production of planting material for ornamental plants, flowers, bulbous and foliage crops.
6. **Value Addition in Flower Crop:** To reduce the post-harvest losses and glut in the market, the dehydration, flower pigment, oil extraction and floral beverages should be promoted.

5.4.5 Protected Cultivation of Horticultural Crops

Protected cultivation offers 3 to 4 times higher gain in productivity and profitability than open field cultivation and create employment for rural youth in agricultural sector. Protected

cultivation presents a significant opportunity to shorten and optimize farm-to-plate supply chains. It offers the chance to cultivate horticultural crops in an entrepreneurial manner. It offers promotion of high value, quality horticultural produce with year-round and off-season production of vegetables, fruits and flower crops by minimizing the use of pesticides in crop production.

Policy Recommendations

1. **Promotion through MPCS:** To give the benefit of protected cultivation to the farmers and rural population, it should be promoted in all the MPCS command areas throughout Punjab.
2. **Enhancing Vegetable Seed Production in Protected Structures:** The potential of vegetable seed production under protected structures and production of disease free nursery plants should be explored. Propagation of healthy, uniform, disease-free planting material with improved germination percentage and better hardening should be taken up for quality production.
3. **Provision of Subsidy for Polythene Sheet and Inputs:** To reduce the cost of cultivation, about 50 per cent subsidy should be provided for replacing polythene sheet after 4 years of installation. Likewise, the inputs required for protected cultivation such as seed, planting material, water soluble fertilizer should also be subsidized.

5.4.6 Beekeeping

Beekeeping is a good eco-friendly economic activity for the landless, farm workers and small farmers -who with proper training can earn good profits with minimal investments. Punjab, with only 1.5 per cent of India's geographic area, is contributing about 13.9 per cent of the national honey production, and also is supplying *Apis mellifera* colonies and apicultural equipment to other states of India. The Punjab state has emerged as the hub of commercial beekeeping in the country. Currently, Punjab has the distinction of having about 4428 beekeepers with an annual production of 18,500 MT honey during 2022-23. Apiary honey from the state was exported to 30 countries during 2022-23.

Beekeeping is a profitable agro-based subsidiary occupation, however, there is great scope in apiculture through the adoption of diversification, which will greatly enhance apiary income. Production of other bee products like pollen, propolis, royal jelly, and bee venom can lead to the generation of several other avenues of beekeeping-related trades and employment. Beekeepers can further augment their income by renting out their bee colonies for pollination services, since honey bees are known to significantly increase seed/fruit yield in several cross-pollinated fruit/vegetable field crops. Breeding and sale of queen bees can further augment farmers' income. There is an urgent need to give it a fast-paced impetus for

its further adoption, diversification, and ensuring higher profitability.

Policy Recommendations

- 1. Establish CoE:** **a)** A Centre of Excellence (CoE) for beekeeping should be established in district Hoshiarpur (Khanaura) to
 - i. Demonstrate the latest beekeeping technologies
 - ii. Train the incumbents for profitable beekeeping
 - iii. Conduct participatory research with PAU and progressive beekeepers
 - iv. Rear and supply queens of high quality
 - v. Lead the state in making beekeeping a profitable profession**b)** Form PFS (Beekeeping) along with CoE (Beekeeping) as an autonomous registered body to promote quality production, value addition, processing and storage, marketing and to lead the beekeeping farmers having liaison with the Institutes of Farm Sector Excellence.
- 2. Processing and Marketing:** Processing and marketing of honey and other hive products like pollen, propolis, beeswax, royal jelly, and bee venom should be entrusted to Markfed for domestic and global markets to check the exploitation of beekeepers by private traders and share a fair part of the earned value to beekeepers to enhance their profitability. Honey should be used and promoted as a healthy food complement for sugar in Verka and other cooperatives' food items like sweet milk, sweet *lassi*, *kheer*, ice cream, etc.
- 3. Strengthening Quality Control Lab:** The quality control laboratory of Punjab Horticultural Post-harvest Technology Centre (PHPTC) at PAU should be strengthened with the latest honey testing facilities including Nuclear Magnetic Resonance (NMR) for testing honey and other hive products to prevent adulteration.
- 4. Registration and Traceability:** Registration of beekeepers and their colonies should be made mandatory to ensure quality supply. Traceability of honey and other hive products should be ensured through geo-tagged scanner to easily track the detail and location of the barcoded beehives. Similarly, sale-purchase traceability of each trader of honey and hive products should be ensured, along with screening of their accounts to check adulteration and malpractices.
- 5. Appoint Nodal Officer:** Provide beekeeping experts as Nodal Officer (Beekeeping) at the district level to address and resolve all the issues in liaison with Centre of Excellence for beekeeping.

6. **Availability of Bee Flora:** Increase the availability of bee flora through crop diversification and planting bee floral trees and plants on government lands. New crop varieties should also be evaluated for nectar and pollen reward availability to bees.
7. **Awareness Campaign:** A mass awareness campaign should be launched aggressively for increasing the consumption of honey and the acceptability of granulated honey.

5.4.7 Mushroom Cultivation

On account of it being a cottage, labour-intensive, and crop waste-consuming industry, mushroom cultivation holds substantial promise in managing the challenge of disguised, especially women, unemployment besides conferring financial, nutritional, and ecological benefits. With about 6.5 per cent share in total national production, Punjab is one of the leading mushroom-producing states of India. Easy availability of composting materials and labour for self and wage employment during the October-March period and export potential constitute important strengths of the state. Major challenges include the lack of high-quality spawn, an unregulated marketing structure, lack of pre-cooling storage, canning and marketing infrastructure, and high raw material transportation charges.

Policy Recommendations

1. **Legislation:** The State Department of Horticulture along with PAU needs to follow up with the Centre to address the shared challenge of regulating spawn production by, bringing it under the Seeds Act, 1966 or other appropriate legislation.
2. **Incentivize Mushroom Cultivation:**
 - a) The subsidized power structure available for the farm sector should be extended to the mushroom sector as well.
 - b) Manpower structure in the Department of Horticulture requires a shift towards subsidiary occupations of mushroom cultivation and beekeeping. Separately created posts should have a unique set of qualifications and expertise.
 - c) In order to provide additional focus, mushroom cultivation should be included as a potential ex-situ paddy residue management technology. Appropriate incentives can be provided for compensating raw material transportation charges under this measure.
3. **Marketing and Training:**
 - a) The perishable nature of mushrooms becomes hindrance in the way of profitable marketing and leads to distressed sales under glut situations. The state should explore setting up an adequate number of canning units and community cold room structures for managing this challenge.

b) Button mushrooms hold a predominant share (about 85%) in the total mushroom production of the state. Appropriate measures for training, handholding, post-harvest and marketing facilities should be taken to diversify mushroom production towards oysters and other varieties.

5.4.8 Sericulture

Punjab is a non-traditional and minor silk-producing state. Agro-climatic conditions of the state largely favour spring (March-April) season crops, this season's crop accounts for more than 70 per cent of the entire cocoon production by generating around 30,000 kg of silk reeling cocoon and around 4000 kg of raw silk annually. Sericulture is an agro-based occupation that mostly employs marginal farmers and economically weaker sections of the rural society in sub-mountainous Punjab, owing to its low input needs and higher returns. Major challenges to the promotion of sericulture in the state include inadequate dissemination of improved technologies, lack of incentives, and technical handholding; and shortage of mulberry plantations and quality germplasm.

Policy Recommendations

- 1. Establish a Reeling Unit for Value Addition:** Cocoons cannot be stored for long whereby the producers have to sell their produce in the glut period at lower prices. After reeling its storage capacity increases to get more than double savings. So a reeling unit should be established by State Department of Horticulture in Pathankot district in its production area to run on custom-hire basis.
- 2. Introduce Hybrids of Mulberry:** Advanced strains/hybrids of mulberry should be introduced or evaluated for commercial cultivation of mulberry silkworms. Hedge gardens need to be maintained for conserving mulberry germplasm.
- 3. Dissemination of Information:** Extension activities should primarily target awareness about various funding schemes run by the Central Silk Board.

5.4.9 Medicinal and Aromatic Plants, and Spices

Medicinal and Aromatic Plants (MAPs) may offer significant opportunities in the state. The processed products of MAPs can serve as valuable profitable resources. The processed products such as herbal medicines, extracts, essential oils, and cosmetics can create ample opportunities for developing small-scale agri-processing industries in the state. *Kandi* region is most suitable for the cultivation of medicinal crops due to many factors such as low use of chemicals in agriculture, availability of wasteland, damage of crops by wild and stray animals, low productivity of other crops and significant area under forest and agro-forestry.

Policy Recommendations

1. Strengthen Research and Development

- a) Exclusive research and development work is required for the screening of medicinal and aromatic plants and their varieties suitable for Punjab especially in the *Kandi* area.
- b) There is a need for research to standardize, propagation and cultivation practices (package of practices) of medicinal plants specifically for the *Kandi* region.
- c) Medicinal Aromatic Plants (MAPs) and spices like ginger, turmeric, *Mulethi*, *Ashwagandha*, *Sarapgandha*, *Tulsi*, *Aloe vera*, *Sadabahar*, *Brahmi*, *Kalmegh*, *Kalihari*, *Pipli*, Lemon grass, *Currypatta*, etc. have a scope of cultivation in the *Kandi* region. Potential medicinal trees are *Arjun*, *Bahera*, *Harar*, *Sohanjana*, *Amla*, *Jamun*, *Bael*, *Neem*, *Ritha*, etc.

2. Promote Cultivation

- a) Cultivation of promising medicinal plants may be promoted under prevailing agroforestry systems such as agri-silviculture, agri-silvi-horticulture, agri-horticulture, silvi-pastoral, etc. (*Poplar*, *Safeda*, *Dek*, and others based agroforestry system).
- b) The availability of quality planting material of promising medicinal and aromatic plants to the farmers is the most important aspect and certified hi-tech nurseries should be developed by the government for this purpose.
- c) With the support of domain experts skill development trainings and transfer of technology on cultivation, processing, and value addition of MAPs is the need of the hour in the target areas of Punjab.

3. Infrastructure and Facilities

- a) For value addition and convenient marketing, the establishment of facilities for processing of medicinal and aromatic plants viz., sorting, grading, drying, storage, distillation units and transportation, etc. may be developed for clusters of villages by involving MPCBs.
- b) Effective marketing linkages with the support of IAMS need to be established between producers and buyers, preferably with effective buy-back arrangements. An integrated value chain needs to be developed and facilitated to solve problems related to the cultivation and marketing of MAPs.

4. Financial and Administrative Support

- a) The entrepreneurship on MAPs may be made easier by tax exemption for value addition, branding and marketing.

- b) Resilient compensation approach may be initiated for the farmers to cope up with crop failure or natural calamities, etc.
- c) A domain expert nodal officer should be appointed to facilitate all the stakeholders to deal with various aspects of medicinal, aromatic and spice crops in the target areas.

5.5 Agroforestry

Exigencies related to diversification, natural capital protection, climate change mitigation, multiple income avenues provided by agroforestry, high wood demand, and limited success with direct afforestation/plantation in increasing area under forests in agricultural regions signify the role of agroforestry in addressing challenges of agriculture in the region. Major strengths of the state in respect of agroforestry include several poplar-based models with a track record of success, promising cultivars with related production-protection measures, and well-established niches. The difficulties include unorganized marketing structure, a limited timber industry, biases in taxation and incentives, and a lack of community involvement.

Policy Recommendations

1. **Set up Wood Market:** In various regions of the state, based on the production quantum of the area, four-five modern wood markets are required to be set up. Dasuya Hoshiarpur Road, near wood industry area, is an ideal location for this market. The land on Hambran road in Ludhiana may be assessed for suitability for establishment of new wood market. Similar markets need to be established at other parts of the state.
2. **Agroforestry Models:** The different agroforestry farming models like intercropping of trees with many horticultural crops like turmeric, onion, potato, marigold flowers and boundary plantations around orchards etc. should be promoted as these models have great economic potential in the state.
3. **Solar Tubewell Supported Micro Irrigation System:** The productivity of poplar based conventional cropping systems can be enhanced with micro irrigation techniques. Given the mismatch between irrigation requirement timings for poplar and conventional cropping system, growers need to be extended suitable incentives for installing solar tubewells supported micro-irrigation system.
4. **Road-side and Field-boundary Plantation:** Some share of the sale proceeds of the wood produce from road side and field-side plantations to adjoining farmers may be given to promote community participation in nursing roadside plantations. Traditional trees (*Tahli*, *Mango*, *Neem*, *Jamun*, *Mulberry*, *Toon*, etc.) can have wider acceptance for roadside plantations.

5. **Eco-Tourism and Heritage with Agroforestry:** In *Kandi* areas of the state, agroforestry based eco-tourism need to be encouraged. Existing *rakhs/birs* need to be protected and promoted as cultural heritage of the state.
6. **Linkages with Horticulture:** Agroforestry should be brought under the domain of Horticulture which may enable the farmers to avail the similar facilities/incentives of drip irrigation, fencing, block plantations, etc. In order to enable mechanized crop protection, pruning, shredding, and harvesting operations, custom hiring equipments/ machineries should be provided to the farmers through Multipurpose Cooperative Societies or Horticulture Estates.
7. **State Support to Agroforestry:**
 - a) Timber produced from agroforestry may be declared as agricultural produce in order to bring parity in tax relief.
 - b) Financial support should be given to PAU from Compensatory Afforestation Management and Planning Authority (CAMPA) funds for developing fast growing varieties/clones, profitable agroforestry models, silvicultural practices, management of pests, etc.
 - c) Some wood-based industries like paper and pulp sector, power and briquettes from forest waste, etc. need to be established in the state.
8. **Promote Bamboo Cultivation:** In the light of latest research findings, bamboo plantations need to be promoted with a view to lower cost of production, longer life, value addition potential and a highly profitable venture in its NGA – the *Shivalik* foothills/*Kandi* area. Such regions of Punjab should be integrated with the National Bamboo Mission to reap their potential for higher profitability and employment generation.

5.6 Integrated Farming and Integrative Income Support (IFIS)

There is need to establish a ‘Centre of Excellence for Integrated Farming and Integrative Income Support’ at PAU to ensure higher profitability for the 3.5 lakh small and marginal farms, and provide supportive income generating part time employment opportunities in other sectors of the economy in rural areas. It shall work to combine the respective potentials of component system in Integrated Farming System (IFS) utilizing the wastes from one production system in another to reduce costs and combine the mutually beneficial mixed cropping. Further, it will provide employment to some members of these farming families in other sectors of the economy in MPCS command areas to form integrative income to the farming family. A Progressive Farmers’ Society (PFS) should be formed along with CoE for IFIS as an autonomous registered body. The PFS will work for enhancing cooperation and technical know-how for the small and marginal farmers of the state.

6. ORGANIC FARMING

The human body as evolved by nature requires balanced fresh foods of diverse kinds produced in each of the different agro-eco regions. Its vital organs- the brain, liver, heart, kidneys, reproductive organs, other parts and the body as a whole - remain healthier and efficient by consuming balanced foods to perform their respective and coordinative functions, and to enjoy the endowments of mother nature. However, when exposed to imbalanced food polluted with chemicals, pesticides, and other toxic substances, the body does not function normally. Even the smallest quantity of such items can adversely affect vital organs, immune system, and ultimately the human health and vitality.

In accordance with these requirements, it is essential to revisit the traditional wisdom of our elders, who practiced agriculture that was primarily organic until the 1960s. The system relied on crop rotations, green manures, composts, mutually beneficial mixed cropping, seed selections in the field, biological pest management, keeping fallow land after exhaustive crop and need-based irrigation or nature-dependent rainfall. It was eco-friendly and human-friendly too. As a result, the produce was healthy and so were the people.

However, hard pressed by the food needs of India and its losing pride for its inability to produce at home, a very small part of the country- the states of Punjab, Haryana and Western UP - was brought under the intensive agriculture model of the Green Revolution. These states made unprecedented achievements in productivity and production, ultimately achieving food self-sufficiency and political stability for the country.

But soon, the inherent push of this system started mining of the nutrients with increasing chemical use, which affected the productive strength of the living soil and its microflora, the eco-system and the quality of produce with respect to nutritional balances and the hazardous chemical residues. Furthermore, due to the increased input costs and exploitation of market surpluses, the farmers' incomes that increased initially during the first decade, started declining, ultimately leading to debt, distress and suicides among the farmers and farm workers.

It has shaken the foundations of healthy living, increasing the dependence of each one on pharma medicines and supplements instead of adopting the old traditional wisdom "Let thy food be thy medicine and medicine be thy food". Such is the fate and bitter experiences of this system accelerated by vested interests which led to disastrous consequences for the society as a whole.

In consideration of this objective status, it is important to appreciate that advances in science in the distant past have made us capable of harnessing natural quality production factors more efficiently. Such capability entitles us to realize better quality and higher productivity potential of the available crop/animal germplasm in their NGA without the use of hazardous chemicals. Moreover, recent research findings have proved that when the required nutrients are applied to the crop through organic amendments, the yield obtained is on a par with those achieved with chemical fertilizers application, while improving the quality of the produce and soil. Greater focus on research and development in the field of organic production may further enhance the gains from existing achievements.

The importance of human health as a prime priority needs to be recognized by everyone vis-à-vis economy or other material aspects in life. This is because one can embrace and realize one's self and nature's endowments only and only through healthier and efficient sensory and vital organs of the human body. It is the organic produce which takes care of all the nutritional and medicinal requirements of the body like vitamins, minerals, antioxidants, fibre, etc. to make healthier and stronger humans.

With increasing global health awareness, the organic produce is not only a necessity with increasing consumer demand for healthier foods, but also an opportunity for lucrative commerce opportunity if dealt with professionally. Now it is becoming the commerce of the nobles.

In contrast to the existing chemical-supported intensive agriculture model, organic farming is an approach and a production management system for balanced quality produce which improves soil fertility and microflora diversity. It prioritizes healthier ecosystems capable of realizing the higher productive potential in the NGA of respective crops.

With the increasing expansion of the foodgrain production centres in other states of India, the chemical-supported surpluses in Green Revolution regions have started weighing against a fair price discovery for the farmer. Farmers lose income, market respect, and health due to higher productivity and lower-quality produce. Furthermore, foodgrain purchase decisions of the Government of India have become increasingly uncertain compared to the distant past.

Given this background, promotion of organic farming – for human health, as a good commerce, with higher profitability and for a healthier ecosystem – has emerged as a historic opportunity and a holy task for civilized society and the governing regime.

Policy Recommendations

1. **Establish CoE for Organic Farming:** **a)** A state-of-the-art Centre of Excellence (CoE) for Organic Farming at a central place, preferably in Ludhiana should be established and linked with all the Centres of Excellence being established in Punjab for participatory research (PAU, line departments and progressive farmers), demonstrations and training of stakeholders for profitable organic farming in the respective NGA of different crops. Under the Department of Agriculture and Farmers' Welfare, the CoE will coordinate with the related agencies for the unified implementation of the organic promotion programme.
- b)** A Progressive Farmers' Society (Organic Farming) should be formed with a mandate to promote organic production, along with processing, storage and marketing of produce/products of the member farmers to enhance their profitability; in coordination with the proposed AMRII and IAMS. It will closely coordinate with the CoE for the latest technologies and keep a collective watch to ensure that the research and extension efforts are pursued efficiently and in the desired direction to benefit the stakeholders.
2. **Strengthen R&D on Organic Production in NGA:** Research and development on organic production of crops/alternatives in their NGA should be strengthened as an end-to-end approach to remove various hindrances. This can be undertaken by developing crop-specific protocols for organic amendments including nutritional support, plant protection alternatives and others along with value addition and special storage systems.
3. **Initial Incentives to Farmers:** Incentivize the farmers for transition from chemical to organic production systems with an initial push to produce quality food items and for healthier ecosystem promoting services to society during the transition phase until farmer starts running the enterprise profitably.
4. **Organic Certification:** Third party organic certification should be ensured as an effective marketing tool to build confidence and assurance of produce/product quality to the consumers. It should build credibility with traceability through geo-tagging scanner and transparency for rapidly emerging domestic markets, in general, and for export, in particular.
5. **Processing and Marketing of Organic Produce through Cooperatives:** Public/Cooperative sector institutions like Markfed/Verka/Punjab Agro, etc., as per their mandate, should be entrusted with the responsibilities of processing, storing, branding and marketing the organic produce/products in the domestic and globally targeted export markets. It is of utmost importance to share a fair part of the earned value to the prime stakeholders—the farmers or the farmers' societies.

6. **Appoint Nodal Officer:** Every district should have a nodal officer as Agriculture/Horticulture Development Officer (Organic Farming). With a focus on this subject, the nodal officer will coordinate with the Centre of Excellence to acquire the latest relevant technologies and any other instructions to assist the farmers in every respect, to make organic farming a profitable venture.
7. **Setup Organic Outlets:** Based on the quantum of diverse organic produce as assessed by the Department of Agriculture and Farmers' Welfare, organic outlets/*kisan* huts should be established with solar-supported, small storage/cold room facilities as per the nature of produce at the district/block level, if it forms the potential area of organic production. Similarly, the diverse local organic produce will be marketed as fresh or processed in the MPCS being proposed in village cluster.

7. LIVESTOCK SECTOR

Livestock being an integral part of human society, has been inextricably linked with social and economic well-being of the human civilization. Livestock serve multifarious needs, viz. nutrition, security, recreation, companion, transportation, fibre, etc. Though, a paradigm shift is going on from ‘production by masses’ to the ‘mass production by a few’, where Punjab is taking the lead, yet about two-third of the total milk is produced by small and marginal farmers in the state. Livestock sector is demand-driven with dairy, egg and meat being predominant.

As per 20th Livestock Census, 2019, Punjab has 1.3 per cent share of India’s total livestock. The state of Punjab has 70.50 lakh livestock, comprising 40.16 lakh (56.9%) buffaloes, 25.31 lakh (35.9%) cattle, 3.48 lakh (4.9%) goats, 0.85 lakh (1.2%) sheep and 0.53 lakh (0.7%) pigs. In addition, there are 14,243 horses and ponies, 1644 mules, 471 donkeys and 170 camels. The total poultry population in the state stands at 176.50 lakh, which produced 6.26 billion eggs in 2021-22 (Annexure X). From 2012-13 to 2021-22, livestock sector has grown with a compounded annual growth rate of 5.76 per cent, which manifolds higher than that of crop sector (0.36%) for the corresponding period. In 2011-12, the share of livestock in Gross State Value Added (GSVA) of agriculture was 26.03 per cent which increased to 39.90 per cent in 2022-23, highlighting the relevance of the livestock sector in rural economy for farm income augmentation and employment generation. In the state, milk is the highest source of income generation from livestock. Punjab is the sixth largest producer of milk (14.30 MT) with the highest per capita availability (1271 g/day) in the country. The share of Punjab in national egg production is 4.68 per cent and stands at eighth position in the country with per capita availability of 200 eggs per year. The per capita availability of meat in the state is 7.51 kg per year, against 6.82 kg for the country. From 2007-08 to 2021-22, the milk, egg, meat and wool production in Punjab increased by 51.6 per cent, 60 per cent, 109 per cent and 3.2 per cent, respectively.

Punjab is a land-locked state, yet fisheries is a promising sector for enhancing employment and income. During 2021-22, the total fish production in Punjab stood at 1.90 lakh tons out of which 1.47 lakh tons (77.36%) came from the aquaculture sector comprising of 12,356 ponds covering an area of 43,690 acres, including 9,566 (77.41%) village ponds. As per advance estimates 2022-23, the contribution of fisheries to overall agriculture and allied activities GSVA is 1.47 per cent.

Livestock sector not only supports agricultural diversification in a big way, it also adds value to the output of crop sector by converting crop residues, agro-processing wastes and low-cost cereals into valuable high quality nutritious foods like milk, meat and eggs. The equitable distribution of livestock resources amongst different categories of farmers makes livestock farming pro-poor, rural employment generator and a tool for women empowerment.

In the current scenario, animal husbandry and fisheries have progressed to the status of primary farming occupation rather than being secondary sectors of agriculture. Livestock farmers mostly undertake crop farming only to support their livestock enterprises and it is no more the other way around. The development and implementation of a forward-looking policy, through budgetary, administrative, educational, research, extension, production and marketing reforms for further upscaling livestock sector is imperative for enhancing stakeholders' socio- economic status.

7.1 Policy Recommendations for Livestock Sector

- 1. Budgetary Allocation to Livestock Sector:** The share of livestock in state's agricultural GVA is 39.90 per cent in 2022-23, while the budgetary allocation to the sector is merely 4.43 per cent (Rs. 603.4 crore, 2023-24) of total allocation to agriculture. This constitutes 0.31 per cent of state's total budget (Rs. 196462.28 crore), even though this sector alone contributes 10.33 per cent of total GSVA. This clearly indicates that Animal Husbandry and Fisheries sector is self-driven without commensurate allocation of budget to this sector. The sector is also devoid of several incentives and calamity related compensation which are available to crop sector. In case, appropriate budgetary support is provided, the sector is likely to accelerate its growth and contribution to state's economy, farmers' income and society's welfare. This has been witnessed in states where appropriate budgetary support was provided in the recent past. Hence, budget allocation to livestock sector should be increased in order to accelerate the growth of the sector. The budgetary allocation and its release to the Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana should be directly from Department of Finance rather than through State Animal Husbandry Department.
- 2. Ease of Doing Business in Livestock Sector Along with Other Utilities:** Livestock sector is neither considered an agricultural enterprise nor an industry in government policies, thus, depriving livestock farmers of incentives which are available to these two sectors. Rather

Key Takeaways

- Commensurate budgetary allocation
- Ease of doing livestock farming
- Reliable data generation
- Promotion of livestock-based IFS

these farmers end up being disadvantaged compared to agriculture and industry players by paying higher tariffs for electricity, bank interest rates, etc. besides being denied subsidies and compensations where applicable. This retards the otherwise huge growth potential of livestock sector through attracting investments at various scales.

Government should declare livestock as a ‘special sector’ on the lines of agriculture and industry, so that favourable and supporting policies regarding change of land use (CLU), bank finance, electricity connections and tariffs, pollution control certification, etc. are put in place. Electricity tariffs levied on commercial dairy farms should be at par with agricultural tariffs. Subsidy on electricity should be used for solar energy production. Punjab Pollution Control Board guidelines become restrictive for large scale investment in livestock. Livestock upto a certain scale (for example 20 buffaloes/cows, 100 goats/pigs, 5000 poultry birds) should be considered in non-commercial agricultural activity for providing financial benefits. These hurdles can be removed by providing single-window support like *Suvidha* Centres with traceability.

Performance based, collateral-free and low interest credit facility should be provided for establishment, expansion and working capital needs of livestock enterprise. Livestock and farm inventory should be considered as collateral for fixing the credit limit of livestock and fisheries enterprise. As several small livestock enterprises like backyard poultry, goatry, piggery, dairy are potentially valuable tools for poverty alleviation, therefore, there should be special subsidy-linked scheme for providing such birds/livestock to landless farmers for employment generation and income enhancement.

3. **Livestock-based Integrated Farming Systems:** Integrated Farming Systems (IFS) ensure the utilization of wastes of one production system into another production system to reduce costs and augment farmers’ income while also preventing environmental pollution. The dairy, poultry, piggery, goatry, fisheries, horticulture, agro-forestry, vermicomposting, etc. are amenable to integrated farming under various integrated farming models like crop-dairy-vermi compost, piggery/poultry/goatry/dairy-fisheries-crop/horticulture/agro-forestry, backyard poultry/sheep-horticulture, etc.

Feed industry is one of the major users of maize, *bajra*, mustard deoiled cake, groundnut cake, cotton seed meal, dried distillers grain with solubles (DDGS), etc. Therefore, with the development of poultry/livestock/fish farming, there will be concomitant increase in the production of maize, *bajra*, mustard and cotton, along with increase in the area under these crops, which marks the diversification through these sectors.

The demonstration and training in different livestock based integrated farming models should be developed on regional basis to attract farmers in making rational choices with comparative analysis of the profit and fund-flow.

