Working Group Report on
"Promotion of Peri Urban Agriculture in Haryana"

Haryana Kisan Kalyan Pradhikaran

Government of Haryana

Working Group Report
on
"Promotion of Peri-Urban Agriculture in Haryana"

Dr. J.C.Katyal, Dr. Neelam Patel, Dr. Nita Khanna, Dr. Shashi Kumar Bhatia and Shri S.K. Goel

2023

Submitted to

Haryana Kisan Kalyan Pradhikaran,
Second Floor, Directorate of Agriculture and Farmers Welfare,
Sector-21, Panchkula- 134116

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Abstract : Haryana Kisan Ayog constituted a Working Group (WG) on Promotion of Peri-Urban Agriculture (PUA) in Haryana. Based on the outcome of consultations with stakeholders and experience elsewhere, the WG has suggested a work plan supporting sustainable growth of PUA in all its aspects.

Working Group Report on "Promotion of Peri-Urban Agriculture in Haryana"

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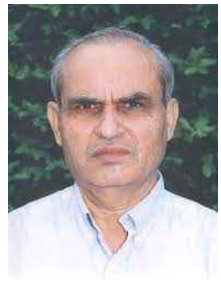

Preface

Haryana Kisan Ayog (HKA) constituted a Working Group (WG) to review "Peri-urban agriculture in Haryana: Current State and Action Plan for Development". In pursuance of this objective, the WG was mandated to recommend an action plan covering research and development for quality and safe fresh produce generation; infrastructure requirements for minimizing waste and maximizing value adding processing for enhancing productivity and profitability; market strengthening which is pro-farmer and pro-consumer; upskilling technology transfer apparatus to infuse science driven farm practices; and to suggest an overarching policy backstopping for sustainable growth of fruits, vegetables, milk, meat and fish in Haryana. The primary focus of the would-be action plan was expectedly on the development of peri-urban agriculture for capturing markets of New Delhi Union Territory Region and making available fresh produce to growing urbanite in Haryana.

HKA constituted WG comprised of Drs. J.C. Katyal, Nita Khanna, S.K. Bhatia, Neelam Patel, and S.K. Goel. Dr. J.C. Katyal acted as Chairman of the WG. Stakeholders' consultation involving farmers, FPOs, Officials of the Horticulture/Agriculture/Fishery/Animal Husbandry Departments, traders, and retailers were organized. The outcome of these deliberations formed the mainstay of the Report while scripting diverse issues constraining modernization of peri-urban cultivation in Haryana. Additionally, relevant review of national and international literature formed the backbone while identifying challenges and suggesting solutions/making recommendations on accelerating the growth of peri-urban agriculture in all its aspects. This wide array of dialogues and studies delayed the submission of Report in time. Also, CORONA pandemic and long lockdowns slowed down further the progress of WG.Inter alia contents of the report outline overall state of, and constraints faced by the development of peri-urban agriculture in Haryana. Included are several recommendations that serve the cause of farmers' income and what consumers pay for the fresh produce. The suggestions made also aligned adequately with the Haryana State Policy on according priority to growth of peri-urban agriculture for diversification, enhancing farmers' income and ecological security.

I, on behalf of the entire WG place on record our indebtedness to HKA for having faith while assigning the task related to growth and development of peri-urban agriculture. Logistic help provided by the HKA office is appreciated with gratitude. As Chairman, WG, I gratefully acknowledge the professional guidance and support I received from the members in completing this task.

J. C. Katyal

J.C. Katyal,
Chairman WG

Dr. Sumita Misra, IAS
Additional Chief Secretary to Government of Haryana
Agriculture and Farmers Welfare Department

Forward

By 2050, a large per cent of the Indian population will be urbanized which will accentuate the demand of good quality agricultural produce from shrinking land, water and other natural resources. The expansion of urban areas leads to conversion of bordering rural areas into peri-urban areas. These peri-urban areas are mostly dependent on urban population for economic prosperity and livelihood. However, these areas are under constant pressure of high population rise, food prices and environmental stresses.

Haryana has large potential for peri-urban agriculture as it has close proximity of National Capital Region and tricities of Chandigarh, Panchkula and Mohali. It gives good opportunity to the farmers of the State for primary processing, branding and marketing for better economic returns. An integrated approach is need of the hour which can address environmental issues, the provision of ecosystem services and the creation of green infrastructure alongside local economic development, and the maintenance of quality of life.

Haryana Kisan Ayog (HKA) constituted a Working Group on "Promotion of Peri-urban agriculture in Haryana" with an objective to identify current status, major bottlenecks that hinder the growth and development of peri-urban agriculture and suggest a policy framework that would facilitate the promotion of peri-urban agriculture in Haryana.

I express my sincere appreciation to Dr J. C. Katyal, Chairman of the Working Group, Members, Stakeholders and officials of Pradhikaran involved in the preparation of this report for bringing out a useful document with valuable recommendations for "Promotion of Peri-Urban Agriculture in Haryana". I hope that the report of the Working Group will more useful for future oriented planning.

Misra

(Dr. Sumita Misra, IAS)

Bhupinder Singh
Chief Executive Officer
Haryana Kisan Kalyan Pradhikaran , Panchkula

Acknowledgments

A comprehensive review of history of Haryana shows that agriculture has always been the mainstay of its economy through the ages. Most of the population of Haryana is dependent on agriculture. It surrounds the national capital on three sides consequently, has large potential for peri-urban agriculture/horticulture. The peri-urban areas (areas adjacent to urban settlements) may give good opportunity to farmers for primary processing, branding and marketing for better economic returns. The role of intermediaries/traders can also be minimized which otherwise gives major setback to farmers for getting desired prices.

The Haryana Kisan Kalyan Pradhikaran (HKKP) brings together the policymakers, researchers and practitioners to develop collaborative solutions on important issues of agriculture and allied sectors. The Pradhikaran constituted a Working Group on Promotion of Peri Urban Agriculture in Haryana with Dr. J. C. Katyal as Chairman, Dr. Neelam Patel, Dr. Nita Khanna, Dr. Shashi Kumar Bhatia and Sh. S. K. Goel as the Members to deliberate on the issue and make recommendations in this regard. The group deserves all the appreciation for their sincere efforts in finalization of this report.