4. **Data Generation with Animal Identification and Registration:** Mandatory implementation of animal identification-registration system is paramount for reliable data generation. This will aid in policy formulation, traceability, identification of elite animals, reporting outbreaks, generating databases, real time reporting, maintaining records, realization of subsidies, insurance, etc. The benefit of government schemes can also be easily channelized and the farmers can be identified which will reduce fraudulent activities as well.

Timeline/real-time database must be generated for aquatic resources (capture and culture), fishers (fish farmers/fishermen/fish workers), socio-economic performance of aquaculture units, impact assessment, marketing, fish quality, etc. for formulating effective action plans for sustainable development of the fisheries sector.

Application of digital data recording with satellite applications like geo-tagging, remote sensing, and artificial intelligence shall be crucial in creation of reliable database.

5. **Promotion of Futuristic, Mechanized and Environment-friendly Livestock Farming:** The primary concerns for the state for further development of livestock production are labour availability and cost, pollution free livestock farming and income generation capacity of the enterprises. For labour saving, mechanized operations with indigenous, low-cost machinery development should be encouraged. Punjab has good base in agriculture machine manufacturing which can be leveraged for livestock farm machinery manufacturing. Future ready artificial intelligence-based tools in dairy production should also be manufactured indigenously.

6. **Branding and Marketing Punjab Livestock Products:** The concept of ‘family farmer’ needs to be introduced and strengthened to boost specific livestock related activities among farmers and to provide safe, reliable and wholesome food to the masses. The alignment of producers with consumers needs to be supported through establishment of an Agriculture Marketing Research and Intelligence Institute (AMRII)/Multi-Purpose Cooperative Societies (MPCS)/ an online platform and empowering the producer with knowledge and support required for producing, storage, processing and transporting their produce/products on a wider scale.

There is an imminent need to develop strategies to promote, and initiate campaigns for creating brand value for Punjab livestock products. Special emphasis shall be laid on buffalo milk and its priced products like Mozzarella cheese, buffalo milk butter, *khoa*, indigenous

sweets, *kulfis*, etc. Separate collection and processing of milk from different species of livestock like goat, buffalo and their high value products like cheese must also be labelled and marketed specifically. There is a strong need to build the capacity of the primary producers for value addition of milk for maximizing the profits.

Strict quality control of milk, meat and their products should be ensured to reduce adulteration and to establish consumer trust in the produce of Punjab. Milk Collection Centres associated with Milkfed should conduct random tests for residues and adulterants.

There is immense scope and urgent need for processing and value addition of goat milk and meat to ensure supply of quality products to the consumers and enhance income of goat farmers. Goat milk can be bottled and sold to the consumers. Cheese making is one of the profitable ventures which should be focused upon. Goat meat can be sold after making marketable cuts in the form of pickled, and other emulsion-based products.

The chicken meat processing industry needs to be revitalized by building the requisite infrastructure and rationalizing the taxation. The individuals interested in setting up their individual processing plants must be provided with suitable incentives and support. Processing of eggs to egg-powder for easy transport and enhanced shelf life should be encouraged as a vibrant source for value addition of eggs.

Presently, north-eastern states are hub for marketing of live pigs from Punjab which are renowned for their quality meat. However, long-distance transportation costs, stress, mortality, and shrinkage issues hinder their marketing. Establishing three slaughter-cum-processing plants of slaughtering capacity of 100-150 pigs each at appropriate places can develop the state a hub for pig processing.

As of now, no shrimp pre-processing/processing plant is available in the region (Punjab, Haryana and Rajasthan). Therefore, a pre-processing/processing plant with adequate cold storage facility needs to be established in the region to minimize post-harvest losses, safeguard farmers' profitability and add-on opportunity of direct export for more revenue generation.

The farmers who are producing milk, eggs or meat at par with the national/international standards with traceability should be supported for export of their product.

7. **Animal Healthcare:** Healthy animals can produce healthy products, hence they should consume good quality feed and fodder and special emphasis should be given on disease prevention. Disease specific vaccination programmes, proactive disease testing, rapid response teams for outbreaks at district levels should be established. There should be adequate

arrangements to bury or incinerate the animals that die due to infectious diseases and adequate compensation should be given to the owners of the dead animals. The use of alternative medicine like homeopathy, ethno-veterinary and *herbal* medicines should be encouraged to reduce the use of antimicrobials in livestock sector and their residues in livestock products, that is leading to anti-microbial resistance. The entry of livestock across borders must be regulated to prevent the entry of transboundary diseases in Punjab.

Capacity building of veterinarians is needed for effective pig and goat health services delivery in the state. The diagnostic laboratory facilities at block and district levels should be established and strengthened for early disease diagnosis with support in the form of relevant equipment, supplies and trained manpower. Basic diagnostic facility should also be made available at Civil Veterinary Hospital level. Ultrasound facilities should be made available at the block level hospitals, for rapid and accurate diagnosis of internal disorders including reproductive dysfunctions. Research on cow-side/pen-side diagnostics should be supported and their mass production can, thereafter, be outsourced. A state level referral laboratory at GADVASU should be supported with required budget.

Vaccine storage, supply and vaccination facilities should be upgraded for complete cold chain maintenance and 100 per cent coverage of candidate population should be ensured. The use of third-party in the entire system should also be explored for complete coverage. Research on development of vaccines against new and emerging diseases like Lumpy Skin Disease and African Swine Fever should be fully supported for quicker outcome. The upgraded facilities of Punjab Veterinary Vaccine Institute, Ludhiana should be put to full use without any further delay for the production of required viral and bacterial vaccines for livestock of the state. The State Animal Husbandry Department should ensure vaccination coverage for pig, sheep and goat population which are generally reared by resource-poor farmers.

8. **Development and Strengthening of Cooperatives/SHGs/MPCS:** The group-based approach based on greater volumes ensures procurement of inputs at low-cost and marketing of produce at profitable levels with greater bargaining power. These can play a vital role in addressing common problems of the stakeholders and safeguard their interests. Currently, the cooperative structure or group-based culture is poor in livestock sector except dairy and poultry. Hence, MPCS, farmer-led cooperatives or Self-Help Groups (SHGs) need to be developed and promoted in livestock and fisheries sectors through group-linked financial incentives, infrastructure creation, initial handholding in activities like feed and fodder, processing and value addition, marketing and branding. These groups should be supported through timely

release of subsidy for consistent financial support, creating equipment infrastructure and subsidized solar energy.

9. **Attracting Youth in Livestock Farming and Capacity Building:** Skill deficit and lack of financial support have held-back the growth of livestock and aqua industry. As a result, the stakeholders have failed to keep pace with growth and demand for greater efficiency at all levels of value chain. Youth-targeted capacity building and financial support policies should be put in place for providing self-employment, self-confidence and improved socio-economic status that will in-turn stem the exodus of youth. Youths are tech-savvy with modern tools for information resourcing, farm mechanization and automation, scientific farming practices, marketing, etc. Use of modern technology can help in reaching larger population of youths across the state in the shortest possible time. A Livestock Business Incubation Centre for handholding of new entrants in the sector should be established at GADVASU, wherein, the ideas of the entrepreneurs shall be mentored with relevant technical support.
 10. **Livestock Waste Management and Green Energy:** The commercial dairy farms, *gaushalas*, cattle pounds, pig farms, poultry farms, goat farms, fish farms, etc., should be provided with technical back-stopping and financial assistance for waste management. Large farms/ *gaushalas* and community-based biogas plants should be made mandatory and supported financially. The village youth can be trained for production of vermicompost at entrepreneurial levels. The workers under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) scheme can be engaged in running community-based biogas plant and vermicompost units.
- Solar energy is a clean and green resource that benefits livestock-based farms by reducing electricity dependence and promoting green energy utilization. New and existing livestock farms, especially fish farms should be granted solar panels for reducing their dependence on electricity.
11. **Creation of Livestock Development Fund:** The state should establish a fund for the development of livestock sector in Punjab by levying a cess @ 10 paisa per liter from establishments processing more than 10,000 liters of milk per day, and @ 10 paisa per bird for slaughter houses sacrificing 5000 or more birds per day, and @ Rs. 100 per buffalo slaughtered in organized slaughter houses. This fund should be used for research, development, extension and training activities through GADVASU and for meeting with the market volatilities and price stabilization.

7.2 Dairying

In 2015-16, the milk production in the state stood at 10.77 million tonnes (MT) which significantly increased to 14.07 MT in 2021-22, registering a growth of 30.64 per cent. This rapid increase in milk production has led Punjab to top in per-capita milk availability, although no major government support/scheme was implemented during this period.

Policy Recommendations

1. **'Breeder State' for Dairying:** The state of Punjab has developed best dairy breeds of buffaloes like *Murrah* and *Nili-Ravi* and cattle like Holstein Friesian (HF), Jersey, *Sahiwal* and their crosses, along with Beetal goat, to crown the productivity in all categories of dairy animals in the country. The farmers of Punjab have procured and produced top of the line *Murrah* buffaloes and exotic cattle through large investments at individual level and through progressive farmers' associations. Governmental support in the form of incentives for creation of organized dairy farm structures like cattle sheds, milking machines/parlours, Total Mixed Ration (TMR) wagons, chaff cutters, harvesters, etc. popped up commercial dairy farming, which needs to be further strengthened to consolidate the position of the state as a dairy breeder state. For this purpose, breeder organizations/associations should be strengthened through regular monthly block-level milk recording championships, encouraging record keeping by individual farmers, identification of bull mothers and bull selection from such elite animals. Commercial farmers having milking parlour software should be roped in for start of bull selection and progeny testing programme. High yielding animals should be identified and their owners should also be incentivized. In-vitro Fertilization (IVF)-Embryo Transfer Technology (ETT) should be encouraged for rapid multiplication of this elite germplasm. Herd book should be started by Animal Husbandry Department/GADVASU in collaboration with breeder associations. Government should invest in research for standardizing genomic selection for different breeds of cattle, buffaloes and goats, while also making the use of recently developed parentage verification technology for its wider application. Semen production and sale should be regulated to make available quality semen from superior bulls.

Key Takeaways

- 'Breeder state' with elite dairy animals
- Buffalo as the preferred dairy animal
- Scientific, mechanized and precision dairy farming
- Climate smart dairying
- Stray animal management
- Value addition of dairy products/meat

2. **Promoting Buffalo as Preferred Dairy Animal:** Superior buffalo breeds are native of Indian sub-continent, more resistant to prevalent diseases than exotic cattle, produce highly nutritious quality milk and also have handsome salvage value ensuring that there are no stray buffaloes on the streets. Buffalo milk is preferred not only for making Indian sweets but also high value-added products like Mozzarella cheese and *ghee* for better price realization to make buffalo farming economically remunerative. Moreover, transportation efficiency of buffalo milk on milk solid basis is 40 per cent higher as compared to cow milk. Punjab is one of the largest buffalo meat producing states having five state-of-the-art export oriented abattoirs, exporting to Association of South-East Asian Nations (ASEAN) and Middle-Eastern countries. The state should promote spent/surplus male buffalo fattening units which can generate good employment in rural areas.
3. **Scientific, Mechanized and Precision Dairy Farming:** The climate resilient sheds should be promoted which will aid in increasing milk production and reducing the disease load at the farm. The mechanization in small family farms (20-50 animals) should be supported through development and fabrication of such low-cost machines/tools to address the scarcity of manpower. Group based approach for development and use of larger dairy/allied machinery should be supported.

Punjab has led commercial dairy farming with concurrent evolution of industry for manufacturing of machines for dairy farming. Machines like TMR wagons, scrappers, balers, fodder harvesters, etc., are being manufactured in the state. The low-cost dairy machinery must be developed with adoption-centric approach keeping in view the concerns of marginal and small farmers. Such industries should be encouraged with suitable incentives to further expand their operations for export of dairy machinery.

Apart from mechanization, the future of dairy lies in development and adoption of artificial intelligence led precision farming and automation. Such technologies for climate control, disease surveillance, reproductive and health management, productive performance and feeding are available in international market but their adoption by local farms is very low owing to high cost. The cost of these technologies needs to be brought within the reach of average commercial farms through indigenization and besides made applicable to the scattered small and medium farmers.

4. **Climate Smart Dairying:** Indian livestock are often blamed for high greenhouse gas emissions. The state should focus on low methane emission per kg milk or milk solids produced. For reducing methane per unit milk production, important interventions required are - germplasm

improvement for efficient milk production, ration balancing, manure management, feed additives and climate resilient sheds. Punjab should also strive for reducing the number of dairy animals to save environment and have efficient system of milk production. For better economic performance, family farms should be supported with minimum 10 cows or buffaloes. Smaller and marginal farmers may be shifted to other livestock like goat/sheep and backyard poultry.

5. **Management of Stray Cattle:** There is a need for amendment of state law(s) for the stray animals, taking into account the changed configuration of states' livestock population. The current act on prohibition of cow slaughter was enacted in 1956 when only *Bos indicus* cow was reared. Later on, in 1970s, another species (*Bos taurus*) was introduced and cross-breeding also took place. Most of the stray cattle in Punjab at present are *Bos taurus* type. Therefore, the protection of law from slaughter should be available only to indigenous holy cows, i.e., *Bos indicus*. The National Highway Authorities/toll plaza officials should make the roads free from stray cattle by proper fencing and by developing stray cattle pounds near toll plazas. The private/NGO *gaushalas* should be made self-dependent with initial budgetary provisions so that the stray animals may be removed from roads and human habitations. The revenue from Cattle Fair Funds should also be used for management of stray cattle. Allocation of MGNREGA scheme workers for stray cattle management should be permitted. Research for prevention of infertility, mastitis and other disease conditions which lead to abandoning dairy cattle should be strengthened. This includes application of sexed semen, IVF-ETT, induced lactation strategies, creation of useful products from the by-products produced by these animals. Additionally, efforts should be made towards low-cost maintenance of unproductive cattle.
6. **Research and Development (R&D) in Feed and Fodder:** For low-cost feeding, quality fodder is a pre-requisite. Fodder varieties should be developed with high nutritive value with ability to resist extreme weather conditions in view of global warming. Seed production for such fodder varieties should be encouraged through appropriate incentives. Spring maize should be supported for cultivation on drip system only, to reduce the use of water and early maturing varieties of maize must be developed along with other fodder crops. The land under respective *panchayats* should be banned for paddy sowing and diverted towards fodder cultivation. The Fodder Research and Development Centre should be established jointly by Punjab Agricultural University and GADVASU for undertaking research in fodder development.

7. **Restructuring Milkfed:** For restructuring of Milkfed to make it a high-performing entity, the government should hire a consultant who has demonstrated exemplary leadership in cooperative sector at national/state level. The Board of Directors and Chairperson of District Cooperative Milk Producers Unions of Milkfed must be ‘Dairy Producers’. 40 per cent members of the Board of these unions should be farmers having more than 50 animals and 60 per cent members having lesser number of animals. The State milk cooperative should be headed by technocrats with fixed tenure of minimum three years. Milkfed should also focus on increasing the spectrum of high value-added products in collaboration with GADVASU.
8. **Rendering Units:** Dead animals have great economic value provided they are rendered quickly and scientifically. Rendering of dead animals for the production of oils, gelatin, gums, meat and bone meal, and hides/skins can increase the income of farmers. The government should support the establishment of rendering plants atleast one in each district. The farmers may be incentivized for bringing dead animals at rendering plants. This will lead to reduction in open disposal of dead animals, reduction in vector population and hence, spread of diseases will also be checked.

7.3 Poultry

Eggs produced by the poultry birds serve as easily available high quality protein source for all segments of the society. The backyard birds are the source of livelihood and augment nutritional security among the rural masses. The egg production in Punjab has significantly increased by 26.84 per cent during the last five years. The per capita availability of eggs in Punjab is 200 eggs/year is way more than the national average of 95 eggs/year. The per capita availability of poultry meat in Punjab is around 4.48 kg/year which is more than the national average of 3.95 kg/year.

Key Takeaways

- Marketing through MPCS
- Promotion of backyard poultry
- Eggs in Mid-day meals and *Anganwadi* centres
- Reduction/Elimination of use of Anti-biotic

Policy recommendations

1. **MPCS – As Major Marketing Agent for Poultry:** The contract farming companies exploit poultry farmers on multiple fronts. The companies often sidestep guidelines provided by the Central government and find loopholes to exploit farmers. Shifting away from the current model of contract farming would undoubtedly benefit poultry farmers. The marketing of poultry products through Multi-Purpose Cooperative Societies (MPCS) would be a viable solution, providing farmers with a robust, fair and profitable marketing platform. This will

offer greater advantages to farmers compared to being bound by exploitative practices under contract farming companies.

2. **Eggs in Mid-day Meal Scheme and *Anganwadi* Centres:** Eggs are not strictly associated with any taboo, therefore, these should be added in the Mid-day Meal Scheme and *Anganwadi* Centres for the children and expecting mothers as is being practiced in 11 states and Union Territories in India. Apart from enhancing the nutrition for the consumers, it will also curtail the losses incurred to poultry farmers due to change in egg prices and stabilize the demand and supply position.
3. **Promotion of Backyard Poultry:** Backyard poultry, a source of livelihood and income for poor, landless and farmers, has increased tremendously in previous few years. Adequate supply of chicks by establishing hatcheries in government and private sector should be ensured along with breeding farms. The marketing of products from traditional/backyard poultry must also be prioritized. It will also help in conservation of native breeds of poultry.
4. **Research on House Fly Menace:** Poultry manure, wet feed, litter and bedding material are major factors for increasing fly population at poultry farms. Only few farmers are following integrated pest management programme. GADVASU must be provided with funds to pursue research on this issue. Manure management in poultry farms should also be dealt as a thrust area for utilization of nitrogen, phosphorus and potassium available in poultry droppings.

7.4 Piggery

Pig farming is flourishing nationwide due to rising domestic and international pork demand, requirement of low initial investment, high profitability, prolificacy, early maturity, and a short generation interval. Punjab has only 52961 (0.58%) pigs out of total 9.06 million pigs in India. Punjab contributes 0.36 per cent to India's total pork production. China is a major pork producer and consumer, while India is net importer of processed pig meat.

Key Takeaways

- Establishment of modern slaughtering-cum-processing plant for pigs
- Strengthening of pig health services
- Waste to wealth by pig farming

Policy Recommendations

1. **Establishment of Modern Slaughtering-cum-Processing Plant for Pigs:** Farm pigs from Punjab are primarily sold in the north-eastern regions of the country. Costs associated with long-distance transportation, stress, death, and shrinkage problems obstruct their marketing. The state can become a hub for pig processing and marketing in India and South-East Asia by

establishing three slaughter-cum-processing plants in *Majha*, *Malwa* and *Doaba* region with slaughtering capacity of 100–150 pigs per day per plant.

- 2. Establishment of Advance Disease Diagnostic Laboratories-cum-Reporting System:** Pigs are susceptible to various diseases, including zoonotic and OIE-notifiable ones, causing economic losses to farmers due to delayed diagnosis, reporting and culling in certain serious diseases like African Swine Fever. Therefore, advanced pig disease diagnostic laboratories and real-time reporting systems are needed for quick diagnosis, control, and containment. Atleast four regional advance disease diagnostics-cum-reporting labs should be established, one as a central referral lab and rest one each in three different regions of the state.
- 3. Germplasm Improvement:** Pig farmers in Punjab need to introduce high-quality exotic germplasm of Large White Yorkshire, Landrace, Hampshire, and Duroc breeds for improved productivity. Urban consumers favour lean meat; therefore, Duroc germplasm introduction in genetic improvement programme as terminal cross may enhance quality lean pork production. The multiplication of exotic germplasm can be done at government pig breeding farms and supplied to the interested stakeholders. The State Animal Husbandry Department should formulate a programme for selection and evaluation of breeding boars for continuous breed improvement.
- 4. Waste to Wealth:** Around 70 per cent of the recurring costs in pig farming are incurred on feed. Pigs can efficiently convert wastes into valuable pork. To economize the pig ration and to utilize the waste from hotels/messes/marriage palaces/vegetable markets and breweries, the wastes should be dried and included in the pig ration. This practice must be done under expert supervision and Standard Operating Procedures (SOPs) for the same must be formulated. This will promote the drying industry and reduce the problem of huge waste. Further, the excreta of pigs can be subjected to various waste management protocols like composting, vermicomposting, fish farming and biogas production.
- 5. Establishment of Pig and Pork Coordination Committee:** A State Pig and Pork Coordination Committee should be established in Punjab for creating awareness among the masses about pork consumption. Establishing this committee in Punjab can break monopolies and reduce market volatility, leading to realization of better profits and thus, welfare of this sector.
- 6. Strict Restrictions on the Influx of Wild Pigs from Other States into Punjab:** Wild pigs are smuggled into Punjab from Rajasthan and Madhya Pradesh for sale at low prices in urban markets. This depresses the market for hygienic farmed pigs raised in the state and poses a risk of contagious diseases. The State Animal Husbandry Department needs to strengthen

check points at inter-state borders with greater manpower and vigilance. Appropriate penalty/punishment should be given to persons engaged in such activities. Health certificate from the state for loading of pigs should be made compulsory. Fees for issuing health certificate for taking pigs from Punjab to other states must be reduced.

7. **National Livestock Mission - Promotion of Piggery Entrepreneur:** Presently under National Livestock Mission (NLM) scheme, provision of 50 per cent subsidy is available on establishment of pig farm with 50 sows + 5 boars and 100 sows + 10 boars, which amounts to Rs 15 lakh and Rs 30 lakh, respectively. Smaller units with 10+1, 20+2 and 30+3 must also be considered under NLM. The state should also formulate state sponsored pig development scheme for easy access to financial assistance for the aspiring pig farmers. Scheme for fattening units to increase pork production and attract youth to livestock farming should be developed and implemented.
8. **Curtailing Social Taboo through Mass Campaigns:** Cultural taboo and social stigma hinder the development of pig farming in Punjab and India. Though the pigs are hygienic, however, conventional scavenging methods undermine this belief. A widespread campaign and institutional extension system should be developed to promote piggery and pork consumption.

7.5 Goatry

Goat is one of the hardy animals with an ability to convert low grade roughages into valuable milk and meat. Punjab is native tract for Beetal breed of goats also known as *Amritsari* at some places. The goat population of the country is 148.88 million out of which only 0.23 per cent, i.e., 3.48 lakh is present in Punjab. Initially, the goat farming in Punjab was practiced for assuring livelihood, but presently many commercial goat farms are being established in the state. The average yield of milk from a goat in Punjab in the year 2021-22 was estimated to be 1.81 liters per day, which was the highest in the country. Goat milk is well-known for its medicinal properties, therefore, should be promoted for better profitability of farmers. The goat meat production in Punjab in the year 2021-22 was estimated to be 5940 tonnes. Punjab is a net importer state as far as goat meat is concerned and largely the goats from Rajasthan are imported in Punjab for meat purposes. The farmers in Punjab have traditionally kept goats at their farms for milk, meat and recreational purposes. The goat population in Punjab has seen a decline over the years, however, the demand for goat meat

Key Takeaways

- Eco-friendly goat farming
- Promotion of stall-fed, loose shed/housing system
- Strengthening of sheep farming

has steadily increased. Goats do not have any taboo associated with them and are relished by all sections of the society.

Policy Recommendations

1. **Expansion of Ecofriendly Goat Farming in Punjab:** The state of Punjab is blessed with quality germplasm of goats. The demand for goats as meat animal in the state exceeds the availability and a large number of goats are brought from other states into Punjab. This indicates that there is immense scope of propagation of goat farming in the state. Goat population can be expanded three to five times in a phased manner. To begin with, one to two farmers from each village should be supported financially to start goat farming. This will ensure the availability of goat milk and meat in the state with a reduction in the net import of goats, thus, saving the state exchequer.

Gradual shifting from grazing system to controlled grazing and later to complete stall-fed system with loose shed/housing system will ensure the improvement in goat production. The housing design should be developed in concurrence with the basic behaviour of the goats. The government through State Department of Animal Husbandry should prepare database and give full technical support to such commercial goat rearing units. The breed improvement programmes on lines of dairy animals (with modified and specified breeding policy) should be implemented in selected goat rearing farms. For production and multiplication of improved Beetal goat germplasm, two advanced Centres of Excellence need to be created one each in *Kandi* area and *Malwa* area to give impetus to breed improvement and livelihood support to resource-poor farmers. Farmers maintaining superior animals should be identified through block level championships and incentivized. These farms will act as breeding buck supply centres for breed improvement in other small scale scattered goat units of the state. Increased impetus on goat rearing will ensure the availability of goat milk and meat in the state with a reduction in the net import of goats.

2. **Regulated Goat Markets:** The goat markets in the state are predominantly unorganized and scattered. As of now, there is no regulation for such markets. There should be a minimum of four to five government approved markets spread across the state for the sale and purchase of goats with strict regulations.
3. **Strengthening Sheep Husbandry in Punjab:** The population of sheep in Punjab has drastically reduced from 2.20 lakhs in 2007 to 0.85 lakhs in 2019. There is a strong need to uplift sheep husbandry sector in the state of Punjab along with conservation of native sheep breeds. Sheep has the potential to gain more weight by feeding on low quality roughages.

Moreover, sheep can thrive on low quality shrubs available in semi-arid zones as these can consume variety of plants compared to any other livestock species. Further, sheep husbandry can help in supplementing farm-based income. The focus of sheep production should be essentially put on increasing the mutton production by using local breeds of sheep like *Kajali*. Efforts should be made on development of an intensive to semi-intensive model for mutton production in the state. Model sheep farms with exotic sheep breeds like Rambouillet can be developed for breed propagation and boosting intensive sheep farming in the state. Breed conservation measures for *Kajali* sheep should be adopted to conserve local germplasm.

7.6 Fisheries

Fisheries is termed as sun-rise sector in India, with a noticeable impact in Punjab. In this state, the fish production in the year 2017-18 was 1.37 lakh tons, which increased to 1.90 lakh tons in 2021-22. Fisheries sector of the state is predominantly dependent on traditional culture of fresh water carp fish species. Now the inland salt affected degraded lands are also being economically utilized for shrimp farming.

Key Takeaways

- Strengthening of existing infrastructure
- Fresh water aquaculture diversification
- Introduction of intensive aquaculture technologies
- Special impetus to shrimp farming
- Optimal working of fish markets

Policy recommendations

A. Freshwater Fisheries

- 1. Strengthening/Optimal Functioning of Existing Fish Seed Hatcheries:** Punjab produced 25.62 crore fish seed (fry) in 2020-21, meeting only 50 per cent of its requirement due to under-utilization of hatcheries of State Department of Fisheries. Hence, there is imminent need to scale-up quality seed production by strengthening the seed farms with required infrastructure and skilled technical staff, besides developing brood bank to supply genetically superior brood stock to all the hatcheries.
- 2. Strengthening/Optimal Utilization of Existing Fish Feed Mills:** The fish feed mills established in different districts of the state under Department of Fisheries, are either under-utilized or stand defunct due to lack of manpower/skilled manpower and required facilities. There is an urgent need to put them to use by creating requisite infrastructure and recruiting skilled technical staff.
- 3. Diversification with High Value/High Demand Fish:** Pangas catfish farming can be adopted to produce 2 to 3 times more fish as compared to carps, for substantial increase in farmers'

income and more efficient production (fish production/unit water volume). Presently, pangas culture adoption rate is low due to influx of fish from Andhra Pradesh and unfavourable climatic conditions during winters. Optimal economic gains from pangas can be ensured by creating cold chain facility for storage of fish to fetch competitive market prices. Establishment of processing units to tap international demand (export opportunities) for pangas fillets should be supported.