I am confident that this report will enlighten a 'Way Forward' for promotion of peri urban farming in Haryana as the beneficial option. I also believe that this important publication will be of immense use to the planners, administrators, researchers, farmers and other stakeholders. I do hope that the implementation of various recommendations will promote peri urban farming in Haryana in a significant way.

My sincere thanks are to Dr. J. C. Katyal, Chairman, for finalizing the report and for his guidance and support during the functioning of the Working Group. I am also thankful to all the stakeholders and farmers of the Haryana state who put forward their valuable suggestions in preparation of this report.

Bhupinder Singh

HARYANA KISAN AYOG

GOVERNMENT OF HARYANA

Anaj Mandi, Sector-20, Panchkula-134116

OFFICE ORDER

No.HKA/WG-14/2018/7968-79 **Dated: 09.03.2018**

The Chairman, Haryana Kisan Ayog is pleased to constitute the following working group on "**Promotion of Peri-Urban Agriculture in Haryana":**

1. Dr. J.C. Katyal, Former Vice Chancellor, CCSHAU, Hisar — Chairman
2. Dr. Neelam Patel, Principal Scientist & Incharge CPCT, IARI — Member
3. Dr. Nita Khanna, Former, Director of Research, LUVAS, Hisar — Member
4. Dr. Shashi Kumar Bhatia, Former HOD, Horticulture, CCSHAU, Hisar — Member
5. Sh. S.K. Goel, Former GM (Agri. Business), HSAMB — Member

Terms of Reference:

1. To review the current status of Peri-Urban agriculture in the State and suggest measures for further improvement as per demand of the NCR market.
2. To analyze the current support system (schemes, policies, technical and infrastructural support) for Peri-Urban farming from the State/Central Government and propose methods for further improvement of Peri-Urban agriculture in Peri-Urban areas of Haryana.
3. To review the status of research and development for Peri-Urban agriculture and suggest measures to address current gaps as per the specific needs of the farmers.
4. To suggest specific crops suitable for Peri-Urban farming in horticulture, vegetables and floriculture as per the need of the market.
5. To review the status of animal husbandry & dairy, poultry, fisheries for Peri-Urban farming and to suggest measures for further improvement of these sectors in Peri-Urban areas.
6. To assess the present status of training programs and extension facilities for farmers in Peri- Urban agriculture and suggest measures for skill development of rural youth, women and small farmers in Peri-Urban farming.
7. To review the current status of present marketing system, available infrastructure and policies for Peri-Urban agriculture and suggest measures for further improvement in linking farmers to the market.
8. To propose most appropriate strategies for adoption and overall growth of Peri-Urban farming in the State.

Other Terms and Condition (Administrative):

1. On submission of report, the members will be entitles for a lump sum honorarium of Rs. 25000/- each, whereas the Chairman will be paid an honorarium of Rs. 50000/-.
2. Members of working group will be paid travel expenses for attending meetings on actual basis and an honorarium of Rs. 2000/- for each meeting, besides local hospitality.

3. The working group should submit its report preferably in six months from the date of this notification.

Note: From Commission side, Dr. Sandeep Kumar, Research Fellow will be the nodal person providing needed technical backstopping, whereas Dr. R.S. Dalal, Member Secretary with extend required administrative support.

MEMBER SECRETARY
HARYANA KISAN AYOG

Endst No. HKA/WG-14/2018/7968-79
Dated:09.03.2018

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6. Vice-Chancellor, CCSHAU, Hisar
7. The Principal Secretary Govt. of Haryana, Agriculture & Farmers' Welfare Department, Chandigarh.
8. Dr. R.S. Balyan, Member, HKA, PKL
9. Dr. Shyam Bhaskar, Member, HKA, PKL
10. Dr. Sandeep Kumar, Research Fellow, HKA, PKL
11. PS to Chairman, HKA, PKL
12. Accounts Officer, HKA, PKL

MEMBER SECRETARY
HARYANA KISAN AYOG

Contents

PERI-URBAN AGRICULTURE IN HARYANA: CONCEPT, CURRENT STATE, AND ACTION PLAN FOR DEVELOPMENT

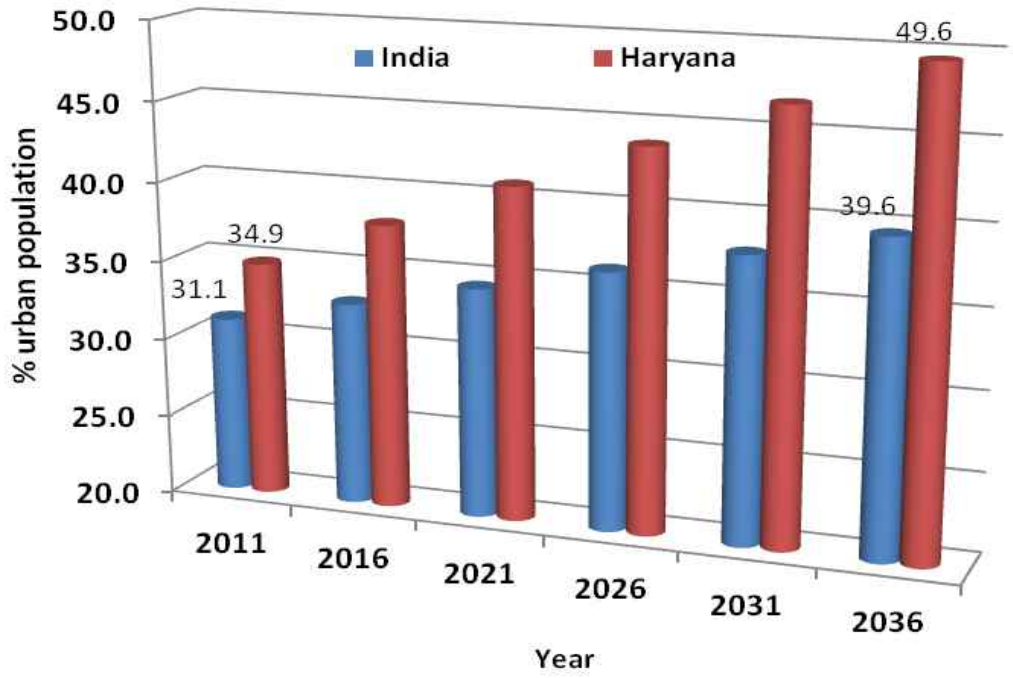
Background

As per 2011 Population Census (National Commission on Population, 2019) almost 70% of India's 1211 million (M) people lived in villages. Against 30% on country basis, the corresponding share of persons living in towns and cities of Haryana was ~35%. This indicates that the segment of urbanite belonging to Haryana was slightly higher than that in the country.

The distribution of population between rural and urban territories is, however, dynamic, and not static. Drift of people, by and large, tends to be more from rural to urban areas. Statistical evidence confirms it. National Commission on Population (2019) has projected, 15 years from now in 2036, 40% of Indians will be living in urban areas, relative flow to cities will be sharper in Haryana. By that point in time, ~50% of its (Haryana) population will get relocated to towns and cities (Fig 1). Also, between 2011 and 2036, Haryana's total population will increase by ~ 9 M, which will coincide with a fall of net sown area/person by ~25% (from current 0.142 ha to 0.104 ha in 2036). Having little possibility of area extensification, feeding the rising population will call for further intensification of agriculture. This is bound to stress more the already stressed land and water resources. More striking is the fact that of the 9 M rise in population, 8 M will occur in urban conglomerates. Greater attraction towards urban territories is and will perhaps continue to be for greater employment opportunities, and for better availability of services/amenities for living. Growing exodus of ruralites is not typical of Haryana/India but is happening across all developing countries of the world. These migrants mostly end-up living on the city fringes as already bulging metropolises can hardly accommodate them in their central core. This is likely to lead to: (i) conversion of bordering rural areas into peri-urban areas, and (ii) rise in demand for good quality agricultural produce. Peri-urban areas (city outskirts or perimeter of an existing town or city), pose special challenges to sustainable food provisioning. Supply-side issues relate to population growth, urbanization, and changing food habits.

While on the demand-side, the issues concern employability, water scarcity, land holding size, quality of tural resources, unstable climatic patterns, and access to technical advice and finance.

Fig 1. Existing and projected (2011-36) urban population (%) of India and Haryana (Data source: National Commission on Population, 2019)



Typically, except staples, peri-urban areas become supply hub of perishable but nutritionally dense-food items like vegetables, fruits, and animal products e.g., fish, milk, meat, and eggs. Driven by shrinking agricultural peri-urban area and rising demand led by burgeoning population, the vacant spaces (roof tops, wasted land spaces) within a town's administrative boundary are likely to be converted into thousands of tiny farms utilizing innovative methods and practices of farming. These miniscule household farms would become important to meet the demand of nearly 29 M persons by 2021; it is also projected that at point in time 7 districts of Haryana will be inhabiting >15 lakhs and 12 districts >10 lakhs people. The areas within or surrounding the towns and cities would have, thus, to be utilized for agriculture or specialty agriculture like olericulture, dairying and poultry. This kind of agriculture is known as urban- or peri-urban agriculture (U&PUA).

Definition of Urban & Peri Urban Agriculture: Urban & Peri Urban Agriculture, as given in Table 1, has been defined/described in various ways. However, for the purpose of this report, the one given by FAO (1999) is used. FAO defines Urban & Peri Urban Agriculture, "Agriculture practices within and around cities which compete for resources (land, water, energy, labor etc.) that could also serve other purposes to satisfy the requirements of urban population." In simple terms, Urban & Peri Urban Agriculture refers to cultivation of crops (mostly fresh produce) and rearing animals (for milk, meat, and eggs) within and on the outskirts of towns and cities. Besides fresh produce, it also includes raising of herbs, medicinal, and ornamental plants for home consumption and market; apparently Urban & Peri Urban Agriculture represents a non-

homogeneous mix of diverse production activities for home, market, and aesthetics; truly an aggregate of multifunctional agricultural activities! Encroachment into agricultural lands, Urban & Peri Urban Agriculture is also a concern for public health and sanitation. In totality, Union Territory of Delhi offers a big and ready market; hence it presents a marketing boon and good source of income for Urban & Peri Urban Agriculture of Haryana. Government promotes Urban & Peri Urban Agriculture as a policy and thence backstops it with necessary finance, marketing infrastructure etc.

Table 1 | Definitions of urban agriculture, urban farming and urban gardening (Source: Sarkar *et al.*, 2019 and other sources).

Definition/Description	**Source**
Urban agriculture has been defined as'...an industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water dispersed throughout the urban and peri-urban area, applying intensive production methods, using and reusing natural resources and urban wastes, to yield a diversity of crops and livestock.	UNDP, 1999
Urban and peri-urban agriculture (UPA) can be defined as the growing of plants and the raising of animals within and around cities. UPA provides food products from different types of crops (grains, root crops, vegetables, mushrooms, fruits), animals (poultry, rabbits, goats, sheep, cattle, pigs, fish, etc.) as well as non-food UPA includes trees managed for producing fruit and fuelwood, as well as tree systems integrated and managed with crops (agroforestry) and small-scale aquaculture.	FAO, 1999
UPA can be defined as the growing, processing and distribution of food and other products through plant cultivation and (seldom) raising livestock in and around cities for feeding local populations	Game & Primus, 2015
Urban agriculture spans all actors, communities, activities, places and economies that focus on biological production in a spatial context which – according to local standards – is categorized as 'urban'. Urban agriculture takes place in intra- and peri-urban areas and one of its key characteristics is that it is more deeply integrated into the urban system compared to other agriculture. Urban agriculture is structurally embedded in the urban fabric; it is integrated into the social and cultural life, economics, and the metabolism of the city.	Vejre *et al.*,2015
Urban agriculture is growing, processing and distribution of food or	Mc. Eldowney,

livestock within and around urban centres with the goal of generating income.	2017
Urban agriculture is an industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water dispersed throughout the urban and peri-urban area, applying intensive production methods, using and reusing natural resources and urban wastes, to yield a diversity of crops and livestock.	Smit, 1996
Urban agriculture is an industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows and raises, processes and distributes a diversity of food and nonfood products, (re-)using largely human and material resources, products and services found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area.	Mougeot, 2001
Urban food gardening encompasses agricultural activities with generally low economic dependence on the material outputs while using food production for achieving other, mostly social, goals.	Simon-Rojo *et al*., 2015
Urban farming refers to intentional business models taking advantage of proximity to the city by offering local or regional agricultural products or services. The importance of the production in proportion to the other societal benefits can vary strongly, both, the production-oriented side or the co-benefit-oriented side may prevail depending on the individual practices of an urban farming operation.	Polling *et al*., 2015

Urban and Peri-Urban Agriculture : Key characteristics :

Urban Agriculture (UA): Urban Agriculture refers to farming that is performed within the city bounds. The general characteristics of UA are: a part-time vocation; undertaken largely to supplement household needs; area for farming is small; constrained by limited availability of space and natural resources; performed in pots (soil culture) or specially ordered vessels with stands (soil-less culture) placed in balconies; normally supports raising of herbal plants like sage, curry leaves, coriander etc.; those of the city dwellers who own houses or have access to roof area undertake roof top farming. Mostly, necessary inputs are bought from local seed shops who advise on their use also. Currently it is common to shop inputs on-line. A step-by-step, easy to use written guide comes along the ordered inputs etc.