- 4. Stringent Enforcement of Laws to Stop Illegal Culture and Marketing of Banned Fish:** Illegal culture of an exotic banned fish, Thai *magur* (*Clarias gariepinus*) in polluted village ponds (unfit for carp culture) of the state is a matter of great concern, as it poses threat to the native aquatic biodiversity being a voracious carnivore species. To safeguard public health, indigenous aquatic biodiversity should be encouraged and market price of fish (carp/pangas) produced within the state should be ensured. It is of utmost importance to enforce stringent laws to check culture and marketing of Thai *magur*.
- 5. Introduction of Intensive Aquaculture Technologies:** Intensive aquaculture technologies like Recirculatory Aquaculture System (RAS) and Biofloc based aquaculture systems, are upcoming climate smart, water saving aquaculture systems capable of producing 20-40 times more fish per unit water volume/land used. R&D funding to develop economically viable energy saving (solar empowered) intensive aquaculture systems as per regional needs and capacity building of the stakeholders is required for successful replication of these technologies in the region.
- 6. Rejuvenation of Village Ponds:** Village ponds are the backbone of aquaculture in Punjab, constituting about 77 per cent (9566) of total ponds 12356 reported under fish farming. The villages in Punjab are blessed with one to three ponds on an average and presently, only 60 per cent of these estimated resources are utilized for aquaculture. Cleaning, scientific management (restructuring for treatment/bioremediation) and leasing out of these resources to farmers for a period of atleast 10 years will help in attracting stakeholder's interest to make investments for its proper management foreseeing long term economic returns. For rejuvenation of ponds, the model given by Punjab Pollution Control Board may be adopted.

B. Inland Saline Water Fisheries

- 1. Promotion of Aquaculture in Salt-Affected Waterlogged Wastelands in South-West Punjab:** Unimaginable income of Rs. 3.0-5.0 lakh/acre/crop of 100-120 days from unproductive/underproductive salt affected waterlogged degraded lands lured the farmers of South-western Punjab (Sri Muktsar Sahib, Ferozepur, Mansa, Fazilka, Bathinda and Faridkot)

towards shrimp farming. As a result, area under shrimp farming increased from 1 acre to 1212 acres during 2014 to 2022. Regulatory guidelines are required to allow shrimp farming only in zero earning salt affected degraded lands (unfit for agriculture) with ensured biosecurity, quality assurance and environmental wellbeing, in accordance with demand in national and international markets, with adequate buffering capacity to absorb unforeseen marketing risks.

2. **Establishment of Shrimp Feed Mill:** Feed accounts for 60-70 per cent of input cost in aquaculture. Presently, there is no shrimp feed mill in the state and hence, farmer has to pay higher price, including long distance transportation charges. As per regional needs, small-scale shrimp feed mill should be established in the south-western region of the state in collaboration with ICAR-Central Institute of Brackish water Aquaculture (CIBA), Chennai. Further, a separate segment for manufacturing of shrimp feed can be developed in the already existing fish feed mills in the state.
3. **Diversification with Brackish water Species (Food/Ornamental Fish/Seaweeds):** Presently, mainly shrimp (high cost-high risk crop) is being cultured in inland saline areas, except for some low salinity areas (<5 ppt salinity), where carps are reared by economically weaker small/marginal farmers. For economic utilization of these areas in an equitable manner, adequate funding should be provided for developing low/medium cost aquaculture technologies (introduction of new fish/shellfish/ seaweed species) for small/medium farmers.
4. **Optimal Working of Fish Markets and Strengthening the Domestic Market:** The state has fish markets in Ludhiana, Amritsar, Patiala and Bathinda. However, only Ludhiana fish market is fully functional. There is need for other fish markets to be organized and made functional in a systematic way with proper hygiene. These fish markets may also be leased out to fish farmers of the state for direct marketing.

8. WATER AND ENERGY

Punjab is on the brink of a “Water Emergency” because of the unregulated and excessive utilization of water resources. This approach not only lacks sustainability, but also poses significant harm to the region’s water ecosystem. Similar slip ups have been witnessed globally, exemplified by Johannesburg in South Africa, where the depletion of all groundwater resources left the population with minimum access to water and rationing of the potable water. Israel, however, is an inspiring example of successful implementation of effective water resource management programmes. Despite facing arid conditions, it has managed to overcome water scarcity challenges through initiatives such as advanced irrigation techniques, desalination plants, and efficient wastewater recycling. It is crucial for Punjab to learn from such success stories and adopt healthier practices to avert the looming water catastrophe. Presently, the way we are using water, Punjab’s total annual water demand is 66.12 Billion Cubic Meter (BCM i.e. 1 BCM=10¹² litre). Given the prevailing water crisis in the state, it is a pressing necessity to set a policy target aimed at saving a minimum of 30 per cent i.e. 20 BCM of the existing water demand thus reducing it to 46 BCM as against water availability of 52.85 BCM. The target of saving 20 BCM annually would not only balance out the water availability/demand for all the sectors but would help in restoring the depleted groundwater aquifers/reserves with 6.5 BCM lesser underground water withdrawal to safer limits for healthier development. The objective of saving 20 BCM water can be realized by implementing the suggested policy measures across various sectors such as agriculture, industry and households. Thus, efficient distribution and use of surface water for agriculture, industrial and domestic sectors would help in lowering the over-dependence on groundwater. Moreover, reuse of treated water as per the irrigation water quality standards can also result in saving of the fresh water resources, both surface and ground water. An annual target of reducing the annual water demand by 4.0 BCM for the coming 5 years would help in achieving the desired target of bringing down the demand to 46 BCM. A comprehensive action plan for the state in the light of the policy recommendation detailed below needs to be prepared by involving all the stakeholders for healthier development.

8.1 Status of Water Resources in Punjab

Water resources in Punjab hold paramount significance, as these are the lifeblood of the region’s socio-economic development.

- i. The state of Punjab is situated within the Indus River System in the northern and north-western regions of the Indian Subcontinent. It is separated from the Ganga basin by the *Ghaggar* river,

which flows seasonally and is known for flash floods in the south-eastern parts of the state. Other notable perennial rivers in the Indus system that traverse Punjab include the Ravi, Beas, and Sutlej, collectively carrying 42.40 BCM of water. Himalayan glaciers contribute around 58 per cent (24.59 BCM) of the water supply for these rivers. Dams strategically located in the catchment areas tap into these rivers, storing water for utilization in irrigation through an extensive network of canals in the command areas.

• Total water demand	: 66.12 BCM
• Agriculture demand	: 62.58 BCM
• Total water availability	: 52.85 BCM
• Effective-rainfall	: 20.98BCM*
• Groundwater	: 17.07 BCM
• Canal Water	: 14.80 BCM*
• Deficit	: 13.27 BCM

* may vary

- ii. The average annual rainfall in Punjab is approximately 565 mm (average rainfall from 1997-2020). The southwest monsoon season, which serves as the primary source of groundwater, begins in the last week of June and recedes by the end of September, contributing to around 80 per cent of the average annual rainfall. Rainfall distribution in Punjab is characterized by both temporal and spatial variability. Annual precipitation varies significantly across the state, ranging from approximately 1000 mm in the northeast to less than 300 mm in the southwest. In recent years, the average annual rainfall has notably decreased compared to earlier periods.
- iii. The total river water available through canals to Punjab is 14.80 BCM which is distributed to the command area through seven main canal systems namely, Sirhind Canal System, Bist Doab Canal System, Upper Bari Doab Canal (UBDC) System, Sirhind Feeder System, Eastern Canal System, Bhakra Main Line System, and Shahnehar Canal System.
- iv. A well-developed and widespread 14500 Kms long canal system and five head-works have been developed for 30.88 lakh ha of the command of canal networks (in addition to pre-partition utilization of 39.47 BCM in the Shahnehar Canal System).
- v. Groundwater levels in Punjab state, in general, vary from almost near the surface to about 60 m bgl. Deep-water levels are recorded in the *Kandi* belt. Water logging conditions exist in some parts of south-western districts.
- vi. As per Dynamic Groundwater Resource Estimate Studies carried out by Central Ground Water Board (CGWB), GoI and Water Resources Department, Punjab, the annual extractable groundwater resources (replenishable) available as on 31st March, 2022 is 17.073 BCM. The annual replenishable resources depend on percolation/seepage from annual rainfall, seepage from canals/reservoirs/tanks/ponds and return flows from irrigation water applied in agriculture fields, both from surface water and groundwater.

8.2 Challenges and Issues

i. Inadequate Water Supplies to Meet the Demand:

Punjab is the major riparian state, but has a limited share in its three perennial rivers (Sutlej, Ravi, and Beas). It has been allocated only 17.95 BCM out of a total average availability of 42.40 BCM. The available canal water is estimated as 14.80 BCM, groundwater resources are 17.07 BCM and the effective rainfall in the state is about 20.98 BCM. So, the total availability of water including surface water, groundwater and rain water is 52.85 BCM. The demand of water for agriculture, domestic and industry is computed as 62.58, 2.41, and 1.13 BCM, respectively making a total of 66.12 BCM. Thus, there exists, a deficit of 13.27 BCM which is met by over-exploitation of groundwater, showing a deficit of 25 per cent for a major riparian state. As per the aquifer mapping studies carried out in the year 2017 under National Aquifer Mapping and Management (NAQUIM) Programme by CGWB, GoI, in-storage (static) groundwater resources for depth ranges up to 100 meter, 100-200 meter and 200-300 meter were estimated. A table showing the depth wise in-storage (static) groundwater resources up to 300 meter is as under:

- Ground water is expected to drop below 300 m by 2039
- About 84800 ha of arable land facing water logging
- Degradation of wetlands

Table 8.1: In-Storage (Static) Groundwater Resources

S.No.	Aquifer and Depth Range	In-Storage (Static) Groundwater Resources (BCM)
1.	Aquifer I (Unconfined) up to 100m Depth	171.53
2.	Aquifer II (Semi-Confining) from 100 to 200 m Depth	75.83
3.	Aquifer III (Confined) from 200 to 300 m Depth	51.76
Total Groundwater Resources up to 300 m Depth		299.12

Source: Central Groundwater Board (2017), Government of India

As the annual water demand exceeds the annual water availability by 13.27 BCM, the same is being met through extraction of groundwater from the in-storage (static) reserves. The agricultural demand constitutes more than 90 per cent of the total water demand, overshadowing the relatively low figures for domestic and industrial sectors. The disparity highlights the pressing need for a reassessment of water use in these sectors to ensure equitable and healthier water resource management.

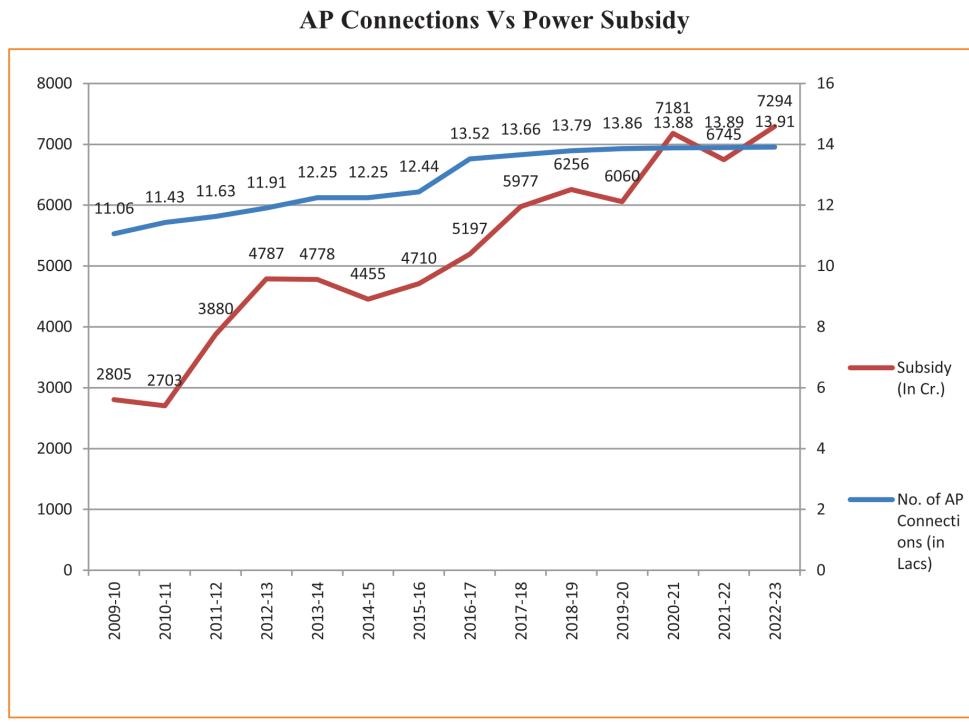
ii. Depletion of Groundwater Resources:

The water available from surface supplies (rainfall and canal water) is not sufficient to meet the growing needs of water in Punjab. The farmers of

the state have invested profoundly in privately owned tube-wells for extracting groundwater resources to meet the irrigation demand. As per the statistical abstract of Punjab 2021-22, the number of energised and diesel operated tube-wells is 13.89 lakh and 1.40 lakh, respectively. The free electricity along with convenience of use of tube-wells has further mounted pressure on groundwater. At times, the farmers having access to canal water prefer using groundwater through tube-wells on account of ease and convenience of operation of tube-wells fitted with auto-starters. The groundwater extraction in Punjab has already reached 150-200 meters in most places of Central Punjab and the overall stage of groundwater extraction is 178 per cent for the state. If the present rate of depletion continues, Punjab's groundwater is expected to drop below 300 m by 2039. As per the methodology for dynamic groundwater resource estimation, the assessment units / blocks are categorised based on stage of annual groundwater extraction with respect to the replenishable groundwater resources.

At present, out of 150 blocks, 15 blocks have stage of groundwater extraction exceeding 300 per cent, 16 blocks have stage of groundwater extraction between 251 per cent to 300 per cent, 29 blocks between 201 to 250 per cent, 53 block between 101 to 200 per cent and 37 blocks have stage of groundwater extraction below 100 per cent groundwater exploitation. The net groundwater availability for future irrigation development in the state is "NIL" in Over-exploited blocks of the state, but in safe, semi-critical, critical, and water-logged areas, it has been assessed as 1.57 BCM.

- iii. **Water logging in South-West Punjab:** Among the 84,800 ha of arable land facing severe water logging issues in Faridkot, Muktsar, Malout, Lambi, Abohar, and Gidderbaha blocks of Punjab, 25 per cent of the affected area borders Rajasthan and Sirhind Feeders. This region also grapples with poor-quality groundwater, which leads to challenges related to soil salinity. Further, persistent seepage from these canals exacerbates the problem, rendering the land increasingly saline and unsuitable for cultivation.
- iv. **Agriculture-Water-Power Nexus:** The Agriculture-Water-Power nexus refers to the inter-connected relationship between agriculture, water resources, and energy. Efficient management of water and power is crucial for healthier agricultural practices, as agriculture is a major consumer of both resources. Balancing these elements is essential for food security, environmental conservation, and addressing energy needs in agricultural processes. At present there are 13.91 lakh energised tube-wells in the state and the power subsidy to the agriculture pump (AP) consumers is whopping Rs. 7,294 Crore. The graph below shows the decadal relationship between AP connections and AP power subsidy.



(Source: PSPCL)

There were 11.43 lakh AP connections during 2010-11 and AP power subsidy was Rs. 2703 crore, whereas during 2022-23, with 13.91 lakh AP connections the AP power subsidy bill has escalated to Rs. 7,294 Crore. In addition to the AP subsidy, there is a cross subsidy of Rs. 990 Crore. Thus, the total subsidy including the cross subsidy is Rs. 8,284 crore. The current average cost of AP power supply is Rs. 6.48 per unit against an AP tariff of Rs. 5.66 per unit. AP power consumption during the *Kharif* season ranges between 65 to 73 per cent of the total AP power consumption. During the year 2022-23, power consumption against total AP power consumption during the months of June, July, August, and September was 14 per cent, 17 per cent, 20 per cent and 16 per cent respectively. The AP power demand / consumption and irrigation water use is impacted by the crop choice and climate. Sowing of Spring / Summer maize for silage / fodder during the months of April and May results in higher water and power demand. During the *Kharif* season, the alteration of crop calendar for Majha, Doaba and Malwa regions is yielding satisfactory results due to fixing of region wise scattered transplantation dates under Punjab Preservation of Sub-Soil Water Act, 2009. Rainfall during the Kharif season is the prime factor influencing the water and power demand / consumption. Similarly, water and power demand is also influenced during the *Rabi* season by deficit or excessive winter rains. A month wise comparison of AP consumption for the years 2021-22 and 2022-23 along with variation in power demand and probable reason for variation is as under:

Table 8.2: Impacts of Climate Change and Changing Cropping Patterns: Comparison of AP Consumption (in MUs)

Sr. No	Month	2021-22	2022-23	%age Variation	Remarks
1	April	271	364	+34	Sowing of Maize for Fodder & High Temperature
2	May	716	879	+23	
3	June	2094	1853	-11	Zoning of Paddy Plantation
4	July	2691	2282	-15	Good Rains
5	August	2434	2711	+11	Deficit Rain
6	September	1632	2194	+34	Deficit Rain
7	October	772	965	+25	Extended paddy requirement
8	November	255	359	+41	Dry Spell
9	December	573	516	-10	-
10	January	84	364	+333	Deficit Rain
11	February	293	656	+123	High Temperature
12	March	715	496	-31	Good Rains
Total		12,350	13,639	+10.43	

Source: PSPCL

- v. **Decrease in Canal Irrigated Area:** The canal irrigated area in the state has declined from 16.6 lakh ha in 1990-91 to 11.59 lakh ha in 2020-21. As per the Department of Water Resources, Punjab, the decrease in surface water availability and maintenance of ageing canal distribution system are the major reasons for this decline. Moreover, free power supply to the agriculture pump sets / tube-wells fitted with auto-starters provide ease of operation to the farmers thereby increasing over-dependence on groundwater. The water courses, especially in Majha and Doaba areas have been encroached due to easy access to groundwater through privately owned tubewells with free power. Restoration of encroached water courses through Under Ground Pipeline System (UGPLs) needs to be taken up on war-footing for restoring the designated Canal Command Areas (CCA) / Gross Command Area (GCA). The additional areas brought under canal water irrigation not only help in conservation of groundwater but would also reduce the ever-escalating AP power subsidy bill through saving of AP consumption to extract the groundwater.
- vi. **Maintenance of the Canal Network:** The network of canals, which is more than 150 years old, is unable to take its full discharge, as it requires major rehabilitation and rejuvenation. Poor maintenance of canal infrastructure, including leaks, blockages, and outdated distribution

systems, leads to significant water losses as water travels downstream. This exacerbates water scarcity at the tail end of the canals. This has resulted in a reduced carrying capacity of the system and decreased availability of surface water; as a result, many of the water courses at the tail end have been closed. The net area irrigated by canals has decreased from 55 per cent in 1960-61 to 27 per cent in 2021-22. As per the Water Resources Department, Punjab, at present there are about 2217.47 Km unlined canals and an estimated amount of Rs. 2728.38 crore is required for the lining of these canals.

- vii. **Low Water Use Efficiency (WUE) in Agriculture:** This is another serious challenge for the healthier development of water resources. At present, the WUE in agriculture is estimated to be between 35 and 40 per cent for canal irrigation and the remaining for groundwater irrigation.
- viii. **Contamination of Surface Water and Groundwater:** The nitrates, heavy metals, pathogens, and agrochemical residues pose serious health risks to those who rely on groundwater for drinking and irrigation. Canal-based water supply is in practice in the South-West districts of Punjab. There is a plan to extend the canal-based water supply scheme to other districts as well. At places, the canal water is also contaminated because of untreated waste water and other solids being discharged into the surface water bodies. In some areas, naturally occurring arsenic and saline intrusion further exacerbates the problem. As per the data available with Central Ground Water Board (CGWB), 800 villages across the state have dangerous levels of arsenic, fluoride above 1.50 ppm, found mainly in Bathinda, Faridkot, Fazilka, Muktsar, and Mansa districts, while isolated locations are also found in Ferozepur, Sangrur, SAS Nagar, and Tarn Taran districts.
- ix. **Degradation of Wetlands:** Several wetlands (Harike, Ropar, and Kanjali) are also facing water quality problems. These wetlands are under extreme stress due to reduced water inflow from the source and infestation of the water hyacinth, which clogs the water channels and severely affects the hydrological functions of a wetland.
- x. **Climate Change:** Water scarcities in agriculture are being forecasted in light of climate change and competition from non-agricultural sectors because of demographic growth, rapid industrialization, and urbanization. These are expected to reduce the share of water in agriculture by 10-15 per cent in the coming two decades.
- xi. **Lack of Awareness among Stakeholders:** There is a lack of awareness among the public about the impending threat of water scarcity and the huge wastage of sweet water; excessive watering of crops is endemic, with total disregard for efficiency and conservation.

8.3 Policy Recommendations

With a view to the water emergency situations in Punjab, set a policy target of saving a minimum of 30 per cent (20 BCM) of the overall water demand (66.12 BCM) in 5 years by adopting the measures advised below:

8.3.1 On-Farm Water Management

1. Shift in Cropping Pattern: There are several measures/alternatives to paddy, which, if adopted wisely, can compete with the rice-wheat system. Some of these are as follows:

a) Ban Long Duration Paddy Varieties in Punjab: With a view to water emergency in Punjab, all the long duration paddy varieties should be completely banned in the state.

b) Prohibition of Paddy Cultivation in Highly Over-Exploited Blocks: In Punjab, 15 out of 150 blocks are in a severe crisis concerning groundwater resources, with stage of groundwater extraction more than 300 per cent (Annexure XI). These blocks have been designated as highly over-exploited, indicating that annual groundwater extraction in these blocks far exceeds the annual groundwater recharge. Similarly, 16 blocks with stage of groundwater extraction between 251 to 300 per cent, followed by 29 blocks with stage of groundwater extraction between 201 to 250 per cent and 53 blocks with stage of groundwater extraction between 100 to 200 per cent fall under over-exploited category. The farmers in these blocks are regularly compelled to spend money from their pockets to deepen the tube-wells and increase the power load of their pumps. The extraction of groundwater from deeper aquifers not only stresses the farmers financially but also results in higher AP consumption. The annual AP power subsidy per connection in these blocks far exceeds the average annual AP power subsidy per connection for the state. The annual AP subsidy per connection for the districts of Barnala, Sangrur, Patiala and Moga is Rs. 89,556, Rs. 84,428, Rs. 78,470 and Rs. 75,812 respectively against an average annual AP subsidy per connection of Rs. 53,984 for the state. The annual groundwater extraction in almost all the blocks of these districts far exceeds annual groundwater recharge and most of the blocks fall under highly over-exploited category. Moreover, the farmers of these blocks are extracting groundwater from the in-storage (static) groundwater reserves of Aquifer-II in addition to that available in Aquifer-I (dynamic) groundwater reserves. The following table

- Save 30 per cent (20 BCM) water in 5 years
- Ban long duration paddy varieties
- Discourage puddling and ban it in phased manner
- Prohibition of paddy cultivation in dark blocks
- Promote crop diversification- cotton, sugarcane, fruits and vegetables, agro-forestry, mustard cultivation using drip irrigation
- Special Purpose Vehicle for micro-irrigation

provides the district wise AP connections, average load in Brake Horse Power (BHP) per connection and annual AP subsidy per connection:

Table 8.3: District-Wise AP Connections and Power Subsidy in Punjab

District	AP Connections (Nos.)	Avg. Load (BHP) per Connection	Annual AP Subsidy per Connection (Rs.)
Barnala	47,068	16.69	89556
Sangrur	1,14,374	17.55	84428
Patiala	89,430	16.23	78470
Moga	68,451	15.00	75812
Mansa	42,522	14.88	73462
Mohali	20,447	13.82	72636
Bathinda	78,325	12.21	67676
Hoshiarpur	51,188	9.53	66837
SBS Nagar	24,790	9.39	60178
Jalandhar	87,784	11.11	59004
Fatehgarh Sahib	32,853	11.93	58427
Rupnagar	21,639	8.74	52,536
Tarn Taran Sahib	79,409	10.43	52378
Ludhiana	1,17,308	10.61	51556
Kapurthala	61,243	9.31	44138
Amritsar	93,946	8.08	40415
Faridkot	45,758	9.73	40323
Firozpur	86,098	10.24	39351
Pathankot	4,864	5.18	30780
Fazilka	51,289	6.62	30095
Gurdaspur	99,581	5.75	29183
Sri Muktsar Sahib	72,535	6.00	21324

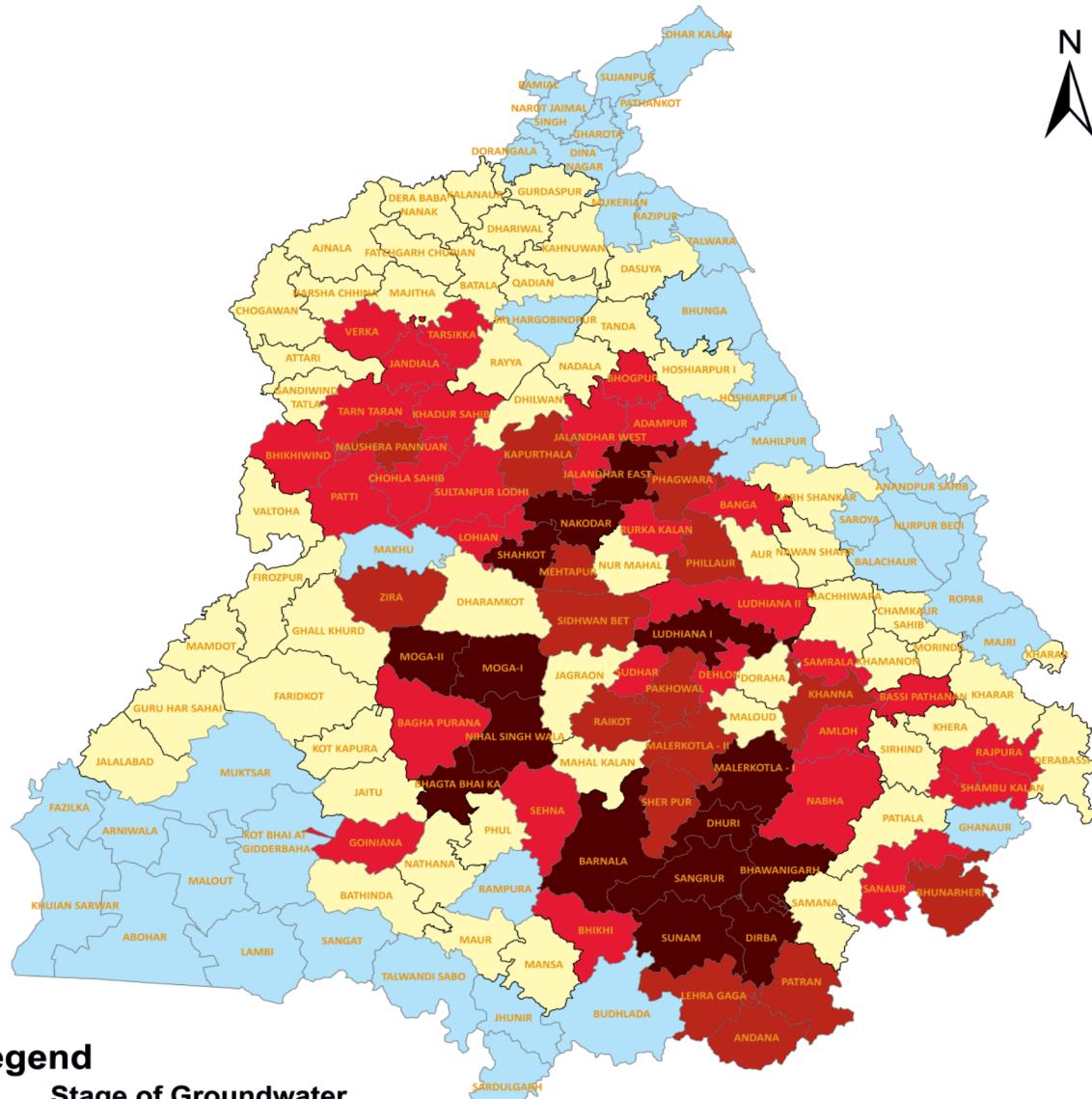
Source: PSPCL

In highly Over-Exploited blocks (blocks with stage of groundwater extraction more than 300%, 250-300% and 200-250%), the area under paddy cultivation needs to be brought down in a phased manner. The option for completely banning paddy in one or two blocks needs to be explored. The cultivated area in these blocks should be put under alternate less water consuming crops such as cotton, maize, sugarcane, vegetables, and orchards to save them from turning barren soon. The farmers in these designated blocks should be compensated in such a way that they may get higher returns from alternative crops than that of paddy cultivation. The blocks with stage of groundwater extraction falling between 100-200 per cent may be undertaken in subsequent phases.

c) Revival of Cotton in Mission Mode

- i. **Cotton-Wheat Cropping System:** To revive the cotton-wheat system, the state government and Department of Agriculture and Farmers' Welfare must strengthen extension system, provide quality inputs and ensure procurement at the MSP. The drip irrigation with canal water storage tanks and solar-powered pumps can save water and power, and improve quality and productivity with reduced pesticides use.
 - ii. **Cotton-Mustard Cropping System:** This is another highly remunerative cropping system that can be adopted in the cotton belt of the state. All measures adopted in the cotton-wheat system can be instrumental in making this system remunerative and saving irrigation water. In addition, value addition of mustard with oil extraction at MPCS should be promoted to enhance profitability to make this crop rotation viable.
- d) Replacing Paddy with *Basmati*:** The water requirement of *Basmati* is lower than that of paddy, as its late transplanting coincides with the onset of the monsoon season. Replacing paddy with basmati should be considered, with market and international demand in mind. To guarantee higher prices and export potential, the State Department of Agriculture and Farmers' Welfare should ensure quality and monitor the pesticide use in *Basmati* to meet international standards.
- e) Increase Area under Sugarcane:** Sugarcane cultivation in Punjab has a niche market and can be expanded with drip system and other techniques to save water and to meet the demand of sugar mills. To incentivize farmers, government should ensure prompt payment to farmers by the sugar mills. Additionally, ethanol production, co-generation and other value addition measures from sugarcane to make it viable should be promoted.
2. **Area under Micro-Irrigation System:** Adoption of micro irrigation systems in the state may reduce groundwater withdrawal and save about one-third of the power subsidy bill. Implement a phased plan for the installation of micro-irrigation systems. The first target area can be under fruits followed by vegetables, flowers, sugarcane, and cotton. This may cover roughly 20 per cent of the total cultivated area under micro-irrigation. In addition, sugarcane and spring crops such as spring maize and sunflower should be mandatorily brought under drip irrigation systems. To achieve this, there is a need to have a Special Purpose Vehicle for micro-irrigation in the state. At present, almost all states in the country have special purpose vehicles for micro-irrigation except Punjab. Further, micro-irrigation systems should be encouraged for all the crops.