Compared to house-hold farming, cultivation of vacant plots or wasted tracts is another source of land for urban farming. These public spaces are cultivated by the Horticulture/Agriculture Department or are leased to private parties for farming. Mostly fruits and vegetables or their nursery plants are raised in the vacant spaces. Urban farming suits very well to specially structured/constructed high-tech high-cost farming containers involving soil-less hydroponics. But these due to high cost are not popular in Haryana/India.

Urban agriculture, however, is not new to Haryana where dairying is part and parcel of life and living. It is mostly in the form of livestock rearing for milk. Also. earlier there used to be slaughterhouse for meat but these stand banned. Dairying in Haryana, no doubt, is largely a rural based enterprise (>80%). However, this vocation in urban areas got impetus after independence in 1947. As part of refugee resettlement plan, government of that era supported those of the migrants having experience in animal husbandry to establish dairying enterprise within the city precincts. With time, however, due to growing social and environmental pressure, city dairies (and slaughterhouses also) were moved away to outskirts of towns and cities (peri-urban areas). Now once again, Haryana Government is planning to allow dairying in urban areas as part of reviving rural white revolution in cities and towns (The Financial Express, 23 October 2017). The scheme is fondly named "PG Hostels for Cattle". Under the Scheme "City people wanting to rear their cattle can use this facility, which will be privately owned. Basically, a dairy farmer will look after the cattle owned by others in his farm for a payment. The cattle owner can get supply of milk from this farm for his personal use. The first such farm will come up in Hisar where land is available" for establishing PG Hostel for Cattle (The Tribune, 09 January 2022). Whether the concept will succeed is a matter of time to see. Nevertheless, it shows government's genuine commitment to promote UA for health and nutrition of city urbanite.

Peri-Urban Agriculture (PUA): Generally, a full-time vocation as there is marketable surplus and better access to land, water, and commercial inputs. However, the land devoted to PUA is always under threat of urbanization. Key characteristics of PUA are:

1. Relates predominantly to flowers and vegetable production, but also includes small-scale dairying, poultry, and fishery. Meat production is another economic activity rising very fast in PUA.
2. PUA farmers have access to requisite resources, essentially land; besides sewerage affluent, they utilize underground water of good quality also.
3. Mostly PUA farmers receive not as much advice from extension people as is extended to those practicing conventional agriculture. Resultantly, they are informed less on new developments. From a technical angle, farmers need to be updated regularly on new farming techniques and are in constant need of necessary inputs and seeds of improved vegetable crop varieties/fruit crop saplings.
4. Information on technologies on sustainable management practices needs dissemination speedily and regularly. Since PUA farmers follow high intensity cropping and end up exhausting the health of soil and quality of water. Advice on neutralizing the after effects of exploitive agriculture is a vital input and, hence, must be extended on a sustained basis. Currently, it is a typical miss. Coincidentally, health of soil and quality of water in PUA areas is in a bad mess.

5. Knowledge and skill-building training on safe produce generation and minimizing pre- and post-harvest losses is necessary.

6. Advice on over-use and misuse of pesticides and other hazardous practices must be emphasized on a regular basis.

7. Since PUA is alleged to produce pollutant laced, contaminated produce and is a cause of environmental degradation, farmers need to be constantly supported on producing and making available high quality and "safe" fruits and vegetables to serve the combined interest of the producer, the consumer, and the environmentalist. Safe produce is one that is free from harmful contaminants and/or has those contaminants within the safe limits prescribed by a creditable agency like WHO. Such foods do not contain any element deleterious to health or disease-causing substances or microorganisms that injure human health.

8. All said and done, currently there are imperfections in market links which reduces profitability of PUA agriculture. Therefore, public support is necessary to help establishing the role of efficiency-enhancing market links in that farmers get maximum for their produce and consumers pay minimum for what they buy. From that angle, PUA represents an 'economic surplus model' in operation. Existing long marketing chain aids and abets defying this goal. Details on marketing methods follow in the next section.

Apart from above listed issues needing attention, production environment of PUA is changing fast and influencing the health of very resources like soil, water, and air on which the sustainable production depends. There are multiple factors contributing to peri-urban environmental degradation, like:

- Relocation of polluting industries from the core of cities to the transitional zones,
- Flows of urban waste from the city's core to the peripheries in the form of landfill sites and waste treatment facilities, and
- Illegal extraction of groundwater by industries and disposal of untreated industrial and domestic waste in open spaces, under the ground and in rivers or other water bodies, thus exposing cultivation of vegetables with polluted waters.

Health hazards from polluted PU ecosystems also extend to those who might consume the produce grown by the local farmers. For example, heavy metals (largely from industries) have been found in PU produce from peri-urban areas, linked to both aerial contamination and uptake through soil contaminated with industrial wastewater. Unimaginably, environmental pollution and safe food production are not considered in pollution monitoring and control. Hence, there is apparent need to expand the scope of testing chemical, biochemical and microbial load of fresh produce and processed produce covered by Food Safety and Standards Act 2006 and Food Safety and Standards Regulations 2011.

Marketing Channels: State and Outlook:

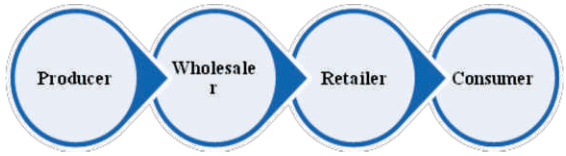
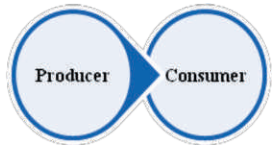
Efficient marketing is necessary to inspire technology-led productivity enhancement, income, and employability of the farmers, customer satisfaction, and overall prosperity of U&PUA growers. In general, marketing of fresh produce traverses a supply chain that involves participation of one or more intermediaries before it reaches the consumers. It means there are several systems of trading fresh produce. In the following paragraphs a brief description is given about the channels (aka 'marketing system') through which the produce passes before it reaches the consumers. Some selected systems of marketing are presented in Figure 2.

Following harvest, a local middleman buys the produce. He collects it from several growers and offers it to area's commission agents/traders. The commission agents are brokers who link local middlemen to prospective buyers – generally bigger traders/wholesalers. They charge a fee both from local middlemen and wholesalers depending on the quantity and value of produce being sold. Once the wholesalers have amassed the produce in big lots, they sell it to local retailers for onward sale to consumers. Since wholesalers run the business from a market yard, there are various charges like market fee, weighing charges etc. which growers incur in the first place (up to wholesalers). And finally, consumers end up paying market fee plus a profit to retailers (beyond wholesalers). Generally, the margin of profit that retailer keep is handsome because they incur transport cost and the wastage (evaporation loss + quality depletion due to repeated customer touch and feel of the produce + leftovers or surplus). As a result of supply chain operations, growers get less value for their produce and consumers pay high price for that. Findings of an RBI commissioned study (https://www.rbi.org.in/scripts/BS_View Bulletin) showed that farmers get between 28% and 33% only what consumers pay. In general, the longer is the supply chain, the lesser is the value farmer gets for the produce and more is the price what consumer pays. Also, as the number of intermediaries increases, so does the marketing related loss of produce during transit and handling. In view of the adverse influence of the widely prevailing mode of marketing systems (involving more than one intermediary; marketing systems 1 through 3 exhibited in Figure 2) on the dynamism and efficiency of the fresh fruits and vegetables trade, both farmers and consumers are seen to gain if each transacts directly with each other. In this system of farmer selling their produce to consumers provides no space to the intermediaries. It is also known as 'direct marketing of produce' and happens in a number of formal and informal ways. Greater details on this system including its working and types are provided in the following paragraphs.

In India, direct marketing channel was evolved during the late 1980s and 1990s *(Singh et.al., 2008)*. This marketing system ensures direct contact of the producers with the consumers without the involvement of middlemen. Following are the advantages of the direct marketing system.

Farmer gets more value

Fig 2. Commnly followed systems/channels for marketing of fruits and vegetables

Marketing system 1	
Marketing system 2	
Marketing system 3	
Marketing system 4	

Consumer pays Less price

I. Allows marketing of small produce enabling even marginal farm-size growers to sell their produce directly to consumers.
II. Farmers have better control on setting the price, particularly if product quality (fresh look, shiny color, right size, and shape…) is more appealing, then they have possibility to get more attractive price.
III. Payment is immediate and farmers prefer that because otherwise their cash receipt is delayed if marketing is through middlemen.
IV. Minimizes transport/transit loss of produce because of shortening of sale chain.
V. Eliminates marketing costs.
VI. Checks margins of the middlemen
VII. Maximizes farmers' profit and reduces price paid by the consumers,
VIII. Ensures availability of fresher produce to consumers.

Without middleman and compared to that with the middlemen the gain to farmers and consumers translates into about 30% higher by the former or direct marketing. In view of the win-win situation both for the farmers and the consumers, direct marketing of fruits and vegetables is being facilitated by many State Governments. Punjab and Haryana were among the pioneers to introduce an innovative direct marketing concept (in late 1980s) called *Apni Mandi.* The system linked vegetable producers and consumers. The farmers bring their produce for sale to a designated place allocated to *Apni Mandi*. From farmers' owned outlets the consumers buy their needs directly. The Agricultural Marketing Committee (APMC) of the area provides space for establishing *Apni Mandi* and organizes necessary facilities like shop counters, water, shed, and weighing balances. *Rythu* Bazar in AP, *Uzhavar Santhai* in TN, *Krushak Bazar* in Orissa, *Shetkari Bazar* in Pune (Maharashtra) – established on the lines of *Apni Mandi* are some examples of effecting direct sale of produce to the perspective buyers. These *Apni Mandis* or *Kisan Mandis* are like the Saturday Farmer Markets of UK and USA.

Apart from *Apni Mandi*, there are several other versions of direct marketing:

- Village *haats* are generally open-air markets where farmers bring produce for selling to local people. These can be periodic (one or two times a week) or are set up as permanent retail shops. *Haats* serve a limited clientele base.
- Roadside markets: These outlets are set up close to farmers' fields on the side of a main road serving large volume of traffic. In this mode, produce has exposure to a larger number of customers who can generally agree to pay good price. Sale of fruits like kinnow/guava is a common sight in Haryana and Punjab.
- Community based marketing: It is the system of direct marketing in which farmers deliver predefined volume/customer/day of produce to the homes of a designated community. Milk is largely marketed through this mode. Generally, each customer pays for the quantity of the produce in advance. With fixed clientele, the grower is assured of regular profit and nearly zero wastage.
- Restaurants/hotels/hostels/supermarkets supported marketing: This is a system of marketing which provides a year-round business for niche crops and varieties grown by a farmer or group of farmers. In this system farmers face pressure to meet quality and quantity standards. But the profits are superior.

Undoubtedly, direct marketing is advantageous both to consumers and producers, but it is not free from some negative outputs attached to it. Typically, the day produce surplus or unsold produce becomes a waste if proper storage facilities are absent. Nearly 30% fresh produce gets wasted due primarily to inefficient marketing system and outdated handling and storage infrastructure (The Hindu dateline 28 May 2021). At farm, long supply chain, during transport, and retail are the main sources causing this colossal loss. There is, hence, a definite need to save the surplus produce from wastage. Safe transport and linking the operation of Apni Mandi with cold storage facility is a key option to minimize the waste. Exposing the produce for sale in lots i.e., dividing the produce in several portions (kept in covered crates/ baskets) and bringing one segment for sale at a time is another option. When one part is nearly sold the other part is offered for sale. Still another route besides selling produce to consumers,

farmers sell it directly in large lots to relatively big buyers like retailers, hoteliers, hospitals, supermarkets, boarding houses etc. *Hadapsar Vegetable Market* near Pune, Maharashtra is a model market for direct sale of large lots of vegetables (Singh *et al.*, 2008). It represents a kind of sub-market, which is located 9 km away from Pune on land owned by the Pune Municipal Corporation. Municipal Corporation charges a nominal fee from farmers who use its space in the market yard. This iconic market operates without commission agents/middlemen and is provided with modern weighing machines. Single lots weighing 100 kg, or 100 numbers are sold to buyers in the presence of a licensed weighman of the Market Committee. The purchaser makes the cash payment directly to the farmer. The Market Committee charges one per cent of the sale proceeds as market fee for the services and facilities provided by the Committee to the farmer sellers and buyers. To minimize avoidable waste, group marketing practices are adopted by the farmers. It means farmers producer organizations/companies undertake marketing on behalf of individual members of the group. As the volume increases so does the negotiability for price. In some instances, farmers' groups buy inputs in bulk. In this way they pay wholesale price which is relatively cheaper than buying in retail. This is another advantage of organizing growers in producer companies or groups not only for selling produce but for buying inputs also.