Blockwise Stage of Groundwater Extraction (Ground Water Resource Estimates - 2022)



Legend

Stage of Groundwater Extraction (%)

< 100

101 - 200

201 - 250

251 - 300

> 301

Block Boundary

District Boundary

0 15 30 60 90
Kilometers

Source: PSFC (2021), Ground water resources of Punjab State (2022) and PWRDA notification 27-1-2023

3. Water Saving within Paddy: Though the state is trying hard for different diversification options to replace paddy, to date the same could not become possible due to various issues like assured procurement, national food security, lack of remunerative alternatives, etc. Some of these interventions, which can be instrumental in water saving in paddy, are:

a) Alteration in Crop Calendar: The state of Punjab has enacted ‘The Preservation of Groundwater and Subsoil Act’ in 2009 which states that no farmer in Punjab can transplant paddy before the notified date, which initially was 15 June for whole of Punjab. This date was modified during different years to commensurate with onset of monsoons. During the year 2022, the Government of Punjab notified staggered transplanting dates for different regions of the state. The implementation of this act in a rational manner will help in saving groundwater in areas where the groundwater situation is very grim. The availability of short-duration paddy cultivars like PR-126, facilitate transplantation of paddy from first week of July without compromising on the yield.

b) Alternate Wetting and Drying in Paddy: Synchronizing irrigation as per critical needs of paddy saves more than 30 per cent water with alternative wetting and drying techniques, whereas, discouraging puddling and banning it in phased manner shall improve percolation of water and soil health with lesser methane emissions. However, assured 8 hours supply of electricity should be provided to the farmers to irrigate as per requirement. Direct seeded rice should also be promoted as a water saving technology.

c) Rationalization of Irrigation through Public Supply Tubewells: The supply of irrigation for paddy crop through public sector tubewells should be banned in *Kandi* region and also discouraged in other areas of the state.

8.3.2 Groundwater

1. Solarisation of the AP Tubewell with Grid-Connected Clean and Green Energy: There is a need to devise a scheme wherein Punjab State Power Corporation Ltd. (PSPCL) will supplement the AP connection with grid-connected solar panels. An assured supply of electricity hours should be ensured as per the cropping pattern of the region/feeder. In this way, PSPCL can offset the power subsidy, and after seven years, can earn money from the power produced from these panels by selling it to commercial consumers. The farmers should be paid rent for the land used for solar panels and

- Supplement AP tubewell with grid tied solar
- *Paani Bachao Paisa Kamao*
- Energy efficient pumps
- Regulation of groundwater withdrawal in urban areas
- Enhancing groundwater recharge

maintenance of the panels. There will be no extra burden on the farmers rather, they will earn from the scheme along with assured power supply.

2. **Rationalization of Groundwater Utilization:** To facilitate adoption of water saving farm technologies and practices in agriculture, cash incentives for saving of electricity under *Pani Bachao-Paisa Kamao* (PBPK) scheme should be provided.
3. **Energy Efficient Pumps:** The energy consumption of pumping has increased rapidly in recent years. There is a huge energy saving potential (kWh) in agriculture pump sets by replacing non-star rated pumps having a pump efficiency of 40 per cent with star rated pumps having a pump efficiency of 50 per cent. Using star rated submersible pumps would account for an approximately 20 per cent reduction in the power subsidy borne by the state. The government should promote the use of BIS/ISI rated pumps only for irrigation. In addition, illegal extension of motor horsepower by users/owners should be checked and regulated.
4. **Regulation of Groundwater Withdrawal in Urban Areas:** For urban areas, the good drinking water supply must be ensured on a community basis, and installation of submersible pumps in independent households should be discouraged. Run-off from a community should be diverted into green spaces or recharge structures.
5. **Enhancing Groundwater Recharge:** Punjab needs immediate attention for drought proofing by means of recharge to groundwater. Approximately 2.135 BCM of available water (Rainwater runoff) for groundwater recharge in Punjab can be utilized. The means and methods for natural / incidental recharge to groundwater should be explored as this would ensure that the water being recharged meets the required quality standards. Artificial recharge through injection wells should be extensively monitored to ensure that no contaminants are passed on to the groundwater bearing aquifers.
 - a) **Rooftop Rainwater Harvesting:** Although rooftop rainwater harvesting structures for groundwater recharge have been made mandatory by the state government, compliance is still very low. Strict measures must be adopted. The municipal corporation should keep the security amount equal to the cost of the system for strict compliance. Preference should be given for rooftop rainwater harvesting and re-use of the harvested water for non-potable purposes. Rooftop rainwater harvesting for groundwater recharge should not be applicable for shallow water table areas and strict monitoring of quality of water being recharged needs to be ensured. Standard Operating Procedures (SoPs) for rooftop rainwater harvesting should be developed and strict enforcement should be ensured.

b) Groundwater Recharge/ Harnessing Excess River/Rainwater: The recharging of groundwater aquifers through surface drains/canal escapes/curtailed tail ends can be enhanced by constructing check structures across these structures at suitable intervals to create pools for the storage of water and steering this stored water to the aquifer through natural recharge to groundwater. Precaution should be taken to ensure that the water for recharge is free from chemical and microbial pollutants. The harvested water can also be utilized by storing it in ponds or tanks specifically designed for this purpose.

8.3.3 Canal Water

1. Restoration and Remodelling of the Canal

Irrigation System: Presently, the old and dilapidated canal network of Punjab requires immediate rebuilding and refurbishment. Canal water distribution systems, particularly secondary and tertiary minors, and water courses, should be rejuvenated. Restoration and revival of encroached field channels should also be undertaken by using underground pipe line system.

- Restoration and revival of water courses
- Regular maintenance and upkeep
- Scheduling canal water supplies to match the demand
- Managing surface water escape from Punjab

The Water Resources Department, Punjab, should prepare a canal system/district/block-wise blueprint with details of the obsolete secondary and tertiary minors, water courses/encroached field channels, and restoration/revival. Lining of the canals, distributaries, and water channels in the south-western zone and in lining on the sides of canal, leaving the bottom unlined in central Punjab, should be executed. There should be an assured supply of canal water as per the demand of the crop for sowing and irrigation as per the directions of proposed State Level Irrigation Schedule Committee. Water user associations at the village or canal water outlets should also be reactivated. The irrigation and drainage department must possess advanced technologies for silt/weed removal from canals to avoid disturbance during the sowing season. A separate fund should be allocated for maintenance and upkeep of these structures.

Canals can be operated at Full Supply Level (FSL) only if these are regularly maintained so that these do not breach. The Water Resources Department should be provided with timely and sufficient funds for Management, Operation and Maintenance (MO&M) of the canal system. The funds for MO&M should be provided two months ahead of every irrigation season and the department should be mobilized to take up de-silting and cleaning of all main canals, while the Water User Associations (WUAs) should take up the MO&M of field channels etc. The distribution of canal water from an outlet is carried out on a controlled

rotational system called ‘*Warabandi*’. The canal water is allocated based on constant time per unit area without considering the seepage and evaporation loss along the channel and is the major cause of inequitable water distribution at a tertiary level. As per Water Resource Department (WRD), the tail-enders get 20 per cent less water than middle-enders, who in-turn get 20 per cent less water than the farmers located at the head reaches of the canal. Under current circumstances, groundwater plays more important role in irrigation than surface water, ranging from 65 per cent dependence on groundwater in head areas to over 90 per cent dependence in tail areas. As a result, groundwater becomes an integral part of the irrigated agriculture environment and no longer supplements the canal water in Canal Command Area (CCA).

As per the report prepared by Mekorot (WCMM 1.1, 2019), the water company of Israel, which was engaged by the state of Punjab to formulate a water conservation and management plan, the surface water escape from the state has been detailed as under:

- i. An average of 5 BCM of water is being released from Ujh river from Dharamkot discharge station (Ravi River) from Punjab to Pakistan. To stop the flow of these waters, the Central Government is currently planning to construct Ujh’s multipurpose project.
- ii. An average of 1.232 BCM (mostly flood water) annually flows from Hussainiwala Head Works to Pakistan.
- iii. An average of 0.126 BCM (mostly flood water) flows annually from Madhopur Head Works to Pakistan, the construction of Shahpurkandi project should put a stop to the flow of flood water to Pakistan. In the absence of Ranjit Sagar Dam up to the year 1999-2000, an average 2.03 BCM Ravi water used to flow from Madhopur to Pakistan.

Managing the surface water escape on priority would enable the state to harness the potential of surface water resources and reduce over dependence on the depleting groundwater resources.

2. **Supervisory Control and Data Acquisition (SCADA):** Canal irrigation is widely used source of water for irrigation. So, management of irrigation canal water is crucial factor in overall irrigation development. The conventional method is used to deliver water as per demand by the water users (farmers) in form of rotations (*warabandi*). The conventional system involves lot of weaknesses, including forecast and actual flow or discharge. Errors may introduce in flow measurements and water content in reservoirs, also imbalances due to human and natural intervention are not considered in the conventional system. Due to this, users at the tail-end endure either excess or shortage of water. To provide efficient delivery and avert imbalance,

canal automation plays crucial role in irrigation. It is proposed that a remote flow control system based on Supervisory Control and Data Acquisition (SCADA) may be implemented for better management of the water resources of Punjab. The SCADA system monitors and controls required flow continuously, also monitors power status, upstream level, downstream level and system status. It initiates push communication in case of any uncertainty. Desired flow command is given by remote SCADA automatically or by operator at main SCADA. In addition to real-time data acquisition systems, the groundwater operations through tube-wells and all projects supplying treated water for irrigation may also be equipped with IoT based pump controllers to bridge them with the SCADA system. The centralized operations and monitoring/management of surface water, groundwater and treated water for irrigation on a real-time basis will allow for optimum/judicious use of available water resources. The Government of Punjab is presently implementing SCADA system on *Shahnehar Barrage* and *Sirhind Barrage & Canal*. The SCADA system needs to be extended in the whole state of Punjab to enhance water use efficiency and better management of the available water resources.

3. **Managing Ujh and Beas River Flows:** Assess and manage the surface water escape from Ujh river (tributary of Ravi) from the Dharamkot discharge station (D/s Madhopur) and excess flows from Beas river for diversion through central Punjab for irrigation use and recharge to groundwater.

8.3.4 Alternate Water Sources

There is a need for the creation of an alternate source of irrigation by the utilization of treated domestic sewage water, fit for irrigation, from STPs (Sewage Treatment Plant) through an underground pipeline system. There are about 15466 village ponds spread in about 12581 villages of Punjab with a total area of 23,450 acres. The government should Repair, Renovate and Rejuvenate (RRR) existing village ponds to enhance the storage capacity and make the pond water quality fit for irrigation. Automation of the solar powered lift irrigation system for lifting pond and STP water should be brought in place.

8.3.5 Floodwater Management

1. Indiscriminate encroachment of flood plains should not be allowed.
2. Illegal sand mining near the *Dhussi Bandhs* along the rivers should be checked. To ensure that no breach takes place, proper height (*bandh*) from the riverbed should be maintained. Irrigation and drainage department must come up with innovative technologies for breach management.

8.3.6 Water Quality

1. Identification and mapping of surface and groundwater water contamination points needs to be carried out, especially in *Budha Nalla, Chitti Bein, Kali Bein, Lisara* drain areas, etc.
 - Zero tolerance for discharge of polluted water
 - PPCB to take strict action against defaulters
2. There should be zero tolerance for water pollution. Strict checks should be in place to curb water pollution through point and non-point sources. The Punjab Pollution Control Board (PPCB) should strictly enforce the establishment of treatment plants by all industries and commercial organisations/users discharging effluents in drains, inland water bodies, sewerage systems, etc., and should penalize the polluter to bear the cost of damages to human health or the environment.
3. In addition, there is a need to ensure continuous monitoring of canal water for the quality and traceability of effluents.
4. Farmers/public representatives within the PPCB are essential for evaluating the board's pollution control operations.

8.3.7 Non-Conventional Sources of Power for Irrigation

1. The standalone solar-powered pump sets should be promoted only with micro irrigation.
2. Alternate sources of energy, such as biogas, ethanol, CNG, CBG, and small hydro-projects on canals, should be explored to replace electricity. To properly implement biogas technology, the state government should offer additional incentives to the beneficiaries in addition to the subsidies offered by the Government of India.

8.3.8 Drainage of Waterlogged Areas

1. Laying intercepting drains along the Indira Gandhi Canal to check the seepage of water.
2. Many water-logged areas have been provided with sub-surface drainage systems. Automation of the subsurface drainage system may help to increase the efficiency.
3. The installation of multiple well-point systems with automated salinity control to tap good quality water floating over brackish groundwater should be promoted.
4. High water requirement plants such as Eucalyptus can be raised on the bunds in waterlogged areas, which can serve to lower the water table.
5. Shallow rooted fruits and vegetable crops on swales/high-bed with solar supported drip system and storage tanks should be promoted to earn higher value from such areas.

8.3.9. Soil and Water Conservation Measures in *Kandi* Region

1. *In-situ* Rainwater Conservation and Water Harvesting: Land and water resources management in the *Kandi* region should be conducted on a watershed basis. Schemes to promote *in-situ* rainwater conservation through the construction of water-harvesting structures, particularly in the *Kandi* area, should be emphasised.

- *In-situ* rain water conservation in *Kandi* region
- Seasonal torrents for recharging aquifers
- Community solar-powered automated micro-irrigation

2. Ground water Recharge through Seasonal Torrents: Originating from *Shiwalik* hills, the seasonal torrents/*choes* had been naturally recharging the groundwater aquifers of sandy *Kandi* and adjoining fertile non-*Kandi* regions before construction of earthen dams. These earthen dams, mostly constructed in 1980s onwards, have adversely affected the vast non-*Kandi* regions by checking their natural water flows for dam storage, leading to lowering of the water table of those vast fertile regions.

The wide sandy *choe* beds are still an excellent recharging source which needs to be tapped by frequent/stage-wise water releases from dams during monsoon season to offset the adverse effects of dams on underground aquifers of the vast fertile non-*Kandi* regions while improving the ground water status of *Kandi* region. This region should be declared as ground water recharging zone.

3. Lift Irrigation Schemes: *Kandi* canal sourced from Pong dam should be efficiently utilized to feed the *Kandi* region with lift irrigation schemes on the lines of the community solar powered automated micro-irrigation project at Talwara in Hoshiarpur district. Agro-forestry, along with other crops of this region, should be promoted in these areas.

8.3.10 Monitoring and Alert Systems

1. Sensors, advanced earth observation, and big data analytic systems need to be utilized for real-time monitoring and management of the water resources of the state.
2. Observation wells/piezometers should be installed at a maximum spacing of 7.5 km to accurately monitor groundwater quality and water level fluctuations, and to identify potential groundwater recharge zones. These piezometers should be equipped with sensors and telemetry devices for data collection and transmission.
3. Develop a transparent and equitable water allocation framework for canal systems in the state. Presently, canal discharge data are observed manually. There is a need to monitor canal discharge remotely using sensors and Internet of Things (IoT) technology for better

management of canal irrigation systems.

4. Flood forecasting capabilities should be upgraded and extended to all flood-prone areas for effective regulation of floods in the state.
5. Home grown innovation in the water sector should be encouraged as much as possible, including investments aimed at start-up companies that promote remote sensing, demand side management and agricultural productivity.
6. To better understand how rainfall patterns will shift, a local climate model should be prepared by pooling computing resources for adopting global climate models to local conditions through regional models.
7. Establish partnerships with international agencies and organizations that specialize in weather simulation modelling and actively engage in emerging international initiatives aimed at enhancing climate services.

8.3.11 Zoning of Water Resources

With due regard to the constraints of configuration of water availability, agro-climatology, and ecology, water zoning of the state should be undertaken to guide, plan, and regulate future economic development:

- i. Drinking water zones
- ii. Groundwater depletion zones
- iii. Groundwater recharge zones
- iv. Flood-affected zones
- v. Salt affected waterlogged zones
- vi. Water quality deterioration zones
- vii. Drought-prone zones

Efforts should be made to ensure the availability of water for diverse purposes in different agro-climatic zones from the appropriate source of water for that zone. Identify and adopt appropriate technological methods (keeping in view the economic feasibility) to improve the quality of water in various zones with a view to maximizing the availability of utilizable water.

8.3.12 Capacity Building of Water Sector

Effectively addressing the impending water crisis requires the highest level of expertise and knowledge in the integrated management of water resources. The capacity building of all

water-related public sector organizations should be given high priority to equip them to ensure integrated water resources planning, development, and management and meet challenges of climate change and demographic constraints.

1. Better coordination between field and research institutes and organizations should be promoted to achieve these goals.
2. Incentives should be offered for high-quality research. A state-level award shall be conferred every year upon a project manager/researcher/team/State department for extraordinary contribution.

8.3.13 Public Awareness

1. The government should adopt micro irrigation systems at government-owned seed farms, gardens, nurseries, and Artificial Intelligence (AI)/IoT-based automation to demonstrate precision irrigation as per crop water requirements with solar power.
2. Department of Irrigation and other related state departments should carry out public awareness campaign as an integral part of their organizational functions.
3. The media should be taken on board through relevant regulatory bodies to launch a comprehensive public awareness campaign regarding judicious use of water.

9. QUALITY CONTROL AND ENFORCEMENT

Quality control is a process to ensure that the product meets the set standards and requirements laid down by regulatory bodies. Quality control as well as quality assurance in the agriculture sector is of utmost significance, particularly in the age of chemical farming and processing additives. Quality produce leads to consumer safety, higher economic value, high market competitiveness, environmental sustainability, and high export potential. The major challenges being faced by the state are adulteration in food and inputs, along with contaminants in food and food-specific quality attributes.

- i. **Adulteration in Food:** The practice of adulteration in food products has been persisting since long, compromising the safety and nutritional values of the products. One of the biggest issues is the adulteration of products like milk, honey, jaggery, oils, etc. Some of the milk producers are adding dangerous chemicals like urea, detergent, starch, and even synthetic milk, while honey producers are adding sugar syrup to increase the quantity of the produce. Also, artificial colours are used for intensifying the colour of green vegetables such as peas, cucumber, bittergourd and other leafy vegetables. Adulteration in food products increases health concerns and ailments in society by reducing nutritional value and adding dangerous chemicals to products. The presence of adulteration in milk adversely affects the honest enterprise because those engaged in adulteration offer lower prices, ultimately making the honest enterprise non-viable, and push them to exit the business.
- ii. **Adulteration in Inputs:** The issue of sub-standard and spurious agricultural inputs like seeds, chemicals, etc. is another grave danger to productivity, thus, lowering the profitability of farming. These sub-standard farm inputs prove catastrophic for farmers since productivity drops drastically and outbreaks of diseases increase due to the low quality of inputs. The quality and safety of inputs determine the levels of productivity, quality of production, compliance with standards, absence of harmful contaminants, safeguards of public health, and prevention of fraudulent practices in the agricultural market.
- iii. **Contaminations in Food:** Another domain that needs the utmost attention is the issue of heavy metals and pesticide toxicity in agricultural produce. Indiscriminate use of pesticides in agriculture and contamination with industrial pollutants has led to growing health issues. In the past few years, increased heavy metal contents and pesticide residues have been witnessed beyond their permissible limits in agricultural produce. It is pertinent to mention that monitoring agricultural produce is the need of the hour to ensure food safety owing to stringent norms of national (Food Safety and Standards Authority of India) as well as international (CODEX,

The United States Food and Drug Administration) bodies for consumption as well as export.

- iv. Food-Specific Quality Attributes:** Apart from the adulterants and contaminants, testing and monitoring of other food-specific quality attributes such as vitamins, antioxidants, minerals, etc. cannot be overlooked as these ultimately decide the nutritional balance and value of food. Hence, nutritional facts of food should be catered along with other tests.

All the above-mentioned aspects are the real-time challenges regarding quality control assurance and enforcement in agriculture sector in Punjab. Fragmented supply chains, promptly changing techniques and trends, limited resources, newly emerging risks and containments, lack of consumer awareness, limited access to information, etc. are among the major concerns to be addressed. The provision of safe, nutritious, and high-quality food and inputs is essential for the development of agriculture and the profitability and well-being of the farmers. Hence, there is utmost need to strengthen the regulatory framework, increase surveillance, conduct regular inspections and testing of food and inputs along with quality checks on the supply line, and ensuring traceability.

Policy Recommendations

- 1. Strengthening of Quality Control Laboratory:** **a)** The National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory established at Punjab Horticultural Post-harvest Technology Centre (PHPTC), Punjab Agricultural University (PAU), Ludhiana should be strengthened to cater to all domains of testing under different sections, viz. section for testing (i) agricultural inputs, (ii) food adulterants, (iii) food contaminants, and (iv) food quality attributes. This Hi-tech laboratory will support the farmers for the export of their agricultural produce and products as per national/international standards.
b) Atleast three full-fledged regional laboratories for quality assurance of milk, milk products and meat products should be established in the state with a referral research and testing laboratory at Guru Angad Dev Veterinary Animal Science University, Ludhiana.
c) Currently, enforcement of regulations and testing of food is being looked after by the Health Department. However, to be more effective, the domain expert/nodal officers of each department such as Agriculture, Horticulture and Dairy Department should be designated by Food Safety Commissioner to check the adulteration in agricultural, horticultural produce/products and milk and dairy products.
- 2. Establishment of Special Legal Cell:** To support the activities of quality control officers, a special legal cell should be established at district level as per the workload requirement to efficiently handle the cases related to adulterated or spurious inputs, produce and products in

agricultural, horticultural, and milk and dairy sector. The law should be made more stringent by making adulteration in food a cognisable offence. The designated officers and concerned departments should take samples of inputs to be tested in the accredited lab. The cases of failure of the samples should be registered and handled by the legal cell.

3. **Quick Detection Test:** The quick detection digital devices for ‘on-the-spot testing’ should be developed and made available to the public in order to test the quality of milk and other food products.
4. **Testing of ETP/STP Water for Irrigation:** Punjab is focusing on using an alternate source of irrigation water by applying Sewage Treatment Plants (STP), Effluent Treatment Plants and (ETP) Common and Combined Effluent Treatment Plants (CETP). The quality of such waters needs to be monitored for heavy metals, other essential nutrients and other irrigation parameters before their use for irrigation purposes to have contaminants-free agricultural produce. The testing of all effluents will be done by the NABL accredited PHPTC laboratory established at PAU, Ludhiana.
5. **Mandatory Receipts for Farm Input Purchases:** The government should make it mandatory for farmers to receive receipts while buying seeds, fertilizers, pesticides, bio-products and other inputs so that stringent action can be taken against the guilty, in case of adulterated/spurious inputs.
6. **Jaggery Quality Check:** **a)** It has been observed that most of roadside sugarcane processors produce and sell adulterated and low-quality jaggery. To check such malpractices and for quality jaggery production, ensuring a training from PAU and registration of the entrepreneur processors by the Department of Agriculture should be made mandatory before starting the jaggery production unit. Moreover, a quality check of jaggery is required in the state to thwart the adulteration of the product. For this purpose, regular sampling, testing and traceability testings are required so that compliance with local and national food safety regulation can be ensured.
b) Efficient jaggery production equipments should be incentivized to promote value addition/cottage industry in rural areas and for its domestic and export marketing to earn higher income.

10. RESEARCH, DEVELOPMENT AND EDUCATION IN AGRICULTURE

Agricultural research and education are among the key factors that drive the agricultural development of the region. These factors must remain in dynamic alignment with the region's challenges while keeping pace with global advancements in quality production, natural resource conservation, global warming concerns, environmental protection, artificial intelligence, genomics, and more. International exchanges continue to be as relevant today as during the early Green Revolution days.

The world has witnessed substantial technological progress in recent decades including advancements in farming techniques. Advances in information and communication have rapidly facilitated the global dissemination of knowledge. Consequently, farmers now have higher expectations regarding access to new techniques. The application of the advancements in genetic improvement, remote sensing, Global Positioning System (GPS), Global Navigation Satellite System (GNSS), drones, and Internet of Things (IoT) is vital for addressing the agriculture development requirements of the state comprehensively. The integration of all these technologies in the farming system of the state necessitates strengthening of research and development as well as policy support of the government. Research efforts should also focus on technologies like accelerated crop breeding, high throughput phenomics, groundwater dynamics and recharge, and simulation of biotic stresses. This requires establishing advanced research units in areas of relevance and unique strength, such as varietal development and precision farming in vegetable and fruit crops, floriculture, apiculture, livestock, fisheries and other subsidiary agricultural activities.

The inter-sectoral conflicts, such as foodgrain productivity versus natural resources depletion pose significant challenges. Additional challenges include competing and complementing the rapid pace of turnover in the private sector research. The existing National Agricultural Research System (NARS) must be evolved towards innovation and solution of the regional issues. The circumstances also warrant thorough investigations into the poor adoption of certain technologies and subsequent adjustments in the research agenda.

The success of agriculture policy requires capacity building of human resources in the research institutes and departments related to agriculture. Agricultural education has also been facing challenges due to the declining number of students and researchers from rural base. Adequate and high quality human resource pool must be ensured for enhancing the growth of the farm sector in the state.