Making *Apni Mandi* more customer friendly:

One of us (JC Katyal) has seen in Hyderabad, Andhra Pradesh (now Telangana) the setting up of Rythu Bazar in 1999. The concept like that of *Apni Mandi* was to facilitate direct marketing between farmers and consumers. It was a hit since the vegetables and fruits were fresher and relatively cheap compared to that in the conventional market. I am a witness to the success of the idea of farmers selling their fresh produce directly to the customers. However, within one year, the system started deteriorating, mainly because of no enforcement of preventing entry of local traders. It appeared that it was in connivance with the farmers. Thin presence of Municipal Corporation Officials fueled the fire. Prices were not prominently displayed and heckling for price became common. Voicing to these kinds of non-formal non-recorded observations on functioning of *Apni Mandi*, an article published in Hindustan Times, Chandigarh News (date line 11 May 2015), entitled, "HT reader's take: Make *Apni Mandi* customer-friendly" brought to fore similar kind of concerns. The article in HT presents a collection of feedback from customers who regularly visit *Apni Mandis* to buy vegies. Following disillusioning observations (quotes from the article) are made:

i. vendors use every trick to dupe customers of their money; inaccurate weighing and not following rate list are common,
ii. uneven walkway and insufficient space between rows of stalls make movement of shoppers, particularly of senior citizens, difficult,
iii. presence of local traders, besides registered farmers, creates problems like under weighment. Near absence of digital machines, which being compulsory is the norm,
iv. lack of adequate and designated space for parking is a bottleneck to attract big crowd of shoppers; wrong parking is common which is a source creating traffic chaos in the area,

v. upkeep of the area is far from satisfactory as one can see heaps of fresh produce rotting and littering with empty cartons and boxes,

vi. lack of public utilities forces sellers and buyers to ease themselves in the open area presenting unhealthy environs and bad scene,

vii. besides marketing fresh produce, farmers sell groceries, confectionaries, plastic ware etc. defeating the very objective of *Apni Mandi,*

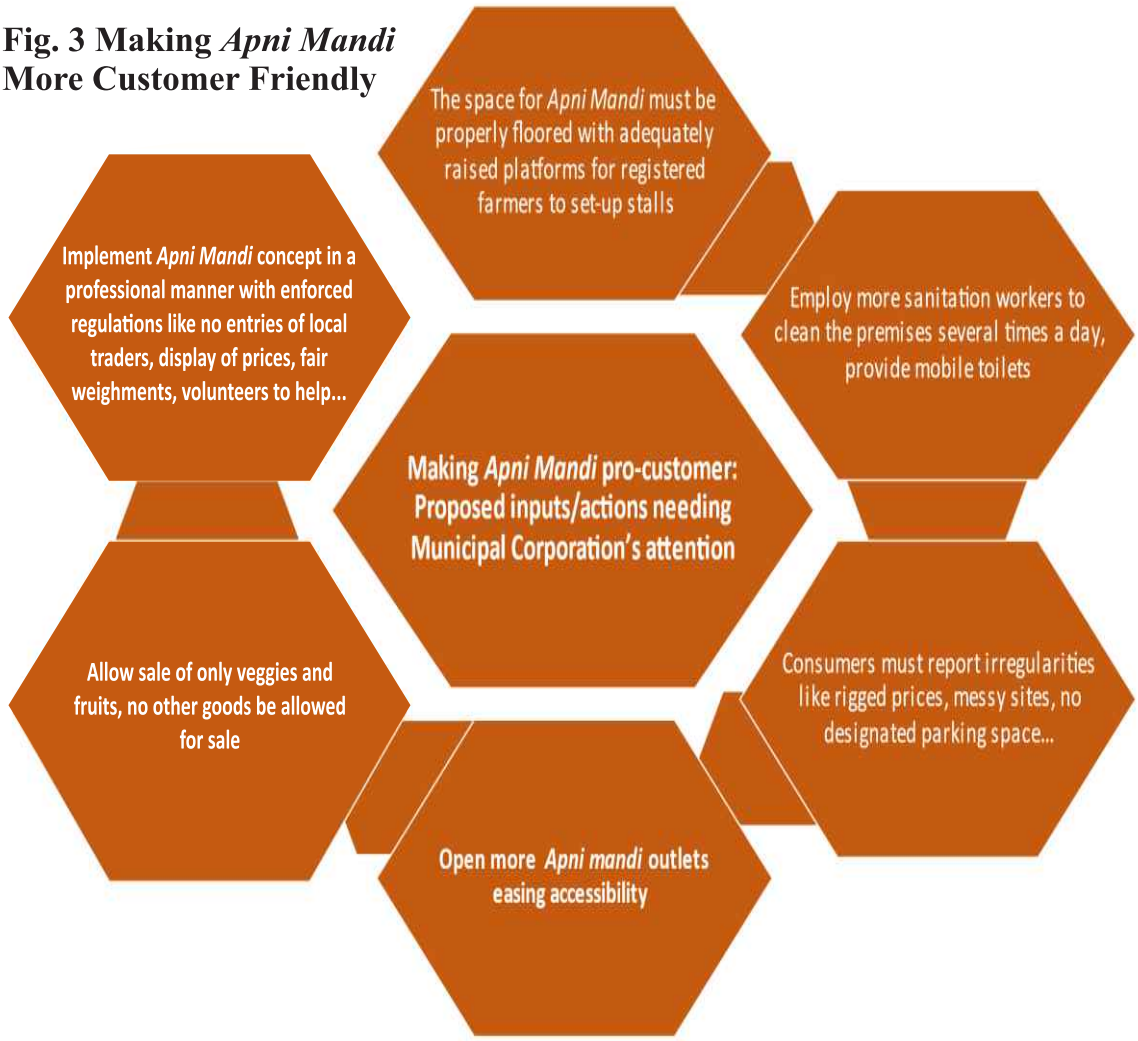
viii. spread wide distribution of *Apni mandis* by establishing one in each sector is need of the hour,

ix. instead of spreading the produce at ground level, allow display and sale from raised platforms or vending carts for ease in shopping and safety of produce during monsoon season, and

x. not just establish but run *Apni Mandis* in a professional manner with regulations specifying dos, dont's, and deterrents.