Policy Recommendations

1. **Budgetary Allocation to Agriculture Sector:** **a)** The agricultural sector of the state significantly contributes to its Gross State Value Added (GSVA), accounting for 28.3 per cent in 2020-21. Additionally, it offers employment to over one-third of the state's workforce. Despite this, the budget allocated to the sector remains at 6.9 per cent of the total state budget. There is a pressing need to increase the budget allocation to the agricultural sector to expedite its growth. Increased funding is essential to facilitate efficient research and development, among other initiatives. It's important to highlight that from 1951 to 1966, over one-fourth of the country's total budget was allocated to the agricultural sector. This allocation played a crucial role in driving the success of the Green Revolution.
b) A special fund should be allocated for the effective implementation of new agricultural policy in the state.
2. **Agriculture as a State Subject:** In the face of peculiar economic, social, political and geographical conditions and challenges, states should be given more scope to free handedly enact laws on agriculture so that the welfare of farmers of the states should be ensured. As per Indian constitution, agriculture comes under the state list. The states should have all the rights in true sense to frame laws for addressing the peculiar conditions of the state. Amid the increasing costs of cultivation and the ongoing distress in the agriculture sector, immediate relief should be provided to the farm sector by exempting taxes on farm inputs. This would significantly reduce the financial burden on farmers and make agricultural practices more affordable. This step will also help combat the prevalence of spurious inputs in the market (purchasing without receipt to save the taxes gives rise to selling and purchasing of spurious inputs) and encourage farmers to adopt latest farm inputs and latest technologies at reasonable prices. Similarly, total tax exemption over the agricultural income should be enforced. Punjab government should take up these issues with the central government for enacting of laws, exemption of taxes on farm inputs and agriculture income of all forms.
3. **Strengthen Policy Making Body:** The Punjab State Farmers' and Farm Workers' Commission, the key entity responsible for agricultural policy formulation, must undergo substantial strengthening. To ensure its effective functioning, this policymaking body should receive consistent financial support and have permanent staff positions allocated to fulfil its mandate. The policy making process necessitates comprehensive research and data analysis, which cannot be undertaken without a team of experts, skilled researchers and supporting staff. Strengthening the coordination between the Commission and agricultural departments, policy implementation, carrying out research studies, stakeholder government interface, are

essential for holistic understanding and solutions of various concerns of the agrarian economy of Punjab. In this context, financial support through an annual grant of Rs. 5 crore should be provided for efficient functioning of the Commission.

4. **Strengthening Research Funding and Faculty:** Adequate financial support is essential for the agricultural research, education, and extension activities conducted at research institutes such as Punjab Agricultural University (PAU) and Guru Angad Dev Veterinary and Animal Sciences University (GADVASU). Currently, at PAU, due to financial constraints, only 49 per cent of the sanctioned posts of 1062 scientists (under state funded schemes) are filled, and a similar pattern is observed with supporting staff, with only 1304 (35%) of the sanctioned 3723 positions are filled. Similarly, at GADVASU, only 59 per cent of the sanctioned posts of 426 scientists (under state funded schemes) are filled and only 481 (39%) of the sanctioned 1218 positions for supporting staff are filled. In the current financial year (2023-24), PAU received Rs. 422 crore, falling short of the required Rs. 547 crore and GADVASU received Rs 81 crore, falling short of required Rs 113 crore, for covering salary expenses alone. Presently, to fill all the sanctioned positions at university, Rs. 1000 crore is needed for PAU and Rs 258 crore for GADVASU, along with Rs. 100 crore working contingency for PAU and Rs. 40 crore for GADVASU for meeting the research, education and extension activities. Furthermore, for the establishment of new infrastructure, maintenance, and the upgrading of laboratories and faculty facilities, a one-time dedicated grant of Rs. 700 crores for PAU and Rs. 300 crores for GADVASU is required. The budgetary allocation and its release to PAU and GADVASU should be directly from Department of Finance rather than Department of Agriculture and Farmers' Welfare and Department of Animal Husbandry, respectively.

Table 10.1: Status of scientists and supporting staff positions and annual salary budget

University	Staff Positions	Posts (No.)			Annual Salary Budget (Rs. in Crores)			Required Budget (Rs. in Crores)	
		Sanct.	Filled	Vacant	For full strength positions	For filled posts	For vacant posts	Actual received	Gap
PAU, Ludhiana	Teaching (Scientists)	1062	524 (49%)	538 (51%)	1000	547	553	422	578
	Non - Teaching	3723	1304 (35%)	2419 (65%)					
GADVASU	Teaching (Scientists)	426	250 (59%)	176 (41%)	258	113	145	81	177
	Non-Teaching	1218	481 (39%)	737 (61%)					

Source: Data gathered from PAU and GADVASU.

Note: One-time dedicated grant of Rs. 700 Cr. for PAU and Rs. 300 Cr. for GADVASU for new infrastructure, maintenance, upgradation of labs. Rs. 100 Cr. for PAU and Rs. 40 Cr. for GADVASU as working contingencies

5. Use Next Generation Technologies: For precision, efficiency and global competitiveness in the agriculture of Punjab:

a) Special focus is required on next-generation farming technologies like genomics, artificial intelligence, robotics, nano-technology, drones, remote sensing, geospatial technology, crop simulation modelling and agro meteorological advances. These technologies hold significant potential for enhancing precision, efficiency, and global competitiveness in Punjab's agriculture. Such technologies can contribute to improving productivity and quality, identifying, and predicting insect-pests and diseases, decision making for pest management, assessing soil moisture stresses and fertility status, predicting surface and groundwater availability, and estimating crop-land suitability and productivity, etc. To support these initiatives, capacity building and the strengthening of specialized laboratories are necessary.

b) Corresponding to the above, develop research initiative platforms and IT modules in consultation with the Departments of Agriculture, Horticulture, Animal Husbandry, Soil and Water Conservation, as well as the extension wings of PAU and GADVASU. Create digital and interactive "Packages of Practices" that involve farmers and stakeholders for pilot-scale implementation.

c) Mobile-enabled technology holds tremendous potential for transforming agriculture. By developing all-in-one app, farmers can access crop sowing and area data, yield forecasting, crop disease mapping, and valuable information dissemination. Encourage widespread adoption through incentives for app usage on hand-held devices, while incorporating analytics and visualization features to provide valuable insights for informed decision-making.

6. Demand Driven Research and Scientists' Work Reward: a) Align the crop research agenda with market demand within specific crop categories. Further, Punjab's role now needs to be seen in terms of nutritional rather than just food security. PAU should focus on its research agenda for catering the needs of consumers for different wheat classes, such as *chapati*, bread, biscuit, pasta, resistant starch, high zinc, and more. Additionally, align government policies to encourage farmers, farm organizations for growing and processing of crops for end product development. Focusing on crop diversification, similar approach has to be followed in other crops and agricultural occupations.

b) Research priorities should be fixed such that PAU scientists work on projects which are in line with the state agricultural priorities. The introduction of Academic Performance Indicators (API) based promotion system by UGC has resulted in research being done in areas which fetch higher citations or more points in Career Advancement Scheme (CAS) most of the times in contrast to the state agricultural priorities and deviating from the requirements of farmers. This has also adversely impacted the teamwork culture among the faculty. The university

should reorient the CAS such that each scientist works simultaneously on prioritised areas as an active team member and also gets sufficiently rewarded academically for promotion on time.

7. **Global Exposure of Scientists:** The government should provide funds for scientists to gain exposure and enhance their capabilities and strengthen linkages with international research institutes for faster exchanges on advanced technology and their utilization as per state's agricultural needs. In order to tap the talent and reverse the international migration, students/faculty trained in advanced labs of foreign universities need to be attracted by giving special incentives.

8. Education in Agriculture

a) Reservation of Students with Rural Background: Students hailing from rural backgrounds have a better understanding of agriculture and allied activities and can provide viable solutions to the farm sector problems in a better way. However, the percentage of such students undertaking graduation at PAU and GADVASU is low. Therefore, to improve the representation of such students in agriculture and allied sectors, a significant percentage of seats in agriculture and veterinary sciences (undergraduate and diploma courses) should be reserved for students with rural background, through an Act of Punjab Legislature.

b) Regulation of Fee Structure of Farm Universities: Although PAU and GADVASU are government-aided universities, there is a need to regulate the fee structure of all the degree programmes. This will help to establish the reasonableness of the fee levied by these farm universities and will also fulfil the educational aspirations of economically weaker sections of the society.

c) Regulations for Quality Education: The universities/colleges offering agriculture degrees must be regulated and monitored regarding faculty strength, suitable infrastructure facilities and other qualitative aspects required to maintain the academic standards of these institutions. Similarly, the curriculum and courses on agriculture, livestock, environment, and other recent innovations should be developed and regularly updated in every school of Punjab.

d) Updation in curriculum of B.Tech Dairy: The B.Tech Dairy curriculum should incorporate a dedicated subject on feed and fodder, given its crucial role in dairy farming. Without a comprehensive understanding of feed and fodder for dairy animals, experts in this field lack the essential knowledge needed to guide dairy farmers effectively. With the knowledge of this crucial subject, experts will be able to guide farmers into fostering healthier and more productive dairy animals.

11. AGRICULTURE EXTENSION AND TRAINING

Agriculture extension in this agri-business era in the post-WTO regime has assumed increased significance with a view to the urgency of adopting the cost-cutting and profit-enhancing technologies in the face of scarce resources and stiff domestic and global competition from best quality produce of the developed economies of the world. Furthermore, increasing disease, pest and soil health problems of the chemical-supported intensive agriculture model, recurring threats of harsh weather due to global warming, declining water table and the need to implement the latest water efficient technologies have made the task of extension experts exceedingly challenging. Additionally, the responsibility to fulfil the chemical residue-free, high-quality food and balanced nutritional needs of the increasing population, to not only improve their health but also to reduce their family expenditure on pharma-supported health care, adds further challenges for the experts.

Such objectivity has enhanced the social importance of qualified extension professionals of respective domains, who have an understanding about the scientific basis of the emergence of such problems and competence to address/resolve these in diverse agro-eco situations as an on-the-spot authority.

In this background, it also needs mention here that a significant gap exists between the generated technologies and their transfer to the farmers' fields. And the extension expert who is an agent of change in agriculture development process has the onus to plug this gap and to provide farmer's feedback to the scientists to reorient their research as per changing field requirements and market demand patterns.

In this light the need to strengthen the agriculture extension system was realized in early 1990s when intensive agriculture model of Green Revolution started showing signs of agrarian crisis in the form of increasing indebtedness of farmers and farm workers, pollution of soil, water and air, and declining water table to name a few. Responding to this situation, once the extension services were rewarded by improving the status of its professionals. However during late 1990s the post-WTO regimes weakened the agriculture extension system in a number of ways. For example, **a)** (i) the pay parity of qualified agriculture extension professionals was broken and pay status was lowered from their veterinary counterparts (ii) later the underqualified cadres were equated with qualified agriculture professionals and deprived the revised pay scales under Assured Career Progression scheme to the latter. **b)** Keeping more than 50 per cent sanctioned posts of qualified professionals i.e. Agriculture/Horticulture Development officers vacant for longer periods. **c)** Recruitment of contractual

staff under centrally funded ATMA scheme and contractual matriculate *Kisan Mitras/Kheti Doot* to replace the direct expert advice of qualified Agriculture Development Officer to the farmers, thus weakening the already poor extension system. **d)** Appointment of Directors/ Heads of Department out of the area of domain expertise who are unable to efficiently address the complex and serious issues of crisis ridden Punjab's agriculture. **e)** Many private colleges and universities have been imparting education degree courses in agriculture without having required faculty, land and laboratories to teach and train the incumbents. These institutes are not able to provide quality education and thus lowering the status of these professional degrees dealing with living beings and producing incompetent pass outs who cannot address the problems of agriculture.

This weakened extension system created free space for vested interests to mislead the farmers for using overdoses of spurious pesticides, seeds and other enforced sale-attached inputs to earn super profits. It polluted the eco-system and lowered the farm profitability leading to indebtedness and suicides of the farmers and farm workers.

Policy Recommendations

- 1. Strengthening the Extension System with Domain Experts and Assisting Staff Support:**
a) To strengthen the agricultural extension system, there is an urgent need to provide domain professionals and assisting staff for its efficient functioning. For this, all the existing vacant posts of extension experts along with supporting staff should be filled in all departments (Annexure XII). The extension experts should be well equipped for immediate solution to farmers' problems in terms of travelling facilities to increase reach to farmers' fields. An efficient mechanism should be developed for immediate filling up of vacant posts for efficient service delivery to farmers.
b) Prohibit Assigning Extra Duties to Experts: For efficient utilization of expertise of the extension professionals, the non-technical lateral/extra duties should not be assigned by local administration. This practice not only results in underutilization of their potential, but also adversely affects the farmers and farming, where the services of these experts are required during the same time.
- 2. Encouragement to Attract Talent:** The present situation of agriculture sector is very grim. To improve the efficiency of agriculture sector, there is need of more talented individuals. This can be done by restoration of the pay parity and status of the Agriculture Development Officer/Horticulture Development Officer and Soil Conservation Officers at par with their veterinary counterparts. Further, the incumbents with higher qualifications during recruitment

process should be compensated accordingly to boost their morale and attract talent.

3. **Domain Experts as HoD:** **a)** The Head of Department (HoD)/Director of Agriculture/Horticulture should be the domain expert of the crop husbandry wing of the respective departments. Appointment of HoD from other than the domain expertise area adversely affects the efficiency of the extension machinery. Necessary amendments in this regard in the relevant service rules should be made.
- b)** Twenty per cent posts of Agriculture Officers/ Asst. Director Horticulture in the Departments of Agriculture and Horticulture, respectively, should be made the selection posts to promote meritorious and competent incumbents in advance to ensure better strata for selecting experts for higher commanding posts.
4. **Nodal Teams to Excel:** All major crops/alternatives of diversifications should have a nominated nodal team as regional professional committee in their respective Natural Growing Areas (NGA) headed by a nodal officer from the line department as regional domain expert of the said crop. This team will include regional nodal scientist of the crop, marketing expert representing Progressive Farmers' Society (PFS) of the crop and eight progressive farmer representatives of the crop. This regional professional committee, in liaison with the Centre of Excellence and the PFS, may lead the state's farmers in growing that crop for producing best quality with higher yield making it globally competitive and highly profitable.
5. **Develop Technology Demonstration Centres:** All government and PAU seed farms, progeny orchards and nurseries should be developed as state-of-the art demonstration centres with latest but most suitable technologies, to instil confidence in the farmers and facilitate adoption of new techniques, practices and models by the farmers.
6. **Provision of Training at CoE:** All the existing and proposed Centres of Excellence (CoE) should impart regular monthly trainings to the farmers and stakeholders as per crop-specific requirements demonstrating the best cost-effective, eco-friendly technologies developed for adoption by the farmers.
7. **Launch Online Portal Services:** A State-level online portal for farmers' trainings/government beneficiary schemes/important farm advisories should be started, where farmers can register themselves directly through a simple online verification process. However, given the lower literacy status of a section of the farmers, the above facilities be provided directly through *Kisan Sewa Kendars* in all Multi-Purpose Cooperative Societies (MPCS) to be established in 3-5 village groups in whole of Punjab.

8. **Enhancing Extension Expertise and Farmer Exposure:** Extension experts should be given national/international trainings and exposure to acquire and implement the latest, but most suitable technologies as per Punjab's conditions. Similarly, the farmers should also be given such exposure for acquiring the latest technologies.
9. **Liaisoning of Extension Staff Systems:** Liaison of PAU, GADVASU, Krishi Vigyan Kendra (KVK) and Agricultural Technology Management Agency (ATMA) staff with Departments of Agriculture and Farmers' Welfare, Horticulture, Soil Conservation, Animal Husbandry, Dairy Development and other related line departments should be made more efficient and transparent. Further, the working of ATMA staff with Department of Agriculture in a single line administration should be made more rewarding for the farmers. It will avoid duplicity of work and effectively transfer the latest technology to the farm sector.
10. **Develop Integrated Complexes for Agriculture and Line Departments:** Offices of all the line departments related to agriculture should preferably be located in one complex for efficient collaborative scheme implementation and for convenience of farmers.
11. **Ensure Timely Farm Input Delivery:** The Department of Agriculture and Farmers' Welfare and the Department of Cooperation should ensure the timely availability of required seeds and other farm inputs to the farmers with advance planning. In case of delay in the timely supply of inputs, the concerned should be held responsible.
12. **Revise Professional Qualifications for Specialized Posts:** The qualifications for the specialized posts should strictly be from the concerned specialized domain. Necessary amendments in this regard may be made in the service rules of State Department of Horticulture and others accordingly.

12. COOPERATION

Based on democratic principles and honesty, cooperation is the power and life of distressed and fragmented peasantry, the farm workers and other weaker sections in rurality. Utilising the coordinated potential of these sections and the pooled resources, cooperation becomes a weapon against exploitation and an opportunity to enhance their profits to check indebtedness and arrest depressive tendencies.

Historically, it has played a great role in development and sustainability of agriculture and the well-being of farmers. The cooperative financial sector is the backbone of the agricultural economy of the state, which provides access to formal credit, especially to small and marginal farmers. Punjab also witnessed the emergence of successful dairy cooperatives, such as the Milkfed under the brand name Verka, which has grown to serve as a national model for cooperative dairying. Dairy cooperatives ensure fair milk prices and provide additional income to farmers by reducing intermediaries. These cooperatives, by fostering a collaborative approach, have strengthened the agricultural value chain, empowered farmers, and created a sustainable and inclusive agricultural system in the state.

Despite tremendous progress in the state, there are still several obstacles in the development of the cooperative sector and agriculture as a whole. Embezzlement, corruption and incompetence of the officials of the cooperative societies have been some of the biggest challenges. The sector is also grappling with financial constraints, governance and management issues, lack of marketing and value addition, and lack of technological advances. The majority of the farmers of the state also lack participation and awareness of the benefits and potentials of cooperative societies.

In the present phase, there is a change in thinking in favour of more autonomous initiatives of people in economic activities. The cooperatives in the present situation can give a big push to agrarian activities in rural areas. It can strengthen farmers' initiatives by involving them in the storage and marketing of agricultural produce and agro-processing along with crop production. The new generation of cooperatives can upscale economic activities and help usher in a high rate of growth, save the environment, develop a healthy interface with industry and generate employment for the unemployed rural youth. Financing and strengthening of cooperative sector can put the cooperative movement back on the track and prepare it for a new and positive role in the future reshaping of Punjab's economy.

Agro-processing units should be established in the cooperative sector. Production and marketing should be the exclusive domain of public/cooperative sectors, whilst, the

mega-corporations and other private players should be kept out of these areas. In the era of liberalization, foreign and domestic corporate giants dominate the capital, technology and market. In such a situation, the agro-processing industry cannot expand without excluding foreign and domestic corporates. There is a need to undertake these activities under the domain of Markfed, Punjab Agro, Milkfed, Sugarfed and Multi-Purpose Cooperative Societies (MPCs).

The cooperative sector requires a supportive policy and regulatory framework to thrive. Inconsistent policies, bureaucratic hurdles, lack of funds, corruption, and complex legal procedures should not be allowed to hinder the growth and functioning of cooperatives.

Policy Recommendations

- 1. Setup MPCS:** **a)** The Multi-Purpose Cooperative Societies (MPCS) should be set up in the state for marketing and value addition. Each society should cater 3-4 villages and provide facilities such as small processing units, market access, capacity building through training, storage units, etc. Moreover, these societies should sell their products by developing their own mega-departmental stores/outlets in major towns/cities. In order to promote and integrate the farmers into the commodity-based value chains, the government should develop strong institutions of farmers through the promotion of MPCS.
b) Each cooperative society should receive latest and efficient agriculture machinery tailored to the need of villages covered by it.
c) Micro dairies should be established under MPCS where all the milk should be stored and marketed with automation. There should also be facilities of bio-gas, composting, artificial insemination etc.
d) Credit facilities to farmers and farm workers should be provided through MPCS at lower rates. Governments should encourage rural populace, especially women to form self-help groups, which should be financed through MPCS.
- 2. Primary Aim and Mandate of Cooperatives:** Every enterprise such as Punjab Agro, Markfed, Milkfed, and Sugarfed should act according to the primary mandate of the organisation without interfering in the operations of other entities. The public sector organisations are farmers' supportive bodies for value addition, processing and marketing. These organisations should not behave like private enterprises to earn super-normal profits but should share a fair part of the earned value with the real stakeholder - the farmers.
- 3. Domain Expert Heads:** Public sector organisations such as Punjab Agro, Markfed, Milkfed, and Sugarfed should be headed by relevant domain experts rather than bureaucrats. Such

stable leadership having in-depth professional knowledge of the subject will make these organisations more profitable.

4. **Reforms in the Functionaries of Societies:**
 - a) To boost the rural economies, the cooperative societies and the working and behaviour of their secretaries, being agents of change, need to be reformed by making them technically more capable. In the past, the qualification of secretaries was simple matriculation which was later changed to graduation. However, in the present context of better functioning of MPCS, the qualification of secretaries should be improved to science, commerce or agriculture graduates with the preference of Masters in Business Administration (MBAs). The appointment of secretary should be made by the Department of Cooperation, Government of Punjab. The secretaries should be mandated to complete their training during the probation period and their probation period should not be cleared unless the mandatory training has been completed. Functioning of the society should be made democratic and transparent. The transfer policy of the secretary of the cooperative society must be put in place.
 - b) Secretaries, inspectors and presidents of the societies should undertake joint training for better interaction, communication and to update their knowledge and enhanced efficiency.
 - c) The committees of cooperative societies should be involved in all the decisions/transactions and overall functioning of the societies.
5. **Strengthening of Cooperatives:**
 - a) Government should ensure a regular and timely supply of all agriculture inputs including seeds, fertilizers, bio-fertilizers and pesticides to cooperative societies on priority. The requirement of these inputs should be anticipated well in advance and production should be done accordingly.
 - b) Cooperative sugar mills should be strengthened and revived by providing financial support. Cooperative banks should provide loans to the cooperative sugar mills at reasonable interest rates. Also, the debt of cooperative organizations, especially societies and sugar mills, should be cleared under one-time settlement scheme.
 - c) The cooperative societies should be strengthened through financing by government to help the loss-making societies run better by filling up posts, construction of godowns for inputs etc.
 - d) The cooperative societies should be provided with licenses of commission agents to provide relief to farmers from exploitation and to earn profits for societies as well.
 - e) Cooperative organizations should acquire no objection certificate (NOC) from each other in order to identify defaulter farmers and to increase cooperation with each other.

- 6. Support Peasantry by Strengthening PADB:** **a)** The Punjab State Cooperative Agricultural Development Bank (PADB) is the only bank which provides loan with simple rate of interest to the farmers. However, the bank has been passing through financial constraints due to non-repayment of loans by the crisis-ridden peasantry. This scenario has adversely affected the farm operations of the peasantry and agricultural development process of the state. To improve the financial health of the PADB and to support the defaulter farmers, the debt of the bank should be settled under one-time debt settlement scheme. Under this scheme, the interest amount should be waived-off and the principal amount should be recovered in easy instalments from the debtors so that the bank's advancement and farmers' borrowing process may be revived for giving push to the farm economy.
b) The PADB should be considered at par with other cooperative banks. PADB's ability to grant advancements to farmers has been restricted, but it should be permitted to offer agricultural credit advancements.
- 7. Infrastructure Development through MPCS:** Cooperative societies should setup cold stores, decentralized silos and warehouses, among other amenities, to assist farmers for storage of their produce. Moreover, the cooperative sector should also extend support by offering farmers additional inputs with establishment of facilities like setting up petrol pumps. To facilitate these initiatives, each cooperative society be allotted a minimum of one acre of suitable *panchayati/government land*, enabling them to have access to the central schemes related to infrastructure development. The Punjab Village Common Land (Regulation) Rules, 1964 should be amended for this purpose.

13. FARM WORKERS AND RURAL ARTISANS

The agricultural and rural economies of the state have greatly benefited from the valuable contributions of farm workers and rural artisans. While the widespread adoption of farm mechanization is often cited as a key factor in the remarkable success of agriculture during the Green Revolution, it is important to recognize the pivotal role played by farm workers in this achievement. The historical role of farm workers in agriculture remains indispensable, since they performed all the important agricultural activities such as sowing, transplanting, weeding, harvesting etc. Over one-third of the 99 lakh workforce of Punjab is currently employed in agriculture, either as a cultivator or an agricultural labourer, which is notably lower than the national average (54.6%). Among the total agricultural workforce of 35 lakh in the state, 15.8 lakh (45%) are employed as agricultural labourers. Nearly two-thirds of these agricultural labourers belong to the Scheduled Caste category (Census 2011), a group traditionally positioned at the lowest in the state's caste hierarchy and facing multiple socio-economic challenges.

The most pressing issues confronting farm workers is the limited and seasonal nature of their employment in agriculture due to the prevalence of mechanization. This has resulted in reduced job prospects in the farm sector over the years and subsequently produced surplus manpower. Low incomes and inconsistent earnings make it difficult for them to meet their children's higher education needs and as a consequence, they are trapped in a vicious cycle of poverty. Additionally, the lack of access to formal credit pushes them towards indebtedness, due to the exorbitant interest rates of non-institutional credit sources. In addition to the social and economic disparities, farm labourers face a lack of social protection and unfair labour practices, such as extended working hours and hazardous working conditions. These challenges contribute to a significant number of farm workers committing suicides due to socio-economic hardships within the state. Between 2000 and 2018, there were a total of 16594 recorded suicide cases in six districts of the state. Among these cases, 9291 (56%) were identified as farmers, while 7303 (44%) were agricultural labourers. It is important to note that a higher percentage of women from labourer families are victims compared to women from farm families as 12.43 per cent of the total suicide victims from labourer families were women, whereas the corresponding figure for farm families was 8.2 per cent (Singh et. al, 2020).

Rural artisans played a significant historical role in the state's agricultural growth. These artisans have been the custodians of traditional craftsmanship, producing a wide range

of tools and equipment essential for agriculture. They crafted ploughs, sickles, carts, and other implements, tailored to the specific needs of the region's agriculture. Rural artisans have been instrumental in the construction and maintenance of irrigation systems, including wells, canals, and water pumps. However, this section has been facing economic vulnerability due to the low demand of their services/products in recent times. This happened due to a number of factors, including the technological obsolescence of hand-crafted tools, mechanization, and increased access to markets by farmers. As a result, many rural artisans have either shifted to nearby towns/cities to set up small shops/businesses based on their craft or converted into agriculture and industrial labourers. An effective policy approach is required to address these issues and support rural artisans.

Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA scheme) is a significant instrument for the provision of employment for rural labour, both skilled and unskilled. In Punjab, over 27 lakh workers are registered under the MGNREGA scheme, but only 15 lakh workers (54.8%) are actively participating. During 2022-23, the MGNREGA scheme provided 321.1 lakh days of work in the state and the average employment provided per household was 37.97 days per annum. Only 13,534 households were provided with 100 days of wage labour. There is a huge potential to employ rural labour under the MGNREGA scheme.

A multi-pronged strategy, including policy interventions, income enhancement, farm and non-farm employment generation, better access to institutional credit, and the provision of social security is urgently required to improve the welfare of the working class.

Policy Recommendations

- 1. Pension Plan:** Farm workers, by making enormous contributions to the farm economy, have built modern society. However, they have often been overlooked and have remained a deprived section. These workers should be repaid with a pension plan scheme as an old age support of the alienated individuals in the society. Farm labourers should get pension coverage upon reaching the age of 60 as a labour reward by the government.
- 2. Registration of Workers:** The state has no registration system in place for farm workers and rural artisans. Consequently, these workers are often deprived of many measures/schemes announced by the government such as access to credit, wages, and compensations in case of suicides, farm accidents and crop failure. These workers must be registered so they can avail benefits of various government schemes.