Based on the above feedback, specific suggestions on improving and strengthening functioning of *Apni Mandis* and make them more customer-friendly are presented in Figure 3. These must be put in action.

Fig. 3 Making *Apni Mandi* More Customer Friendly



State of Peri Urban Agriculture in Haryana

Generally, there exists a stark dearth of information on the nature, extent, and significance of urban and peri-urban agriculture in Haryana. Such data, if generated, would be immensely useful to support constructive dialogue among researchers, extension functionaries, traders, and farmers for evolving a development strategy. Typically, dialogue with primary stakeholders (farmers) will help understanding their constraints and outlining solutions while to script a mutually agreed upon plan of action to resolve them. According to Te Lintelo *et al*.,(2001), there is very little published empirical data, and it is challenging to piece together information on rapidly changing face of peri-urban crop distribution, good agricultural practices, and environmentally safe production techniques. Considering non-availability of market intelligence statistics, it becomes more complex to fix goal posts of PUA planning and growth. This ignorance leads to foresee demand for a particular food or information on consumer preference. In fact, market demand changes fast because of exploding online availability of material on nutrition and health literacy. Still more daunting it is to predict sustainable and stabilized market prices in the face of oscillating production patterns driven by ongoing climate change leading to unpredictable and uncertain weather forecasts.

Nevertheless, whatever empirical data are available, Te Lintelo *et al*., (2001) informed that a high proportion of the fresh and perishable produce is grown in peri-urban areas adjacent to the urban core. Crops are produced largely by smallholder farmers and marketed through conventional channels. Livestock keeping for meat production and rearing fish to satisfy growing urban needs for non-veg foods and milk, respectively are other activities taking place across PU areas.

Haryana has made great strides in fruit and vegetable production (Fig 4); a 51- and 50-folds increase, respectively in fruits and vegetables production since the formation of the State in 1966-67 until 2021-22 (http://hortharyana.gov.in/en). Specifically, cultivation of flowers, mushrooms, and herbs is a fast-moving activity. Compared to fresh produce, production of flowers and mushrooms is a relatively new activity. It began in the year 1990-91 (Fig 5). Remarkably, with respect to mushrooms, having produced ~ 11000 tons in 2021-22 (http://hortharyana.gov.in/en), the State ranks 3rd in the Country. Haryana though is giving push to raising vegetables under protected conditions, currently, only ~ 6, 14, and 32% %, respectively of tomato, capsicum, and cucumber of the total produce are grown under controlled environments. This is a sunshine area as it has potential to aggrandize income, employability, and yield superior quality. Above all, there is presence of a responsive market. Protected cultivation needs far bigger support than it is receiving now.

Fig 4.Growth in fruit and vegetable production ('000' tons) since the formation of Haryana state (Data source: Horticulture Department:http://hortharyana.gov.in/en)

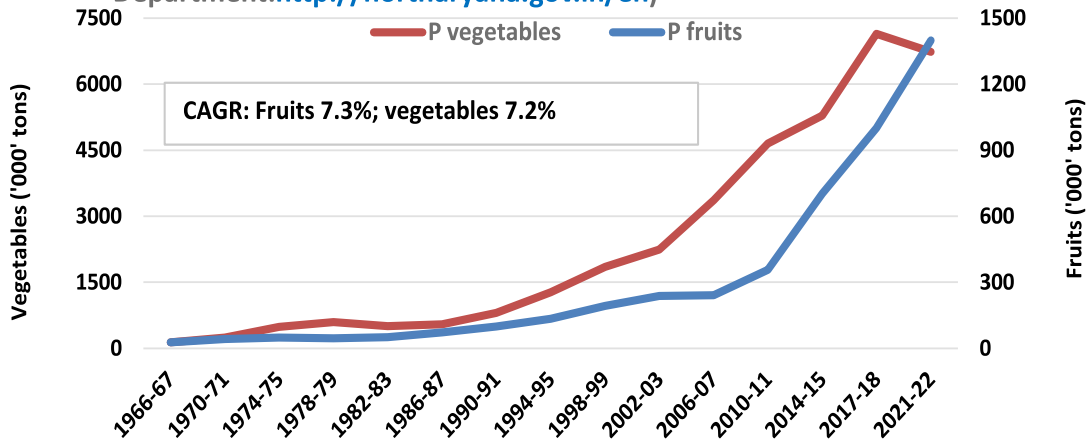
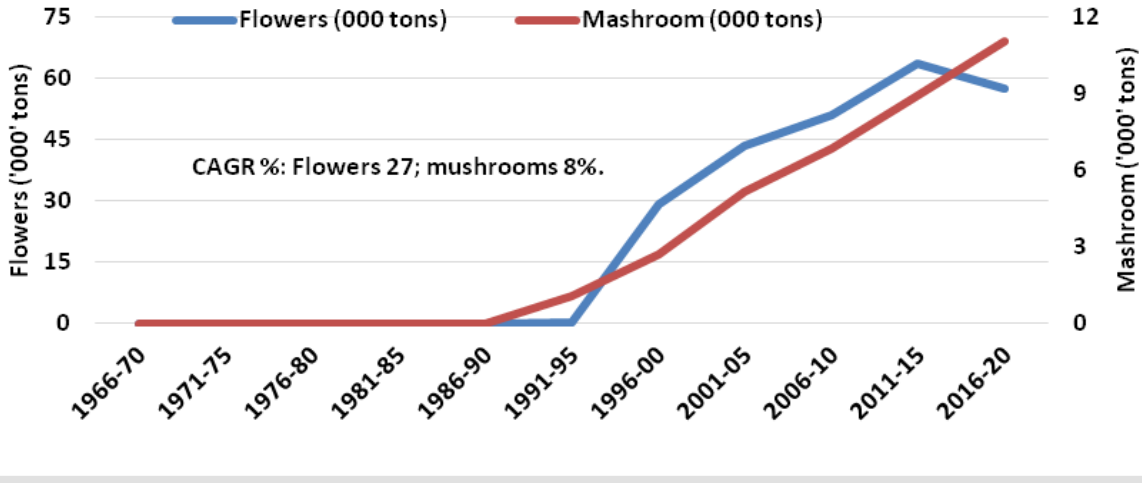