3. **Enhancement in MGNREGA Employment:** The economic conditions of farm workers can be improved through the MGNREGA scheme. Therefore, the mandatory work of 100 days under the MGNREGA scheme should be increased to 200 days. The state government should hold dialogue with union government for this matter. Currently, the MGNREGA scheme has been providing average employment of 38 days per household per annum, which should be enhanced atleast five times by making special efforts such as preparation of project reports, renewal of job cards, etc. MGNREGA scheme workers should be engaged in developmental activities, particularly plantation, land improvement etc. with the coordinated efforts of the Departments of Rural Development and Panchayat, Agriculture/Horticulture and others.
4. **Credit/Debt:**
 - a) Ensure the availability of cheaper credit to farm workers, tenants, and rural artisans by including them as effective members in the Primary Agricultural Cooperative Credit Societies (PACS) or Multi-Purpose Cooperative Societies (MPCS). The state government should contribute to maintain the financial health of cooperatives/societies.
 - b) A one-time debt settlement scheme should be devised for farm workers. In order to pay off the loans obtained from non-institutional sources; the Scheme for Debt Swapping of Borrowers should be implemented to convert the non-institutional loan owed by the farm workers into an institutional loan. Additionally, it is essential to establish a cap on interest rates for microfinance companies, ensuring that they do not charge more than 1 per cent interest over and above the prevailing rate of interest by the Public Sector Banks.
5. **Suicide Compensation:**
 - a) Provide compensation of Rs. 10 lakhs to the suicide victim families of farm workers/rural artisans, along with waiving off their entire institutional debt, a government job to the next kin of the suicide victim, and free education for their children.
 - b) Identity cards should be issued to women or the next of kin from families of suicide victims so that they can avail benefits from all government schemes on a priority basis.
 - c) Ensure immediate compensation to all families of suicide victims by the attestation of the village Sarpanch. This is essential to address situations where these families have faced difficulties in accessing government compensation due to a lack of necessary documentation like post-mortem reports and credit records.
6. **Healthcare and Compensation:**
 - a) Free healthcare should be provided to farm workers/rural artisans. A compensation of Rs. 5 lakhs should be provided to the family in case of the death of a worker due to a farm accident. In case of disability caused by farm accidents, compensation should be given as per the status of disability.

- b)** In the event of crop loss due to natural calamities, the farm workers/rural artisans should be allocated with 15 per cent of the crop loss compensation provided to the affected area. This allocation is to compensate for the loss of livelihood incurred by these workers due to crop failure.
7. **Access to Land:** One-third of the *Panchayati* land and other common lands should be leased out to farm workers. This land should be meant for the Integrated Farming System (IFS) under cooperative farming.
8. **Integrative Income:** Farm workers should be given opportunities to boost their earnings through integrated approaches. The workers and their families should receive training in various skills, including automobile/computer/phone/TV repair, plumbing, carpentry, and hairdressing, among others. Special attention should be given to promoting women-centric skills like stitching, embroidery, child/women healthcare services etc. Arrangements of such training should be made at MPCS. Furthermore, ensuring convenient access to affordable credit for these endeavours is essential.

14. WOMEN IN AGRICULTURE

Women's perspectives can only be included in designing and implementing macroeconomic and social policies if their role is adequately understood. Women play a significant and crucial role in development of agriculture and allied fields, including primary crop production, livestock production, horticulture, post-harvest activities, agro-forestry, fisheries, etc. For the state of Punjab, women in rural areas constitute around 47 per cent of the population. However, social and other barriers limit the participation of women in the workforce, and even more so in rural areas. The literacy rate of women in rural areas is 65.8 per cent compared to 79.2 per cent of their urban counterparts. As per the Periodic Labour Force Survey 2018-19, the female worker participation rate of Punjab is 17.3, which is less than the national average of 23.3 per cent. Lack of data hampers the policymakers in clearly understanding the extent of participation of women in farm operations.

Mechanisation of agriculture in the state has drastically reduced farm employment and work opportunities for rural women. The lack of employment in agriculture sector has forced them to seek alternate job options away from their homes, which too are limited. This drags them into economic and financial insecurity, making them to fall in the traps of local micro-finance companies who exploit them by levying heavy rates of interests. Limited employment opportunities, job insecurity and ever rising rate of inflation adversely affects their mental and physical state, making them a vulnerable part of society. Majority of the rural women are also suffering from many health-related issues like anaemia and other chronic diseases, with limited access to healthcare facilities.

The major brunt of prevailing agricultural crisis is borne by women of agrarian households. Suicides among women of such households are an indicator of deepening of agrarian crisis. According to a study of Punjab Agricultural University, Ludhiana, 12.43 per cent of women from labourer families and 8.2 per cent from farm families are suicide victims (Singh et. al, 2020). These suicide victim families were found to be suffering from a dire sense of fear and social insecurity as well as severe psychological disturbances.

Policy Recommendations

- 1. Empowerment through Education:** Women education strengthens economies and reduces inequality. The government should encourage and provide financial support to make education mandatory for all girls/women, particularly of the weaker sections of the society. Empowering women through education enables them to participate in decision making and build better futures for themselves and their families.

2. **Pension Plan:** Women from small farmer and farm worker families should be entitled for pension coverage upon reaching the age of 60.
3. **Suicide Victim Families:** As much as one-third of the suicide victim families lost their sole bread earners due to suicides and, hence, have been struggling to make both ends meet. Women in suicide families should be given special package of social security schemes. To overcome depression and mental stress, such women should be given free access to clinical psychologists, counsellors, and mental health practitioners by establishing special rehabilitation centres. In order to avail benefits from various government schemes on a priority basis, identity cards should be issued to women of suicide victims.
4. **Skill Development:** Training should be imparted regarding the latest technologies to women for undertaking subsidiary occupations such as goetry, backyard poultry, micro dairy and related household activities such as stitching, embroidery, etc. to upscale their knowledge as well as family income. Efforts should also be made to utilize the skills and capabilities of successful women farmers and entrepreneurs as last-mile extension workers and trainers to extend extension services to other women farmers and potential female entrepreneurs in rural areas.
5. **Credit Facility:** **a)** Since low-income households do not generally have collateral to offer to the financial institutions for taking loans, Multi-Purpose Cooperative Societies (MPCS) can extend loans to rural women based on individual or group guarantees.
b) To prevent the exploitation of rural women, the government should make efforts to regulate the functioning of local micro-finance companies and strict action should be taken against those who are found guilty.
c) Micro lending programme for rural women should be established in which small loans up to Rs. 1 lakh at 4 per cent interest rates should be given to any woman who would like to establish small ventures or facilities within their homes or community to generate a higher off-farm income for their families or their communities at large.
6. **Revisiting Land Property Rights of Women:** Despite laws and policies in place to protect and uphold the rights of women to own and inherit land and other properties, women have traditionally faced significant obstacles in acquiring and physically controlling these properties. To encourage women empowerment and reduce gender bias in the society, the land property rights of women should be looked upon.
7. **Healthcare:** Provide free and easily accessible healthcare facilities to all rural women. This will help in reducing the economic burden of rural households.

15. CREDIT, DISTRESS AND ECONOMIC SUPPORT

The availability of credit to farmers and farm workers is extremely important for the growth of agriculture and the rural sector as a whole. The efficiency and outreach of institutional credit, especially through the cooperative sector, is a pressing priority. The farmers and farm workers face numerous challenges such as lack of access to formal credit, delayed loan repayments due to crop failures or health ailments, financial illiteracy, along with insufficient institutional support and high dependency on money lenders. The state requires an effective policy to make formal credit accessible to farmers, especially small and marginal, and farm workers at subsidized rates with easy repayment facilities. The improvement in accessibility of credit facilities should also include tenants and rural artisans.

The non-institutional sources of credit like private lenders, micro-finance companies etc. are a major source of exploitation, contributing significantly to the ongoing debt crisis in the state. Dependence on non-institutional credit can only be curtailed if institutional credit regulations are aligned with the key feature of their service i.e. providing instant liquidity. The debt crisis needs special attention in order to provide relief to the debt-ridden farm sector of the state. As per the National Bank for Agriculture and Rural Development (NABARD) estimates, the institutional debt on farmers of Punjab is Rs. 73673 crore (2022-23). Another study reveals that of the total outstanding loans of agricultural households in Punjab, 78.7 per cent are from institutional sources, while 21.3 per cent are from non-institutional sources (NSSO, 2019). The elimination of ongoing exploitation of rural communities by institutional and non-institutional credit sources is the need of the hour.

Agrarian distress is innately related to a range of socio-economic issues, such as the farming community's deteriorating physical and mental health, drug addiction, mass migration, educational disparities, and infrastructure challenges and so on. These significant socio-economic issues have impacted the social and economic harmony of Punjab, which in turn, further impedes the growth of our economy. Rising farm costs and dwindling employment opportunities lowered the real income of the farmers and farm workers, pushing them into indebtedness. Conditions of helplessness and depression stemming from constant financial insecurity and growing debt burden lead to suicide. The alarming rate of suicides by farmers and farm workers presents a grim picture of the challenges and vulnerabilities they continue to face.

In such a situation, it is of utmost significance to offer economic support to the farming community, while in addition focusing on eliminating the causes of distress. Granting subsidies,

pensions and other means of support to farmers and farm workers will have a substantial positive impact on their financial security and ability to alleviate distress. However, it may present some short-term challenges in terms of additional financial support, sustainability, and implementation hurdles. Therefore, there is a need to formulate a comprehensive and inclusive policy to enable the farmers and farm workers to have respectable earnings, making them capable of paying their dues themselves, thus eliminating the basis of their dependence on freebies for leading a life of high self-esteem.

Policy Recommendations

1. **Pension Plan:** Small farmers (with up to 5 acres of land) should get pension coverage upon reaching the age of 60 through the creation of a Social Welfare Fund.
2. **Improve Institutional Credit Facilities:**
 - a) A single-window credit system under a central cooperative bank should be set up with simplified procedures enabling farmers to avail credit with minimum transaction cost.
 - b) The commercial banks/cooperatives should advance credit to the farmers by focusing on simplifying loan procedures, improving adequacy and timeliness along with lowering the transaction costs. Additionally, loans to farmers for heavy machinery should be strictly based on economic feasibility.
 - c) The Multi-Purpose Cooperative Societies should provide credit to the farmers and farm workers at a nominal rate of interest.
 - d) The rate of interest on institutional credit advanced for agriculture-allied activities should be at par with the agriculture sector.
3. **Debt Settlement:**
 - a) Small farmers are under severe economic squeeze, therefore, special debt waiver scheme should be crafted for small and marginal farmers (who own upto five acres of land).
 - b) There must be effective implementation of the “Punjab Settlement of Agricultural Indebtedness Act, 2016” so that farmers do not have to pay more than double the principal amount. In order to pay off the loans obtained from non-institutional sources, the “Scheme for Debt Swapping of Borrowers” should be implemented, which will convert the non-institutional loan owed by the farmer into an institutional loan. In case of crop damage due to natural calamities, there must be a loan moratorium, with an interest waiver for that period on all debt collection.

4. **Non-Institutional Credit System:** The functioning of institutional and non-institutional lenders including microfinance companies, commission agents, and private money lenders should be made transparent and debtor-friendly with the following measurements:
 - a) There must be registration of money lenders. These moneylenders should be required to issue passbooks to debtors in order to have transparency in the accounting systems and make debtors eligible for other support measures.
 - b) There must be prevention of blank cheques and promissory notes on credit disbursement along with charging of exorbitant interest rates by these credit sources.
 - c) The flow of institutional agriculture credit should be enhanced through Primary Agriculture Cooperative Credit Societies (PACS) and commercial banks so that farmers may be guided away from the exploitative non-institutional providers.
5. **Suicide Compensation:** a) Provide compensation of Rs. 10 lakhs to the suicide victim families of the farmers (in case of debt-related suicides) along with the waiver of their institutional debt, government job to the next kin of the suicide victim, and free education for their children.
 - b) Issue identity cards to women or the next of kin from families of suicide victims so that they can avail benefits from all government schemes on a priority basis.
 - c) Ensure immediate compensation to all families of suicide victims by the attestation of the village Sarpanch. This is because families of suicide victims, in certain circumstances, have been denied the government's compensation due to a lack of required documents, such as post- mortem reports, credit records, etc.
 - d) Farmers, farm workers, and family members suffering from depression should be given free access to clinical psychologists, counsellors, and mental health practitioners by establishing effective rehabilitation centres. Drug rehabilitation centres should be managed either by government agencies or by reputed medical institutes or service providers having quality experience in managing addiction among rural youth.
6. **Accidental Death Compensation:** A compensation of Rs. 5 lakhs should be provided to the family in case of the death of farmers due to farm accidents. In case of disability caused by farm accidents, compensation should be given as per the level of disability.

7. **Community Support:** Within MPCS, community halls should be constructed in village clusters. These halls would serve as venues for various social gatherings, including weddings and other social events in rural areas. Furthermore, a provision should be made within the fair-price shops to offer wedding essentials such as clothing, flour, sugar, and other necessities at subsidized rates to support the rural community during these occasions. Additionally, a mass outreach awareness campaign should be launched by relevant departments, gram *panchayats*, and other social organisations through print and vernacular/social media to address the socio-economic concerns of the farming communities.

16. NATURAL CALAMITIES, RISK MANAGEMENT AND INSURANCE

Agriculture is inherently exposed to a multitude of risks, spanning from adverse weather conditions and pest infestations to other natural disasters. Many times, the bumper crop grown by farmers is ruined by biotic (pests, diseases, weeds, etc.) and abiotic (climate, natural disasters, etc.) factors. Effective risk management strategies can help farmers minimize the negative impacts of these risks and make informed decisions to protect their crops and livelihoods. Similarly, effective insurance schemes are considered superior options for safeguarding the interests of distressed farmers. There are, however, several challenges in formulating and implementing effective insurance policies. The main challenges to the effectiveness of insurance schemes are inadequate coverage, high premiums, delayed compensation, complex administrative process, lack of farmers' awareness, and difficulties in data collection and claim verification. These issues must be addressed through the formulation of insurance plans tailored to the prevailing conditions in Punjab.

Despite Punjab's high crop productivity, the farm sector has been facing a severe economic crisis. One of the primary reasons for farmers' and farm workers' indebtedness is crop failure resulting from extreme weather events or natural disasters, such as droughts, floods, hailstorms, pests, or diseases. Crop insurance schemes with low premiums and wider coverage can address these issues by compensating the farmers for their crop losses.

Human resources play a significant role in agricultural production, with farmers and farm workers being indispensable to the sector. The state should prioritize the well-being of these individuals by ensuring access to effective human life and health insurance schemes. Life and health insurance may help in preventing issues like substance abuse, suicides, and related problems. Similarly, the livestock sector plays a pivotal role in sustaining the economic stability of rural communities. It is essential to extend insurance coverage to this important sector which provides income and employment to the farm sector. The formulation and implementation of effective insurance programmes for crops, humans and livestock is crucial. Such initiatives would not only offer economic security to the farming sector, but also foster the growth and prosperity of the rural economy of the state.

Policy Recommendations

- 1. Establish Crop Insurance Fund:** Design Punjab's own crop insurance scheme by generating a crop insurance fund to mitigate crop loss. The crop insurance fund should be established with a nominal contribution from the farmers, equal to 0.1 per cent of the total value of the crop

procured and the double amount by the government. Initially, a fund of Rs. 200 crore should be established with an equal contribution by both the state and the central government. The farmers feed the nation and so deserves to be taken care of by the state on behalf of civilized society. In case of crop loss due to natural calamities, the farmer should be fully compensated, recognizing that farmers invest in the next season's crop while also fulfilling their family livelihood obligations. The crop loss considering acre as a unit should be compensated under this scheme.

2. **Livestock Insurance:** The livestock sector is highly prone to risks due to contagious diseases among animals, resulting in mass mortality and causing economic distress to the owners. Therefore, a livestock insurance scheme should be initiated through Milkfed and Dairy Development Board to provide financial protection to farmers against losses arising from livestock-related risks, contributing to a more resilient and secure livestock sector.
3. **Human Life/Health Insurance:** A human life/health insurance scheme should be developed for farmers and farm workers, ensuring affordable and world-class healthcare services including the coverage for mental health and psychological well-being.
4. **Risk Management:** Effective risk management in agriculture is essential for safeguarding the long-term sustainability of the agriculture sector and ensuring a stable food supply in the face of various uncertainties and challenges. A well-executed weather forecasting helps farmers, and the state to reduce the adverse impacts of abnormal weather, such as floods, drought, frost, hurricanes, etc. Timely weather forecasts enable farmers to make informed decisions on crop planting, irrigation, and harvesting, ultimately enhancing agricultural productivity and food security. For instance, in case of a frost forecast, farmers can enhance the frost resilience of their crops by irrigating the fields. Further, agriculture experts can advise suitable measures to the farmers based on the nature of the forecast, outlining crop-specific actions, and even formulating strategies to address potential disease and pest outbreaks during abnormal weather events. The strengthening of the weather forecast, along with advance and quick warning and advice systems with the latest technologies is urgently required to manage the risk and uncertainty in farming. In this context, the Punjab Remote Sensing Centre should be strengthened and reformed.

17. AGRO-PROCESSING AND VALUE ADDITION/COLD CHAIN

Agro-processing and value addition have emerged as highly rewarding activities to enhance farm profitability and boost rural economy, with technological advances that enable precision and perfection in producing quality products without the need of additives. To fully tap its vast potential with manifold profit margins, it is essential to professionally meet the basic requirements of this process, adhering to global standards, wherein the following is of utmost importance:

- i. Quality raw material in the Natural Growing Area (NGA)
- ii. Selecting the most efficient and cost-effective equipment
- iii. Knowledge about the strength of the products
- iv. Locating the hot demand market sites
- v. Feasibility analysis and professional management

It is imperative to ensure that the gains of agro-processing primarily accrue to the producer farmers, who are the main stakeholders, and to village consumers, to enrich the rural population, elevate their standard of living, and improve their educational status, while checking the migration of people to cities and abroad.

In this context, processing and managing volumes of diverse agricultural produce efficiently, with minimal costs and engaging competent professionals require a community-based approach, whereby the Multi-Purpose Cooperative Societies (MPCS)/Progressive Farmers' Societies should be supported to take up these processing ventures successfully. It will have a ready home market in the rural areas with the surplus going to the cities. It will also have the capacity to hold back produce for storage in efficient cocoons/cold rooms in case of a market glut to avoid distress sales.

Policy Recommendations

1. **Availability of Produce Specific-Processing Machinery at MPCS:** a) Diverse produce of different natural growing areas like fruits, vegetables, pulses, oilseeds, cereals, sugarcane, forestry, etc. (Annexure XIII) require produce-specific efficient processing equipments or a group of need- based equipments. These equipments should be installed in Multi-Purpose Cooperative Societies (MPCS)/ Progressive Farmers' Societies so that gains of earned value accrue to the producer farmers. These democratically-governed societies will have progressive farmers in the governing board and the processing operations should be run by professional

teams. To facilitate marketing and to make the production and value addition process demand-based, these MPCS shall have liaison with the proposed Innovative Agricultural Marketing Society (IAMS) and Agricultural Marketing Research and Intelligence Institute (AMRII).

b) These MPCS should be equipped with integrated pack houses and solar supported cold-chain facilities to increase the profitability of the farmers by avoiding market glut and distress sales.

2. **Strengthen PAIC Processing Facilities:** Punjab Agro Industries Corporation (PAIC) should strengthen the processing plants established at Abohar and Hoshiarpur with the latest technologies to maximize the processing capacity of Punjab's horticultural produce. As a public sector organization, PAIC must deliver a major share of the earned value back to the farmers to energize the rural economy. It should also support the farmers' societies and farmer entrepreneurs to establish small processing units in rural areas and help in market linkages to ensure profitable disposal.
3. **Single Window by PAIC:** PAIC should establish a single window service for farmers' societies and entrepreneurs, particularly for obtaining essential approvals like change of land use (CLU) certificates, no objection certificates (NOCs) for pollution control, enterprise registration, power connections, food safety standards authority of India (FSSAI) certificates, bank loans, or any other relevant documentation. Dedicated officials should be appointed for this task.
4. **Set up CoE for Agri-processing:** A Centre of Excellence (CoE) for Agri-processing and Value Addition and development of agri-entrepreneurs should be established at PAU, Ludhiana. It will focus to indigenize the latest efficient global equipments as per Punjab's requirements to make the value addition cost effective and competitive in all respects.
5. **Improve Post-Harvest Management:** State Departments of Agriculture and Farmers' Welfare and Department of Horticulture should establish clusters for fruits, vegetables and other crops/ alternatives for quality production in respective NGA. These clusters should be supported in creating post-harvest handling, packaging and cold chain systems for domestic and export marketing. Such clusters should be linked to CoE (Agri- Processing), Punjab Horticultural Post-harvest Technology Centre (PHPTC), and Food Industry Business Incubation Centre at PAU, Ludhiana for entrepreneurial trainings. For cost-effective post-harvest handling and marketing solutions, these clusters should be linked to MPCS and IAMS.
6. **Storage Facilities:** The government should set up silos/multi-chamber cold storage facilities at the MPCS, PFS, and Horticulture Estates. Such facilities should be developed collectively

for niche areas having the potential for the production of horticulture crops/livestock products. To avoid distress sale of fruits and vegetables during peak season, the Punjab Mandi Board should arrange cold storage facilities on rent at distant domestic markets. Similarly, cold storage should be provided in both centralized and decentralized mode (farm level, owned/rented by the farmer).

7. **Juice Vends in Rural Punjab:** Young farmers/entrepreneurs should be supported and allured in setting up insulated solar-supported vends with hygienic juicing equipments to supply fresh fruit juices, sugarcane juice, and vegetable soups along with home delivery as a nutritious option. This will make rural Punjab healthier and provide ethical and productive employment opportunities for rural youth.

18. FARM MECHANISATION

Agricultural production in Punjab made quantum leaps through mechanization and the adoption of other advanced agricultural practices. The years during the Green Revolution boosted production, enhanced income levels, and a substantial rise in Punjab's contribution to the central pool. Mechanization has played a crucial role in enhancing time efficiency, precision, operational effectiveness of inputs, cropping intensity, along with workers' ease and crop productivity. During 2018-19, Punjab had an average farm power availability of 5.68 kW/ha, which was 2.8 times higher than the national average. However, despite the progress in mechanized agriculture, several issues have emerged, including:

- i. Over-powered tractors,
- ii. over-mechanisation; and
- iii. the requirement of precision and efficient equipments.

Currently, Punjab faces various challenges related to farm mechanization, including high per hectare investment costs, under-capacity utilisation of farm equipments, limited availability of suitable farm machinery for small farms, higher fixed farm costs, and limited mechanization of horticultural crops. These problems must be addressed to ensure the competitiveness and profitability of agriculture in Punjab.

As input costs of cultivation increased over time, the returns from agriculture began to shrink due to a number of inter-related factors. While on one hand, there was under-utilization of farm machinery; on the other hand, access to it became expensive and difficult for the majority of small farmers, leading to depeasantisation. Therefore, there is a pressing need to improve the level of farm mechanization in the state in a manner that enhances the economies of scale and benefits farmers across all categories. To tackle these issues, it is essential to provide easy access to farm machines and equipment through Multi-Purpose Cooperative Societies (MPCS).

Policy Recommendations

1. **Establish MPCS:** Currently, Punjab has 3523 Primary Agricultural Cooperative Credit Societies (PACS)/Multi-Purpose Cooperative Societies (MPCS). These PACS should be upgraded as MPCS equipped with farm machinery for custom hiring. These societies should be established in village clusters to cover all the 12581 villages in Punjab over the next five years, in phases. These should be connected to the nearby societies via farm machinery applications like Uber, to lower the expenses of fixed farm costs and provide efficient

machinery. These MPCS should offer a diverse range of equipment tailored to the cropping patterns of their respective areas, all equipped with Global Positioning System (GPS) for monitoring and optimizing machinery usage.

2. **Precision Equipments:** MPCS and Progressive Farmers' Societies should have access to the development, assessment, and dissemination of precision machinery (pneumatic planter, dehusker-cum-thresher, sugarcane harvester, efficient pruners, green pea thresher-cum-depodder, electrostatic sprayers, etc.). These machines should be available as per their respective production region for alternative crops for diversification, with a special focus on maize, cotton, sugarcane, oilseeds, pulses, and horticultural crops.
3. **Set up Directorate of Agricultural Engineering:** Establish a separate Directorate of Agricultural Engineering in the state for effective implementations of mechanization, post-harvest processing, soil water/irrigation, and renewable energy schemes. Further, to ensure the supervision and accelerating mechanization in farm sector, district-wise and block-wise posts of Agriculture Engineers should be created.
4. **Next-Generation Technology:** For better precision and efficiency, the adoption of next-generation technologies like Artificial Intelligence (AI), Internet of Things (IoT), Global Navigation Satellite System (GNSS), GPS, electric tractors, drones, etc. should be promoted in the farm sector in a way to generate productive employment opportunities.
5. **Establishment of CoE for Farm Machinery:** Establish a state-of-the-art Centre of Excellence (CoE) for Farm Machinery and Equipment at PAU, Ludhiana. This centre should facilitate efficient and precise farming operations and serve as a testing and certification centre for farm equipment. Under this centre, a farm machinery demonstration-cum-skill centre should be established for training the farm workers and rural youth on the operation, repair and maintenance of farm machinery. This skill-oriented intervention can help engage the state with youth employment challenges. Machinery-equipment stakeholders such as farmers and manufacturer groups should be linked to this centre for interactive advisory.
6. **Punjab as a Machinery Hub:** Innovative manufacturers in Punjab are now producing a wide range of farm machinery and, thus, with the support of CoE, the state should be promoted as a hub of farm machinery, in both domestic and global market. The state can capture international export market by developing low-cost versions of farm machinery. Plan and schedule government-led expert exposure trips for target nations like Italy, Japan, etc. to explore and identify prospective machinery, equipment and tools for import required for

Punjab's diverse agriculture that can further be indigenized at low costs to suit local crops and soil conditions.

7. **Subsidized Machinery:** The existing subsidy support mechanism transfers subsidy directly to the manufacturer/dealer. The system is reported to be misused for inflating prices and compromising quality. The subsidy component should be directly transferred to the beneficiary farmers so that they may benefit from marketing competition in terms of both quality and price.

19. REGIONAL ISSUES

Punjab has diverse agro-climatic zones, each with its own unique geographical, climatic, and socio-economic conditions. This has led to the development of region-specific agricultural practices, tailored to the specific climates, availability of irrigation infrastructure, and accessibility to markets. Farmers in different regions grapple with unique challenges that are specific to their respective areas. In the border regions of Punjab, a particular set of issues emerge, primarily related to security concerns and land access problems. These challenges have far-reaching consequences, including livelihood instability and decreased land productivity. These areas often suffer with lack of adequate infrastructure including, lack of roads, irrigation facilities, and access to markets, etc. During the partition of the country, the people living in this region suffered immensely. They bore the brunt of the country's two wars with the neighbouring country along with many skirmishes. They have coped with deterioration in their incomes and living standards over the years as the industry has largely shifted out of Amritsar to Ludhiana and Jalandhar since partition. Currently, the people of the border areas are facing multi-dimensional problems which need to be addressed.

Shivalik foothills with its sub-mountainous North-eastern part of Punjab, comprising districts of Roopnagar, SAS Nagar, SBS Nagar, Hoshiarpur, and Pathankot, is known as the *Kandi* region. This region, which is around 11 per cent of the state's geographical area, is characterized by low hills, undulating topography, steep slopes and poor eroded soils. The groundwater table is deep, soils mostly sandy, varying in texture between sandy and loam at the surface and loam to clay in some areas at the sub-surface level. The main source of livelihood in the area is mixed farming, i.e., subsistence agriculture with pockets of commercial agriculture/horticulture crops, supplemented by agroforestry plantations and livestock. Therefore, major issues like eroded weak soils with low productivity, and stray & wild animals significantly affect the agriculture sector of the zone. Other areas of Punjab also face area-specific issues such as challenges faced by the Bet region of Punjab including the risk of flooding, inadequate infrastructure development, environmental conservation, water resources management, etc. Similarly, the waterlogged regions of Punjab face issues like lower crop productivity, soil degradation, livelihood instability, etc. A suitable policy is required for the development of these areas.

By addressing these issues and promoting healthier agricultural practices for selected crops of its Natural Growing Areas, the profitability of farmers of the *Kandi* belt and other regions can be enhanced. It is imperative to understand these region-specific issues of the

state and formulate a policy for the development of agriculture in these areas.

Policy Recommendations

1. Regional Development in Mission Mode: The Department of Agriculture, Horticulture and Forest should be entrusted to address and resolve the respective issues of these different regions in a mission mode for which *Kandi* area mission, border area mission, *bet* area mission and water-logged area mission be formed with required initial dedicated fund for submission of report within a given timeframe which may be a few months. The government may implement the recommendations of these reports after deliberation through respective missions.

2. For *Kandi* Areas

a) The paddy cultivation area should be shifted to *basmati*, agroforestry (poplar and eucalyptus), medicinal plants (*amla*, *harar*, *bahera*, etc.), potato and other vegetables, groundnut, maize, etc. based on agro-eco situations in different pockets of this long *Kandi* belt. Bamboo cultivation should be included in forestry for *Kandi* and uneven lands so that farmers can earn profit by cultivating bamboo. Moreover, this area is also suitable for the cultivation of a number of medicinal plants which should be focused for earning higher value with processing and marketing interventions, through multi-purpose co-operative societies of respective areas.

b) The recent amendments made in the Indian Forest Act, 1927 regarding removal of bamboo from tree category, should be implemented in the state. Following this, bamboo growing in non-forest areas will be exempted for getting the requirement of permission for its felling or transportation for economic use. Bamboo cultivation should be promoted in *Kandi* area as it can be a highly profitable venture with a view to lower cost of production, longer life, and value addition potential.

c) Barbed wire fence facilities should be provided to *Kandi* farmers in order to protect their crops from wild/stray animals. Alternatively, crops which are not damaged by wild animals can also be promoted such as *taramira*. There must be proper demarcation of forest areas in this region. Where after, whole Shivalik foothill area should be fenced/solar fenced to contain the wild animals in forest area and to check the theft of forest wood.

d) Farmers should be encouraged to raise silkworms in the demarcated region by Horticulture department. For this purpose, mulberry trees should be planted in maximum numbers, along with a reeling unit for silkworm cocoons to enhance the income of silkworm rearers.

e) The natural habitats for wild animals should be established along with the conservation of

natural forests in this area. Moreover, eco-tourism spots in this area should be identified and developed.

f) Nursery of quality planting material of horticultural, agroforestry and medicinal plants should be established at PAU Regional Research Station, Ballowal Saunkhri, District SBS Nagar.

g) Agro-forestry is the mainstay of the *Kandi* region, but the farmers are exploited by the middlemen. Thus, to check this exploitation, a regulated wood market should be established at a suitable place on Hoshiarpur-Dasuya state highway near the wood processing industry.

3. For Bet Areas

a) A region-specific integrated model along with market assurance is required to put in place.

b) Agro-forestry and other flood tolerant crops, such as sugarcane, should be promoted in this area.

c) In order to mitigate flooding and efficiently manage rainwater, the reservoirs, lakes, and ponds should be constructed in this area along the river banks. These water bodies will serve as crucial storage facilities, enabling the year-round implementation of solar-supported micro-irrigation systems using the stored water.

4. For Border Areas

a) It is a fact that people are apprehensive while considering making an investment in border areas of the state for obvious reasons, therefore, the Punjab government should initiate the dialogue with the central government for setting up a special border agri-zone. In this zone, special incentives, which include tax holidays/GST refunds for 15 years should be provided as was done in the past for neighbouring Himachal Pradesh. Further, long-term loans at zero or very low interest rates should also be offered to encourage investors for making investments in this zone. This incentive would generate employment and help overcome the problems of crime, smuggling and other illegal activities, which would reduce the overall expenditure of the union and state governments incurred on paramilitary forces.

b) In these areas, activities like precision farming of vegetables and fruits, dairying and milk product processing, food processing, and agro-forestry should be promoted. This should be supported with establishment of pack houses and cold chains, linking it with the efficient marketing outlets through Markfed, Punjab Agro Industries Corporation Limited (PAIC), Multi-Purpose Cooperative Societies (MPCS) and the Innovative Agricultural Marketing Society (IAMS).

c) The farmers cultivating across the barbed wire in Indo-Pak border areas are not allowed to plant crops of their choice due to security reasons. As a result, the farmers grow less remunerative crops. Given this challenging scenario, farmers should be incentivized for growing less remunerative crops such as pulses, by creating special linkages with industry. Furthermore, there should be incentives and support provided for the development of agro-processing industries within the border areas to facilitate this initiative.

5. For Waterlogged Areas

- a) Suitable fruit, vegetable and other crops on swales/broad high beds with drip-fertigation should be incentivized based on research and development focus.
- b) Every village should have a water recharge system to regain water level.
- c) Proper water drainage and storage systems can be built outside the covered fields and the water logged due to heavy rains can be reused when required in the fields.
- d) Tubewells installed in waterlogged areas, which are not being used presently, should be used to supply canal water.
- e) In brackish water areas, subsidies should be given to farmers for the construction of water storage tanks for mixing of poor quality water and canal water along with solar-supported drip irrigation systems for growing vegetables, fodder, fruits, forest, medicinal and forest crops to obtain quality produce.
- f) Waterlogged areas should be provided with facilities of drainage. Moreover, due to poor quality of groundwater, canal irrigation and micro-irrigation should be expanded in the area.

Punjab State Agricultural Policy

MAIN RECOMMENDATIONS

For

Healthier, Profitable and Globally Competitive Agriculture in Punjab

by

Developing Agriculture with Multistage Institutional Cooperative Frameworks

1. Growing Crops in their Natural Growing Areas (NGA)

Different crops / alternatives of diversification are to be promoted in their respective Natural Growing Areas (NGA) which should be the primary areas of research, extension, quality production, value addition and marketing efforts. Natural factors will help in producing quality with minimal costs to make it globally competitive.

2. Establishing Institutes of Farm Sector Excellence

i. **Centres of Excellence (CoE):** Thirteen Centres of Excellence (CoE) for different crops/ alternatives should be established in their NGA as light house of knowledge with the mandate to demonstrate the latest technologies and train the farmers and other stakeholders.

Mandate

- Demonstration
- Training
- Participatory Research (PAU + Dept. Experts + Representative Farmers of PFS)

- | | |
|------------------------------------|--|
| 1. Basmati (Gurdaspur) | 8. Beekeeping (Khanaura, Hoshiarpur, Department of Horticulture, Punjab) |
| 2. Cotton (<i>Malwa</i>) | 9. Small Ruminants (<i>Malwa</i> , GADVASU) |
| 3. Sugarcane (Bhogpur, Jalandhar) | 10. Dairy Development (Kapurthala, Dept. of Dairy Development, Punjab) |
| 4. Maize (Garhshankar, Hoshairpur) | 11. Food Processing and Value Addition (PAU) |
| 5. Pulses (<i>Malwa</i>) | 12. Machinery and Equipment (PAU) |
| 6. Oilseeds (<i>Malwa</i>) | 13. Integrated Farm Systems and Integrative Income Support (PAU) |
| 7. Organic Farming (Ludhiana) | |

Five CoEs have already been established in Punjab.

ii. Forming Progressive Farmers' Societies (PFS):

Each CoE should be linked to the proposed crop specific Progressive Farmers' Societies for quality production, value addition, storage and marketing for co-ordinated promotion of the crop by participatory research as per field needs and adopting the demonstrated technologies.

Mandate

- Quality Production
- Value Addition/Processing
- Storage & Marketing

iii. **Agricultural Marketing Research and Intelligence Institute (AMRII):**

To balance demand and supply the proposed institute should be established as a Special Purpose Vehicle at PAU and shall be the global market eye of the crop specific Progressive Farmers Societies.

Mandate

Demand-Supply Balance

iv. **Innovative Agricultural Marketing Society (IAMS):**

It will be the apex marketing body of 18 crop-specific Progressive Farmers' Societies to market their diverse quality produce with advance planning keeping in view the demand-supply scenario of produce.

Mandate

Marketing of Diverse Agriculture Produce

v. **Multi-Purpose Cooperative Societies (MPCS):**

To provide required diverse facilities for farm sector at grassroot level in the villages in a co-operative mode, the existing 3523 MPCS should be supported and updated. These Societies should facilitate the farm sector with cost effective quality input supplies, value addition, storage, market outlet for local community and distant city supplies and fulfilling the other basic livelihood requirements. All these institutes to be managed by qualified secretaries, with co-ordinated and cooperative arrangements shall ensure higher profitability and raise happiness index of the farmers and rural community.

Mandate

- Input Supply
- Value Addition/Processing
- Marketing and Storage
- Credit Facilities
- Other Livelihood Support Services

3. **Punjab as Seed Hub:** Develop Punjab as "Seed Hub" by developing seed village clusters in the state. The clusters can be made as per suitable ecology for seed production of selected crops e.g. potato in *Doaba* region; wheat and paddy in Ludhiana, Sangrur, Barnala and Moga; pea in Patiala and Fatehgarh Sahib; *Basmati* in Gurdaspur, Tarn Taran and Amritsar; onion and garlic in Bathinda and Mansa; radish in Gurdaspur.

4. **Wheat:** In wheat, trait specific, and nutraceutically rich varieties like PBW 1 *Chapati*, PBW RS1, WHD 943 will be grown and processed for consumer specific markets under various brands. For local community these brands will be marketed by MPCS and for distant marketing by IAMS.

5. **Cotton**

- i. In cotton belt of Punjab, ensure canal water availability from mid-April onwards for timely sowing before 15th May.
- ii. Strengthen professional extension cover for quality seed, input supply and quality production advisory.
- iii. Discourage paddy cultivation and incentivize cotton in the defined cotton zones of South-western districts.

- iv. Promote and support micro-irrigation for cotton-wheat rotation in conjunction with solar pumps and water storage structures on individual farms.
 - v. Market intervention by the Government of Punjab and Cotton Corporation of India to provide fair price for cotton to avoid loss to farmers in the events of price instability.
- 6. Maize:** Remunerate maize by providing maize dryers of appropriate scale at MPCS/market channels, drip irrigation support for quality production and water saving mandatorily for spring maize and diversifying to baby corn, sweet corn, pop-corn with processing facilities at MPCS.
- 7. Basmati:** *Basmati* holds significant importance for the state due to its export potential and its capacity to conserve water resources. To harness these benefits, paddy should be replaced with basmati. Markfed should intervene with price stabilization fund in the situation of price distress of *basmati*.
- 8. Sugarcane**
- i. The payment to the farmers should be made immediately on the delivery of raw sugarcane to sugar mills.
 - ii. Ensure power-canal water supply for need-based irrigation, especially during the ‘Grand Growth Period’ and the critical times as per crop requirement in consultation with experts.
 - iii. Strengthen, modernize and revive cooperative sugar mills with grant-in-aid, increasing their crushing capacity, Ethanol production or ENA (Liquor), Co-generation Bio-CNG.
 - iv. Revive Sugarcane development scheme for effective extension and regulatory umbrella.
 - v. Strengthen the Sugarcane Research Station at Regional Research Station (PAU) Kapurthala with bio-control, tissue culture labs and for crop physiology- modelling studies with required scientists – supporting staff and budgetary support.
- 9. Pulses and Oilseeds**
- i. Ensure MSP and assured procurement of the pulses with competitive prices. Encourage and facilitate primary processing (cleaning, grading and packaging), storage and retailing through MPCS.
 - ii. MPCS must be supported to set up small scale units to start *Kachi Ghani* oil extraction of *sarson* due to high preference of the consumer. Focus should be laid on confectionary type varieties of groundnut to harness the market trends.
- 10. Fruits**
- i. Strengthening of nurseries for high quality planting material availability to farmers.

- ii. Upgrade *Kinnow* value addition infrastructure with latest efficient models of 5 tonnes/hr capacity along with packing lines and cold stores at citrus estates.
- iii. Special coaches/reefer boggies should be attached to passenger/freight trains from Punjab's production centres with subsidized freight to transport the produce to distant hot markets. Similarly, inland reefer haulage and ocean freight needs to be subsidized.
- iv. Punjab Mandi Board to ensure recovery of sale proceeds of the seller farmers in distant markets by tying up with Directorate of Revenue Intelligence, Government of India.
- v. Promote high-value *kinnow*-based liquor products and extraction of Limonin Glucoside being a high value medicinal phytochemical.

11. Vegetables

- i. Strengthen Punjab State Seed Certification Authority (PSSCA) and horticulture extension umbrella for developing Punjab as tissue culture /aeroponics based "Seed Potato Hub" for national and export market.
- ii. The State Department of Horticulture should be entrusted to closely monitor Punjab's cold stores with regulatory powers/control for their storage status, inflow-outflow details and temperature humidity status to check malpractices.
- iii. Mechanize production (grading, sorting and packing) of vegetables through MPCS.
- iv. Markfed and Punjab Agro (PAIC) should develop processed and frozen products of onion, garlic and other vegetables.

12. Organic Farming:

Organic farming should be promoted and third-party organic certification should be ensured as an effective marketing tool to build confidence and assurance of produce/product quality to the consumers.

13. Water and Energy

- i. With a view to water emergency like situation in Punjab, set a policy target of saving a minimum of 30 per cent (20 BCM) of state's total water demand (66.12 BCM).
- ii. All the long-duration paddy varieties should be completely banned in the state.
- iii. In highly Over-Exploited blocks (blocks with stage of groundwater extraction more than 300%, 250-300% and 200-250%), the area under paddy cultivation needs to be brought down in a phased manner. The option for completely banning paddy in one or two blocks needs to be explored. The cultivated area in these blocks should be put under alternate less water consuming crops such as cotton, maize, sugarcane, vegetables, and orchards to save them from turning barren soon. The farmers in these designated blocks should be compensated in such a way that they may get higher returns from alternative crops than that of paddy cultivation. The blocks with stage of groundwater extraction falling between 100-200 per cent may be undertaken in subsequent phases.

- iv. Improved paddy quality and yield with 30-40% less water is possible through water-saving technologies such as alternate wetting and drying without puddling, drip irrigation systems and others. Incentivize these new technologies and agricultural research and extension should be laid on these areas. However, traditional puddling should be discouraged and banned in phased manner.
 - v. Implement a phased plan for the installation of micro-irrigation systems to reduce underground water extraction and save 30-35 per cent power subsidy bill. The first target area can be under fruits followed by vegetables, flowers, sugarcane, and cotton. This will cover roughly 20 per cent of the total cultivated area under micro-irrigation. In addition, sugarcane and spring crops such as spring maize and sunflower should be mandatorily brought under drip irrigation systems. To achieve this, there is a need to have a special purpose vehicle for micro irrigation in the state.
 - vi. Assess and manage the surface water escape from Ujh river (tributary of Ravi) from the Dharamkot Discharge Station (D/s Madhopur) and excess flows from Beas river for diversion through central Punjab for irrigation use and recharge to groundwater.
- 14. Grid Connected Solar Panels:** Punjab State Power Corporation Limited (PSPCL) should supplement the AP tubewells with grid connected solar panels. An assured power supply of electricity hours as per expert advice should be ensured according to the cropping pattern of the region/feeder. This will be beneficial for the farmers and the state.
- 15. *Pani Bachao Paisa Kamao* Scheme:** The *Pani Bachao Paisa Kamao* (PBPK) scheme should be effectively advocated and implemented through cash incentives to the farmers for saving water and electricity.
- 16. Canal Irrigation:** The canal irrigation system in Punjab is in dire need of repair and modernization. This includes reviving the distribution networks and dealing with encroachments through underground pipes. Detailed plans should be made to restore obsolete channels. Water user associations should be reactivated, and advanced technologies should be used for canal maintenance.
- 17. Cooperatives**
- i. Public sector organisations such as Punjab Agro, Markfed, Milkfed, and Sugarfed should be headed by relevant domain experts. These organisations should work according to their primary missions, which are to support farmers in value addition, processing, and marketing.
 - ii. Government should ensure a regular and timely supply of all agriculture inputs including seeds, fertilizers, bio-fertilizers and pesticides to cooperative societies on priority.
 - iii. Punjab Agro Industries Corporation (PAIC) should strengthen the processing plants

established at Abohar and Hoshiarpur with the latest technologies to maximize the processing capacity of Punjab's horticultural produce.

- iv. Government should set up silo/multi-chamber cold storage facilities at the Multi-Purpose Cooperative Societies (MPCS), Progressive Farmers' Societies (PFS), and Horticulture Estates. Punjab Mandi Board should arrange cold storage facilities on rent at distant domestic markets.
- v. Promote rural juice vends to supply fresh fruit juices, sugarcane juice, and vegetable soups as a nutritious option for making rural Punjab healthier and for providing ethical and productive employment opportunities for rural youth.
- vi. Functioning of the society should be made democratic and transparent. The appointment of secretaries of MPCS with improved qualification should be made by the department of cooperation and the transfer policy of the secretary must be put in place.
- vii. Each cooperative society should be allocated atleast one acre of suitable *Panchayati*/ government land in order to make societies able to avail benefits of various central schemes such as setting up cold stores, petrol pumps, warehousing, etc.
- viii. One-time debt settlement scheme should be initiated through Punjab State Cooperative Agricultural Development Bank (PADB) and other cooperative banks to provide relief to farmers.

18. Farm Workers

- i. Farm workers should be registered by the government so that they can avail benefits of various government schemes.
- ii. The mandatory work of 100 days under the MGNREGA scheme should be increased from 100 days to 200 days. The state government should hold dialogue with union government for this matter.
- iii. Provide compensation of Rs. 10 lakhs to the suicide victim families of farmers, farm workers/rural artisans.
- iv. Free healthcare should be provided to farmers, farm workers/rural artisans.
- v. One-third of the Panchayati land and other common lands should be leased out to farm workers. This land should be meant for the Integrated Farming System (IFS) under cooperative farming.
- vi. A one-time debt settlement scheme should be devised for farm workers.

19. Agriculture Research and Extensions

- i. Adequate financial support should be given to institutions like PAU, GADVASU and PSFC for agricultural research, education and policy making.

- ii. To strengthen the agricultural extension system, it's crucial to fill all vacant positions of extension experts and supporting staff in all the line departments.
- iii. All major crops/alternatives of diversification should have a nominated Nodal Team as regional professional committee in their respective Natural Growing Areas.
- iv. A unified web portal/Kisan Portal should be developed for all the agriculture related schemes of the state and central government.

20. Quality Control

- i. It is essential to bolster the accredited laboratory at PAU's Horticultural Post-harvest Technology Centre (PHPTC) in Ludhiana, broadening its testing capabilities. Furthermore, establish three regional laboratories for milk, milk products, and meat quality assurance in the state.
- ii. The quick detection digital devices for "on-the-spot testing" should be developed and made available to the public in order to test the quality of milk and other food products.
- iii. The Government should make it mandatory for farmers to receive receipts while buying seeds, fertilizers, pesticides, bio-products and other inputs so that stringent action can be taken against the guilty, in case of adulterated/spurious inputs.

21. Land

- i. The land tenancy laws need updating. The informal lease (*theka*) system creates unregistered tenants, depriving them of benefits like crop insurance and access to MPCS.
- ii. Sale-purchase and transfer agreements should be recorded in simple language and government employees should replace the *Vasika Navees* (document writers) and mediators in the tehsil complexes.
- iii. Timelines and rates of all services should be displayed outside the office and proper receipt should be issued to the clients.
- iv. Land ownership passbooks linked with Aadhaar cards should be issued to land owners.

22. Livestock

- i. Livestock sector in Punjab should be declared as special sector with separate policies regarding change of land use (CLU), bank finance, electricity tariffs, pollution control certification, etc. for facilitating ease of doing business.
- ii. A credible database of the livestock farmers needs to be generated in the state for formulating effective action plans and welfare activities.
- iii. The state should strive for becoming breeder state by breed development, disease control, regulation of semen sale and semen banks.

23. Farm Mechanization

- i. Set up separate Directorate of Agriculture Engineering in the state for implementations of mechanization, post-harvest processing, soil water/irrigations, and renewable energy schemes.
- ii. Build Punjab as a machinery hub for innovative manufacturers as a hub of farm machinery, for domestic and global market.

24. Women in Agriculture

- i. Credit and training facilities for subsidiary occupations should made accessible for women through MPCS.
- ii. Better and mandatory education should be given to girls for empowerment and development of women.
- iii. The ownership land rights for women should be looked upon. Priority should be given to the landless women engaged in small-scale agricultural activities while leasing out village common land.

25. Pension Plan: Farm workers and small farmers (with up to 5 acres land) should be given pension coverage upon reaching age of 60.

26. Credit and Debt

- i. A single-window system should be made available for the credit system.
- ii. Small farmers are under severe economic squeez, therefore, special debt waiver scheme should be crafted for small & marginal farmers (who own upto five acres of land).
- iii. A scheme for Debt Swapping of Borrowers should be initiated for debt settlement.
- iv. For better functioning of non-institutional credit system, registration of money lenders should be done.

27. MSP: A legal guarantee of procurement of MSP crops cultivated within the state should be established. Additionally, the public distribution system should be strengthened. The Punjab government should hold a dialogue with the Union government for this matter.

28. Insurance: Design Punjab's own crop insurance scheme by generating crop insurance fund to mitigate crop loss. Similarly, a scheme for livestock insurance should be initiated through the Milkfed and Dairy Development Department.

28. Mission Mode for Regional Development: A mission mode strategy should be adopted for the development of *Kandi* area, bet area, border area and for water logged area. Under this mission, Departments of Agriculture, Horticulture, and Forestry will jointly work for addressing the specific issues of these regions.

ANNEXURES

Annexure I

Policy Suggestions given by Farmers, Individuals, Groups, Associations, Departments and Institutes

Sr. No	Suggestions received through	Number of Suggestions
1	First <i>Kisan Milni</i> at PAU Ludhiana	60000
2	Second <i>Kisan Milni</i> at PAU Ludhiana	20000
3	Email, landline, Whats-App, letters, Messages	15000
4	Individuals & others NRI farmers	4000
5	Farmers Union, Groups, Organizations, Associations	3000
6	Departments, Board, Corporations, Societies & Institutes	800
	Total Suggestions	102800

Total 102800 policy suggestions given by farmers, individuals, groups, associations, organizations, departments and institutes.

Annexure II**Details of field visits and discussions with Farmers' Groups, Scientists, Experts by the Committee**

Date	Details of Discussion	Participants
15-01-2023	Discussion with scientists and farmers at Bakersfield, California, USA	80
16-01-2023	Discussion with Dr G S Khush, World Food Prize Winner, California, USA	07
17-01-2023	Discussion with scientists at University of California, Fresno, California and farmers at Daleno, California, USA	30
23-01-2023	Discussion with committee members of policy (Online)	13
24-01-2023	Discussions with Farmers' groups, Societies, FPO at PAU Kisan Club, Ludhiana	126
28-01-2023	Discussion with group of agricultural scientists in USA and Canada (Online)	35
09-02-2023	Discussion with committee members/officials at Punjab Bhawan, Chandigarh	26
20-02-2023	Discussion with committee members/officials at Commission's office	18
10-02-2023	Field visit at Golden Natural Farm, Village Ajowal, Hoshiarpur	38
12-02-2023	First <i>Sarkar-Kisan Milni</i> at PAU in which 15,000 farmers participated and suggestions given by 6000 farmers	15000
27-02-2023	Discussion with Bhartiya Kisan Union, Ugrahan and Agriculture Minister, at Punjab Bhawan, Chandigarh	36
28-02-2023	Field visits at Good Grow Farm Phagwara, CoE for Fruits at Khanora and Citrus Estate at Bhunga, Hariana in Hoshiarpur	42
01-03-2023	Field visits and discussions with farmers' groups in Gurdaspur Mustard oil production unit, Mirzewalla, <ul style="list-style-type: none"> • Turmeric & millets processing unit by Gurmukh Singh, Rangeenpur • Discussion with Young Innovative Farmers Groups/ FPO, Gurdaspur • Jaggery/Shakkar unit & sugarcane juice processing units by Young Innovative Farmers' Group (YIFG) 	312
01-03-2023	Visit and Discussion at CoE for Potato, Dhogri, Jalandhar and CoE for Vegetables, at Kartarpur (Jalandhar)	28
03-03-2023	Discussion with Progressive Farmers and Natural Farming Association (NFA) in the Commission's office	16
06-03-2023	Meeting and Discussion with scientists of PAU, US based NGO-PAGRI and Retired Agriculture/Horticulture Technocrats Association (RATA), at PAU, Ludhiana	20

06-03-2023	Visit at the Punjab Horticultural Post-Harvest Technology Centre, Ludhiana and their lab facility for testing heavy metals in food/water	27
08-03-2023	<ul style="list-style-type: none"> • Field visit at Sidhu Organic Farm, Moosa, Mansa • Visit to Model Farm, Dullowal, Mansa • Visit to Jot Nursery Farm, Gharangana, Mansa 	52
09-03-2023	Discussion with scientists and farmers at GADVASU, Ludhiana	24
16-03-2023	Visit at FPO of Fruits & Vegetables, Ghagga, Patiala and Farm 77 Nursery Unit, Sangrur and Beauscape Farms at Langrian, Sangrur	85
18-03-2023	Discussion with eminent scientists Dr. G. S. Khush (Rice Breeder) and Dr. B. S. Gill (Wheat Breeder) and PAU scientists at PAU, Ludhiana	28
19-03-2023	Discussion on IFS model at PAU and visit at Good Grow Farm Phagwara	88
03-04-2023	Field visit to Barnala and Mansa <ul style="list-style-type: none"> • Barnala Natural Farmers' Association, Wahegurupura, Barnala • Chohan Kudrati Kheti Farm, Mansa • Farmer Produce Processing and Marketing Society (FARO Group), Burj Dhilwan, Mansa 	76
03-04-2023	Visit to CoE (Brackish Water) Bathinda and Jyani Farm, Fazilka	27
04-04-2023	Field visit at Khunjan Society, Sohangarh Natural Farm (Ferozepur) and Waheguru Dairy Farm, Baghapurana	125
11-05-2023	Second <i>Sarkar-Kisan Milni</i> at PAU in which more than 10,000 farmers participated	10000
12-05-2023	NRI Farmer Conclave and <i>Kissan Goshti</i> / Discussion with Farmers at Shergill Farm Hoshiarpur	74
09-06-2023	Discussion with Food & Drugs Administration, Punjab at Kharar, Mohali	18
	Discussion with scientists and experts at IIT, Rupnagar	22
10-06-2023	Brain-storming session with national scientists on dairy economics at GADVASU, Ludhiana	36
14-06-2023	Discussion with different HoDs at PAU, Ludhiana	25
04-07-2023	Discussion with Progressive Farmers of Citrus Estates, Hoshiarpur	20
18-07-2023	Visits to Agro-processing Unit at CIPHET, PHPTC, GADVASU and PAU, Ludhiana	95

The committee has made field visits and discussed various policy issues with total 26649 participants including farmers' groups, scientists, experts.

Annexure III**Details of Discussions/Meetings with different Departments, Boards, Corporations, Research Institutes and Commissions by the Committee**

Date	Departments	Details of Discussion	No. of Participants
20-04-2023	1. Department of Agriculture & Farmers' Welfare, Punjab 2. PUNSEED 3. Cane Commissioner 4. Punjab State Seed Certification Authority 5. PAU, Ludhiana 6. GADVASU, Ludhiana	Agriculture sector	36
21-04-2023	1. Punjab Agro Industry 2. Punjab Agri Export Corporation Limited 3. Department of Food Processing 4. Markfed 5. PAU, Ludhiana	Processing of agriculture produces & Value Addition	42
24-04-2023	1. Department of Animal Husbandry 2. Dairy Development Board 3. Department of Fisheries 4. GADVASU, Ludhiana 5. Milkfed 6. Farmers' Associations (Dairy, Poultry, Piggyery, Fishery)	Livestock sector	55
25-04-2023	1. Punjab Mandi Board 2. Punjab State Ware-House Corporation 3. Department of Colonization 4. PAU, Ludhiana	Agricultural marketing	34
28-04-2023	1. Department of Cooperation 2. Sugarcane 3. Department of Rural Development & Panchayat 4. PAU, Ludhiana	Cooperatives & rural development	37
02-05-2023	1. Department of Horticulture, Punjab 2. Horticulture Estates 3. Potato & Bee Keeping Associations 4. Horticulture Farmers	Crop diversification with Horticulture	60
04-05-2023	1. Department of Soil & Water Conservation 2. Punjab Energy Development Authority 3. Department of Forests & Wildlife Preservation, Punjab 4. GENCO	Natural resources, Climate change & Energy	28

05-05-2023	1. Punjab State Power Corporation Limited 2. PAU, Ludhiana	Power Sector	15
15-05-2023	1. Department of Water Resources 2. Punjab Water Resources Management and Development Corporation 3. Punjab Remote Sensing Centre 4. PAU, Ludhiana	Irrigation & water resources	32
16-05-2023	1. NRI farmers & Scientists 2. Progressive farmers & Entrepreneurs	Suggestions on Agri Policy	32
22-05-2023	1. Regional Research Stations, Ballowal Saunkrhi, SBS Nagar (by PAU, Ludhiana) 2. Department of Agronomy PAU, Ludhiana 3. University Institute of Pharma Science, Chandigarh University 4. National Medicinal Plant Board, Ministry of Ayush, Govt. of India	Medicinal & aromatic plants	18
23-05-2023	1. Kheti Virasat Mission, 2. Dr. Khadar Vali 3. Organic farmers 4. Natural farmers 5. PAU Experts of School of Organic Farming	Organic farming	40
22-08-2023	Vidhan Sabha Committee on Agriculture	Agri Policy	25
23-08-2023	All Chairmen of Boards & Corporations	Agri Policy	32
06-09-2023	Department of Water Resources & PWRDC	Groundwater & Canal Irrigation	20

During the discussions/meetings, total 506 participants of different Departments, Boards, Corporations, Research Institutes and Commissions discussed various policy issues with the Committee.

Annexure IV**A. Market fee and RDF of different Agricultural Commodities (2023-24)**

Sr. No	Commodity name	Market Fees (MDF) levied	RDF
1	Wheat, Barley (Jau), Great Millat (Jowar), Spiked Millet (Bajra), Oats (javi), Paddy (Dhan), Rice (Chawal) and any broken part of Rice	3%	3%
2	Basmati	1%	1%
3	Maize (Makki), Maize Cob	1%	2%
4	Timber and Firewood	1%	1%
5	Fruits and Vegetables* (in 2020)	1%	1%
6	Potato**	0.25%	0.25%
7	Cotton	0.50%	0.50%
8	Pulse and Oil Seed	0%	0%
9	Goat Hair, Camel Hair	0%	0%
10	Gur, Shakkar, Khandsari, Haldi, Mehndi, Fenugreek (Methi)	0%	0%
11	Flowers	0%	0%
12	Egg, Honey, Fish and Meat	0%	0%

*earlier it was 3%

**earlier it was 2%

B. Changes in the Rates of Commission Paid to Commission Agents in Punjab

Period		Commission Rates (%)	Crops	Basis
From	To			
26-05-1961	10-04-1990	1.5	Cereals : Wheat, Barley (Jau), Great Millet (Jowar), Spiked Millet (Bajra), Paddy (Dhan), Rice (Chawal)	ad valorem
11-04-1990	21-05-1998	2.0		
22-05-1998	01-01-2024	2.5		
08-01-2020	01-01-2024	5.0	Fruits and vegetables	ad valorem
		1.5	Chillies (dry and green)	
		3.0	Dry and green fodder	
		4.0	Timber and Firewood	

Source: Punjab Mandi Board

**C. Commission Charged by the Commission Agents on Wheat, Paddy and Cotton in Punjab
(Rs. Crores)**

Year	Wheat		Paddy		Cotton	
	Market fee	Commission to Commission Agent	Market fee	Commission to Commission Agent	Market fee	Commission to Commission Agent
1985-86	20.69	15.56	20.83	15.66	5.64	4.24
1989-90	26.98	26.98	33.29	33.29	13.44	13.44
1995-96	53.77	53.77	55.75	55.75	24.13	24.13
1999-2000	87.35	109.19	115.01	143.76	11.79	14.74
2005-06	115.64	144.55	179.47	224.34	35.96	44.95
2009-10	237.65	297.06	344.79	430.99	41.40	51.75
2015-16	298.50	405.38	391.72	366.00	7.42	21.35
2019-20	715.22	633.85	904.38	741.60	19.36	59.10
2022-23	403.62	320	1145.54	937.5	3.57	11.99

Source: Punjab Mandi Board

Annexure V**A. Estimation of Proposed MSP in India, 2020-21 (Rs. per Quintals)**

Crops	Existing MSP	Existing C ₂	MSP as per Swaminathan's Report (GOI 2006)	As per Ramesh Chand Committee Report* (GOI 2015)			% Difference between Proposed MSP (6) and Existing MSP (1)
				C ₂	(4+10%)	(4+50%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Wheat	1,925	1,425	2,138	1,858	2,044	2,787	44.77
Paddy	1,868	1,667	2,501	2,077	2,285	3,116	66.80

Source: Singh, Sukhpal and Bhogal S (2021). MSP in a changing agricultural policy environment.

Economic and Political Weekly 3: 12-15.

*Cost estimation as per field survey of Punjab farmers by authors, 2019–20.

B. MSP of Rabi Crops in Punjab (Rs. per Quintals)

Year/ Crops	1965-66	1970-71	1980-81	1990-91	2000-01	2010-11	2020-21	2023-24
Wheat	54-58.50	76	130	225	610	1170	1975	2125
Barley	-	-	-	-	-	780	1600	1735
Gram	-	-	145	450	1100	2100	5100	5335
Masur	-	-	-	-	-	2250	5100	6000
Mustard	-	-	-	570	1200	1850	4650	5450
Sunflower	-	-	-	600	1170	2350	5885	6760

C. MSP of Kharif Crops in Punjab (Rs. per Quintals)

Year Crops	1965-66	1970-71	1980-81	1990-91	2000-01	2010-11	2020-21	2023-24
Paddy Common	40.50	53.30	105	205	510	1000	1886	2183
Paddy Grade A	-	-	-	215/225	540	1030	1888	2203
Maize	40.25-50	55	105	180	445	880	1850	2090
Moong	-	-	200	480	1200	3170	7196	8558
Cotton medium Staple	40.50	-	304	620	1625	2500	5515	6620
Cotton long Staple	-	-	-	750	1825	3000	5825	7020
Groundnut	-	-	206	580	1220	2300	5275	6377

Source: Ministry of Agriculture and Farmers' Welfare, GoI

Annexure VI

A. Area, Yield and Production of different *Rabi* crops in Punjab

Crop / Year		Wheat	Barley	Potato	Gram	Mustard	Masar/ Lentil	Sugar-cane	Linseed	Sun-flower
1950-1951	A	1137	100	3	851	89	21	91	4	-
	Y	901	650	7333	600	494	558	25419	350	-
	P	1024	65	22	511	44	12	2313	1.4	-
1960-1961	A	1400	66	9	838	106	30	133	4	-
	Y	1244	798	14805	813	509	574	32889	586	-
	P	1742	52	133	681	54	17	4374	1.8	-
1970-1971	A	2299	57	17	358	103	13.3	128	-	-
	Y	2237	1022	12752	797	555	399	37030	-	-
	P	5145	57	217	284	57	5.3	4740	-	-
1980-1981	A	2812	65	40	258	146	19.8	71	2	-
	Y	2730	1640	19287	582	528	445	49739	421	-
	P	7677	107	771	150	77	8.8	3531	0.8	-
1990-1991	A	3273	36	23	60.3	69	9.3	101	-	14
	Y	3715	2759	19863	743	1014	686	55368	-	1610
	P	12159	99	457	44.8	70	6.4	5592	-	22
2000-2001	A	3408	32	60	7.7	53	4.7	121	0.6	9.7
	Y	4563	3393	19563	953	1213	660	58092	1000	1154
	P	15551	109	1174	7.3	64	3.1	7029	0.6	11.2
2010-2011	A	3510	12	64.4	2.8	31	1.2	70	-	14.6
	Y	4693	3652	24988	1291	1313	667	70065	-	1620
	P	16472	44	2088	3.6	41	0.8	4905	-	14.7
2020-2021	A	3530	5.7	107	1.8	32.1	0.6	89.4	-	2.5
	Y	4868	3767	27500	1321	1591	598	83835	-	1794
	P	17185	21.5	2949	2.4	51.0	0.4	7495	-	4.5
2022-2023	A	3517.5	5.5	114.9	1.7	45	0.5	90.3	-	1.5
	Y	4710	3840	27645	1060	1623	910	83123	-	1987
	P	16567.4	21.1	31760	1.8	73	0.5	7506	-	3.0

(A) Area (000 ha), (Y) Yield (kg/ha) and (P) Production (000 tonnes)

Tobacco 1970-71 A 123 Y 2616 P 200 1980-81 A 70 Y 1671 P 117

Source: Department of Agriculture and Farmers' Welfare.

B. Area, Yield and Production of different *Kharif* crops in Punjab

Crop / Year		Paddy	Maize	Bajra	Cotton	Moong	Ground-nut	Mash	Til	Basmati	Arhar	Jowar
1950-1951	A	120	252	217	225	17	38	51	24	-	-	8
	Y	1331	565	382	203	352	658	332	233	-	-	250
	P	160	142	83	269	6	25	17	6	-	-	2
1960-1961	A	227	327	123	446	6	67	19	8	-	-	-
	Y	1553	1135	471	269	310	925	363	346	-	-	-
	P	354	371	58	705	2	62	7	3	-	-	-
1970-1971	A	390	555	207	397	6.9	174	25.9	14.6	-	-	5
	Y	2774	1555	1176	371	565	970	456	390	-	-	550
	P	1082	861	243	866	3.9	169	11.8	5.7	-	-	2.8
1980-1981	A	1183	382	69	648	15.1	83	21.5	16.9	-	21.3	1
	Y	4099	1602	1244	309	735	1249	400	314	-	1056	739
	P	4850	612	86	1178	11.1	104	8.6	5.1	-	22.5	0.7
1990-1991	A	2015	188	12	701	50.3	11	8.4	18.2	-	14.5	-
	Y	4833	1784	1090	463	748	818	437	372	-	876	-
	P	9759	335	13	1909	37.6	9	3.7	6.8	-	12.7	-
2000-2001	A	2612	165	6	474	29.5	4	3.5	19.2	104	8.7	-
	Y	5259	2793	842	430	624	879	486	497	2328	874	-
	P	13736	461	5	1199	18.4	4	1.7	9.5	242	7.6	-
2010-2011	A	2830	134	3	484	8.5	2.2	2.9	6.7	448	4.4	-
	Y	5713	3707	900	641	808	1825	578	385	3660	932	-
	P	16168	497	3	1825	6.9	4	1.7	2.6	1640	4.1	-
2020-2021	A	3149	108.1	0.4	251.7	2.6	1.5	2	2.5	406	1.8	-
	Y	6631	3667	640	691	960	1980	614	384	4381	1167	-
	P	20882	396.4	0.3	1023	2.5	3	1.2	1.0	1780	2.1	-
2022-2023	A	3168	93.3	0.6	248.9	3.8	1.7	1.3	2.1	494.5	1.2	-
	Y	6479	4393	690	303	780	1717	418	345	4678	1107	-
	P	20524	409.9	0.4	444	3	2.9	0.5	0.7	2313	1.3	-

(A) Area (000 ha), (Y) Yield (kg/ha) and (P) Production (000 tonnes), for Cotton Production (000 bales)

Summer Moong (2022-23) A-21 Y-1080 P-22.7

Source: Department of Agriculture and Farmers' Welfare.

Annexure VII

Present Status and Proposed Crushing Capacity of Sugar Mills in Punjab

Sr. No.	Type of Sugar Mills	Number of Sugar Mills	Present capacity (TCD)	Capacity to be expanded to (TCD)	Remarks
1	Cooperative Sugar Mills Operational	9	23300	51500	Needs to be strengthened
2	Cooperative Sugar Mills (Zira, Rakhra, Sheron) Non-operational	3	4500	15000	Needs to be revived
3	Proposed New Cooperative Sugar Complex in Sangrur District	1	0	7000	Proposed to be operational in 2024-25
4	Proposed New Cooperative Sugar Complex (5-year Plan)	4-5 In their NGA	0	31000	Proposed Plan to be operational from 2025 to 2030
5	Private Sugar Mills Operational	7	35500	35500	-
	TOTAL	20	58800	140000	-

Source: Department of Agriculture and Farmers' Welfare.

Presently, the Cooperative Sugar mills are running for about 100 days per annum, which should be run atleast for 180 day per annum for economic viability.

Annexure VIII**Proposed Budget for Complete Mechanization of Sugarcane Cultivation of Punjab
(Season 2022-23)**

S. No.	Name of implement/machine	Required quantity	Estimated cost per unit (Rs.)	Total value (Rs. In lakhs)
1	Subsoiler	150	20000	30
2	Trencher (Double row)	750	40000	300
3	Trencher (Single row)	500	35000	175
4	Semi-automatic sugarcane planter	200	300000	600
5	Seedling planter	200	400000	800
6	Bud cutter (Mechanical)	200	30000	60
7	Bud cutter (Manual)	400	2000	8
8	Ratoon manager/Stuble shaver	200	75000	150
9	Power weeder (Manual operated engine)	200	150000	300
10	Mini tractor (25-30 HP) & rotavator	200	500000	1000
11	Hoeing rotavator (special for sugarcane)	200	150000	300
12	Discs plough for hoeing	100	20000	20
13	Earthing up discs plough	200	20000	40
14	Tractor-mounted power sprayers	400	100000	400
15	Self-propelled protektor sprayer	25	2000000	500
16	Inter crop sowing drill (Mechanical)	200	40000	80
17	Inter crop sowing drill (Manual)	200	12000	24
18	Plastic pro-trays	200000	20	40
19	Cocopeat (25000 kg for nursery raising)		40	10
20	Sugarcane harvester along with 2 Enfielders	40	12500000	6000
	TOTAL			10837

Source: Data gathered from discussion with relevant domain experts of line departments.

- The proposed budget for complete mechanization of sugarcane cultivation of Punjab is Rs.108.37 crore for the season 2022-23
- The provision of 25% to 60% subsidy on these machinery equipments is already available, which can be availed.

Annexure IX

A. Area, Yield and Production of Fruit Crops in Punjab

Year/ Crops	2013-14			2015-16			2017-18			2019-20			2022-23		
	A	Y	P	A	Y	P	A	Y	P	A	Y	P	A	Y	P
Kinnow	47.1	21607	1017.7	49.4	3103	1140.3	51.6	23396	1208.4	54.2	24500	1329	47.8	26832	12842
Guava	8.2	22032	180.8	8.1	22454	182.3	8.7	22503	195.6	9.6	22575	217.7	12.8	22936	2928
Mango	6.7	15952	107.6	6.7	16830	113.5	6.9	16895	116.5	7.0	16940	118.8	9.0	18283	1645
Pear	2.9	22652	65.6	2.9	22940	66.0	3.2	22995	72.8	3.5	23390	81.9	4.7	23494	1102
Sweet Orange	2.7	8033	21.5	2.7	8238	22.4	3.0	8353	25.1	3.1	8633	26.9	4.0	8800	353.
Litchi	1.8	15153	28.0	2.2	16209	34.9	2.7	16232	44.0	3.1	16385	50.1	3.7	16540	624
Lime Lemon	0.7	7652	5.0	0.8	7701	5.8	1.0	7738	7.6	1.2	7754	9.7	3.1	8055	250
Peach	1.7	17679	30.2	1.8	17763	31.3	1.9	17844	33.9	3.5	23390	81.9	2.7	17919	491
Ber	1.8	16634	30.1	1.7	16740	28.0	1.5	16779	25.4	1.6	16882	27.6	1.6	17594	281
Amla	0.4	13678	5.6	0.5	13745	6.6	0.6	13746	7.7	0.6	14707	8.9	1.0	15546	147
Plum	0.2	17697	3.9	0.2	17816	4.2	0.3	17695	5.1	0.3	17480	5.9	0.6	17732	97
Grapes	0.4	28612	11.8	0.3	28589	8.5	0.3	28672	8.2	0.3	30182	8.5	0.2	309	69
Banana	0.1	57158	9.3	0.1	57375	6.4	0.1	57956	5.2	0.1	56790	5.6	0.1	61018	11759
Others	1.7	13716	24.1	1.7	15036	26.9	1.9	15092	29.0	3.7	12506	46.4	8.3	14931	1236
Total	76.6	20122	1541	79.1	21208	1677	83.6	21331	1784	90.4	21802	1972	99.7	22241	2218

Source: Department of Horticulture, Punjab

(A) Area (000 ha), (Y) Yield (kg/ha) and (P) Production (000 tonnes)

B. Area, Yield and Production of Vegetable Crops in Punjab

Year/ Crops	2013-14			2015-16			2017-18			2019-20			2022-23		
	A	Y	P	A	Y	P	A	Y	P	A	Y	P	A	Y	P
Potato	87.2	25092	2189.2	92.4	25825	2385.3	98.5	26096	2571	106.1	27058	2870	114.9	27645	3175.9
Peas	20.5	10263	210.9	31.3	10324	323.2	37.6	10472	394	43.9	10642	466.8	45.5	10645	483.5
Root Crops	20.5	20530	421.8	22.4	22676	507.4	26.9	22801	613.8	27.6	23850	657.6	35.6	24772	882.9
Cauli flower	12.2	17932	219.2	14.9	18414	273.5	18.2	18558	338.5	22.9	18255	418.7	26.1	19621	512.3
Vine Crops	14.1	15066	212.5	14.4	15851	228.2	16.2	15928	258.6	17.7	16102	285.0	23.5	20140	474.2
Tomato	7.4	24515	181.1	7.7	24851	191.2	9.0	24897	224.3	10.3	25002	256.9	10.7	25944	277.6
Onion	8.3	22272	185.4	8.5	22883	193.7	9.4	22912	214.5	10.3	22880	236.5	10.7	23360	249.4
Chilli	13.7	1726	23.6	15.0	1877	28.2	16.4	1892	31.1	17.6	1931	33.9	10.6	2018	21.4
Garlic	11.8	11145	131.2	12.9	11422	147.5	14.5	13043	189	15.5	11956	185.3	9.1	10941	100.0
Cabbage	5.0	17614	87.2	5.6	18651	104.4	6.2	18465	115.2	6.9	18691	128.7	8.3	16305	135.3
Musk Melon	5.0	17395	86.1	5.1	17814	91.3	5.6	17826	99.1	6.3	18111	114.8	7.3	19500	141.5
Brinjal	3.9	21253	82.0	4.0	21667	86.6	4.8	21712	103.6	5.4	22096	119.7	6.3	25583	160.6
Okra	3.2	10408	33.4	4.1	10424	42.6	4.6	10437	47.6	5.3	10449	55.4	6.3	10412	65.4
Water Melon	1.1	17533	18.41	1.2	17851	22.3	1.4	17834	25.1	1.9	17967	34.5	2.8	18180	51.9
Others	2.6	2511	6.6	4.3	2778	12.1	4.6	2911	13.5	8.2	2993	24.6	2.1	3542	74.8
Total	203.7	19687	4011	229	19798	4549	258.5	19804	5120	289.3	19969	5778	338.8	20089	6807

Source: Department of Horticulture, Punjab

(A) Area (000 ha), (Y) Yield (kg/ha) and (P) Production (000 tonnes)

Annexure X

A. Production of Fodder Crops in Punjab over Time

Years	Rabi		Kharif		Total		Area (000 ha)
	Production (Million tonne)	Yield (Qtl/ha)	Production (Million tonne)	Yield (Qtl/ha)	Production (Million tonne)	Yield (Qtl/ha)	
2000-01	26.53	834.43	18.40	403.51	44.93	580.56	774
2007-08	25.03	774.69	17.16	532.58	42.19	653.81	645
2010-11	25.35	754.56	25.24	495.23	50.59	598.27	846
2014-15	26.61	756.77	26.55	503.77	53.16	605.02	879
2015-16	26.39	741.72	26.74	504.94	53.13	600.11	885
2016-17	28.60	796.16	28.88	539.02	57.48	642.22	895
2017-18	28.69	796.79	27.19	506.47	55.88	623.02	897
2021-22	28.66	796.15	27.39	507.40	56.08	623.20	900

B. Livestock Produce Production in Punjab

Year	Milk Production (Million tonnes)	Meat Production (000 tonnes)	Egg Production (Million number)	Fish Production (000 tonnes)
1970-71	2.0	-	-	-
1980-81	3.5	-	-	3.00
1990-91	5.14	6.12	1928	11.00
2000-01	7.77	5.70	2964	52.00
2010-11	9.42	175.27	3544	97.04
2020-21	13.39	223.74	5661	150.4
2022-23	14.30	252.24	6260	190

C. Livestock Population in Punjab over Time

(millions)

Species	Total Livestock	Total Bovines	Cattle	Buffalo	Goat	Sheep	Pig	Poultry*
1966	7.60	6.15	3.16	2.98	-	-	-	-
1972	8.65	7.19	3.39	3.80	0.80	0.38	0.05	3.02
1977	9.00	7.42	3.31	4.11	0.72	0.49	0.13	5.54
1990	9.68	8.41	2.83	5.58	0.54	0.51	0.10	15.28
1997	9.86	8.81	2.64	6.17	0.41	0.44	0.09	11.46
2003	8.61	8.04	2.04	6.00	0.28	0.22	0.03	10.53
2007	7.33	6.76	1.76	5.00	0.29	0.21	0.03	18.89
2012	8.12	7.59	2.43	5.16	0.33	0.12	0.03	16.79
2019	7.05	6.55	2.53	4.02	0.35	0.08	0.05	17.65

Source: Livestock statistics Handbook, 2022 (GADVASU)

*Poultry is not included in Total Livestock Population

Annexure XI**List of highly over-exploited blocks of Punjab**

Sr. No.	District	Block	Stage of Groundwater Extraction (%)	Status
1	Barnala	Barnala	320	Over-exploited
2	Bathinda	Bhagta Bhai Ka	345	Over-exploited
3	Jalandhar	Jalandhar East	400	Over-exploited
4	Jalandhar	Nakodar	313	Over-exploited
5	Jalandhar	Shahkot	344	Over-exploited
6	Ludhiana	Ludhiana-1	353	Over-exploited
7	Malerkotla	Malerkotla-1	308	Over-exploited
8	Moga	Moga-1	333	Over-exploited
9	Moga	Moga-2	344	Over-exploited
10	Moga	Nihal Singh Wala	331	Over-exploited
11	Sangrur	Bhawanigarh	348	Over-exploited
12	Sangrur	Dhuri	344	Over-exploited
13	Sangrur	Dirba	342	Over-exploited
14	Sangrur	Sangrur	310	Over-exploited
15	Sangrur	Sunam	341	Over-exploited

Source: Groundwater Resources of Punjab State, 2022 and PWRDC

Annexure XII

Manpower Strength in different Departments, Boards/Corporations, Universities/Research Institutes, Punjab

A. Strength in different Departments					
Sr. No.	Name of the Department	Group A Sanctioned posts	Group B Sanctioned posts	Group C Sanctioned posts	Group-D Sanctioned posts
1	Agriculture	2236 (38.82)	428 (44.86)	1736 (47.87)	1747 (62.45)
2	Horticulture	276 (52.54)	20 (0.00)	143 (27.27)	587 (50.60)
3	Soil Conservation	310 (36.13)	193 (37.82)	973 (50.36)	287 (62.37)
4	Water Resources	799 (15.02)	2324 (15.49)	5139 (20.22)	7525 (15.39)
5	Forest	112 (35.71)	266 (39.85)	1593 (23.60)	398 (51.51)
6	Animal Husbandry	1728 (29.17)	182 (32.42)	2509 (34.91)	174 (32.18)
7	Dairy	27 (66.67)	58 (37.93)	174 (55.17)	59 (59.32)
8	Fisheries	6 (33.33)	113 (30.09)	144 (51.17)	244 (65.16)
9	Food Supply	64 (17.19)	639 (29.73)	2079 (27.13)	538 (33.46)
10	Cooperative	45 (31.11)	1160 (43.28)	704 (31.11)	42 (26.19)
B. Strength in different Boards/Corporations					
11	Mandi Board	115 (91.30)	259 (94.98)	436 (91.06)	254 (28.74)
12	Warehouse	8 (12.50)	727 (29.44)	568 (48.24)	886 (75.17)
13	Colonization	4 (50.00)	20 (50.00)	39 (58.97)	19 (73.68)
14	Milkfed	744 (61.69)	372 (47.31)	2919 (62.18)	1106 (0.18)
15	Markfed	171 (43.27)	358 (55.31)	286 (54.55)	1587 (21.11)
16	Sugarfed	54 (70.37)	176 (48.30)	1413 (34.04)	31 (45.16)
17	Punseed	17 (47.06)	34 (91.18)	39 (51.28)	254 (28.74)
C. Strength in Commission/Universities/Research Institute					
18	PSFC, Mohali	8 (87.5)	4 (50.00)	7 (57.14)	6 (50)
19	PAU, Ludhiana	1188 (48.65)	655 (46.41)	1574 (67.09)	1368 (74.49)
20	GADVASU Ludhiana	497 (38.23)	229 (56.71)	603 (68.66)	295 (60.34)
21	Punjab Remote Sensing Centre	18 (11.11)	16 (68.75)	11 (27.27)	7 (14.29)
	Grand Total (A+B+C)	Group A Sanctioned posts 8427 (39.13)	Group B Sanctioned posts 8233 (36.5)	Group C Sanctioned posts 23089 (40.78)	Group D Sanctioned posts 17160 (32.44)

Source: Data gathered from respective departments.

Figures in parentheses are percentage of vacant posts

Annexure XIII**Horticultural Crops: Opportunities and Challenges for Processing and Post-Harvest Handling**

S.N.	Crops	Processed Products	Opportunities	Challenges
1.	Potato	Potato Chips, Flakes, Powder, Frozen Products, Starch	High production of commercial potato varieties in the niche area	Local Market acceptability, processing suitability of varieties and consumer perception. Cluster processing unit in the niche area.
2.	Tomato	Tomato Puree, Paste, Ketchup, Instant soup mixes	Huge demand in domestic, commercial & export markets. Can tackle low price in glut season.	District level incubation facilities and processing units for handling of the produce.
3.	Turmeric	Fresh slices, Turmeric Powder, curcumin	Ancient medicinal crop, high utility at household and commercial level for both colouring and medicinal properties.	
4.	Chilli	Chilli Powder, Paste, Flakes, Chilli sauces Oleoresin	Processing varieties have huge export potential.	Need of cluster processing unit in the niche area.
5.	Methi, Karela, Moringa	Minimally processed and dried vegetables	Easy to store and preserve after drying.	District level incubation facilities and processing units for handling of the produce. Hybrid technologies for drying. Packing and storage facility.
6.	Onion	Onion Flakes, Onion Powder, Paste and Puree, minimally processed onion	Production at marginal farmer level and household consumption	Lack of mechanization, processing infrastructure suitable for local varieties, drying units, and special storage facilities
7.	Garlic	Garlic Paste, Powder and minimally processed garlic	Increasing demand for ready-to-use products both in domestic and commercial level.	

8.	Peas, Sweet Corn, Yellow Carrot Broccoli & Cauliflower	Frozen, Ready to Eat and minimally processed products	Emerging demand in the ready-to-cook/ frozen segment. Suitable agro-climatic conditions.	Processing mechanization & cold chain logistics. Need of cluster processing unit in the niche area.
9.	Pear, Peach, Plum & Litchi	Juice, Concentrate, Candy, Preserve and minimally processed products	Local varieties with export potential.	Need of cluster processing unit in the niche area District level incubation facilities and processing units for handling of the produce. Linkages between cooperative/commercial processing industries.
10.	Guava	Pulp, Juice, Concentrate, Jelly, Jam Candy, Leather and minimally processed products	Varieties with diverse qualities, export potential and productivity	Technologies to minimize the processed product bitterness based on citrus.
11.	All Citrus Fruits & Kinnow	Juices, Blends, Concentrates, Fresh Juice and Lemon Powder	Niche area with consumption in fresh form.	Cluster processing unit in the niche area. District level incubation facilities and processing units for handling of the produce.
12.	Amla	Juice, Candy, Preserve and Powder	Traditionally used in different forms owing to its medicinal properties	

Source: PHPTC, Ludhiana, Department of Food Technology, Department of Processing & Food Engineering, PAU, Ludhiana and CIPHET, Ludhiana

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