Fig 5. Growth in flowers and mashroom production (mean of 5 years in 000 tons) since formation of Haryana (Data source: Horticulture Department, http://hortharyana.gov.in/en)



Previous studies (Te Lintelo *et al*., 2001) have revealed that despite lack of quantitative information, PUA is found supporting livelihoods of millions by providing a safety net for poor and marginal (<1ha) smallholder (1–2ha) farmers. According to an assessment (both structured and unstructured) pieced together by them demonstrated that of the households surveyed, 70–

90% were involved in agriculture, many of them were part-time operators (earning 25–66 per cent of household income). Food production within the PUA provided households with direct access to nutritious food, which was natively acceptable. And indirectly, the sale of cash crops facilitated the purchase of other household needs (Marshall *et al*., 2002). Livestock keeping, particularly dairy herds, meets an increasing urban demand for milk products (Singh and Rai, 1998). Typically, findings of Te Lintelo *et al*., (2001) focusing on PUA of some villages belonging to Delhi Capital Territories and Faridabad district of Haryana revealed that PUA is an important activity in dissipating seasonal hunger and poverty. The diverse activities – ranging from fresh produce to meat, milk to fish production, covered by it are the source of a very high proportion of perishable produce being supplied to the city core. Haryana has a ready market in Delhi Capital Territory.

PUA represents a multifunctional food production activity. It is both a source and sink of maintaining environmental quality and human health. One example of grave concern is continuous irrigation of crops with untreated sewage water. To a limit soil's inherent ability to filter, sinks influence of harmful contaminants present in sewage water from entering the food chain. However, due to nonstop use, chances of crossing native filterability limit increase. Once that happens, application of sewage affluents then becomes a source of unsafe food for human health. Besides, presence of harmful biochemicals endangers the well-being of microbes. This situation promotes degradation in quality of soil health, water, and air. Indeed, such are the results (Marshall and Randhawa, 2017, and Singh, 2021).

European Union's Common Agricultural Policy (CAP) (Curry *et al*., 2014) considers PUA a reliable source of income and employment. It is also considered to boost local socio-economic development and alleviate poverty with the inclusion of economically low class of men and women. To harness these benefits, PUA must be well integrated into agricultural policies of town planning and development. Provisioning professional wastewater treatment, rail/road transport, cold storage, and processing units must be part of agricultural policies contained in the town planning document. Also, a huge quantity of solid waste is generated during handling and marketing of fresh vegetable produce. In metro cities it creates health and environmental hazards. Safe handling and recycling must be part of the agricultural policy of town planning.

Haryana State Policy on PUA: Recognition of the significance of urban and peri-urban agriculture is gradually entering mainstream debate in Haryana. In pursuance, the State has put together very ambitious plans to develop and nurture it. PUA, of late, is becoming a priority item of planning decisions on agricultural development, even when some planning activity does occur beyond municipal boundaries in city regions, such as Delhi's National Capital Region. Formal recognition of PUA is seen to facilitate access to resources and provisioning of appropriate advice is being reinforced to this otherwise neglected activity. State Department of Horticulture is playing the lead role.

Five years back during Agri-Summit 2017, PUA was a focus area of deliberations. It was pronounced providing an enabling environment to the farmers of the State (with forward and backward linkages) in meeting the demand for fresh vegetables, fruits, flowers, poultry, milk, and milk products in the New Delhi National Capital Region market. Focus on capturing Delhi market is borne out of the fact the proximity as it surrounds by forming its northern, western, and southern borders. Establishing and backstopping forward (marketing support) and backward (preliminary processing) linkages was a highlight of the PUA policy pronouncement. Coincidentally, during Agri-Summit Haryana 2017, Department of Horticulture pitched for the "Crop Cluster Development Program" that intends to collectivize small producer farmers to create on-farm infrastructure (collection and cleaning centers and pack houses) for sorting, grading, packaging, including logistics and market support to develop a coordinated supply chain.

As a follow up to deliberations of Agri-Summit Haryana 2017, in 2018, Haryana Agriculture Department Additional Director Suresh Gehlawat confirmed, "We are focusing on promoting peri-urban farming in the State whereby fresh fruits, vegetables, milk, flowers, poultry, food grains, pulses and other items will be supplied to the target market of Delhi" (PTI, 24 March 2018, Business Standard). The Official revealed this on the sidelines of the 3-day Agri Leadership Summit-2018 Rohtak. He reiterated that Delhi offers a close by market as 4 districts – Gurugram, Panipat, Sonipat and Jhajjar surround it. With that advantage, development of PUA offers excellent potential to raise income, employability, and nutritional security of poor small and marginal farmers. The region also has an untapped scope to develop and produce organic items, which have price advantage and ready market. In pursuance, Rs 4 crore (Rs 40 million) are being sought under the aegis of Rashtriya Krishi Vikas Yojna to set up a pilot project at Faridabad. The goal of the pilot is envisaged evolving a PUA model presenting holistic development of this unique class of agriculture.

To give a decisive push to PUA, the Haryana Fisheries Department has decided "to take on lease land on which the farmers are unable to carry out farming activities due to the water-logging problem. About 16,000 acres of waterlogged land in Jhajjar and Rohtak has been identified for this purpose (The Tribune, 16 April 2017). Former Agriculture and Farmers Welfare Minister, Mr. O.P. Dhankar, gave this information at a meeting of senior officers of the Departments of Fisheries, Irrigation,Development and Panchayats at Chandigarh. It was outlined that during the first phase improvement in fisheries will take place though a to-be-launched pilot project by the Agriculture and Farmers Welfare Department at Jhajjar and Charkhi Dadri. The Department would carry out fish rearing on the land taken on lease. The proposed strategic plan along with that for horticulture and dairying would prove to be a milestone on the road to promoting holistic PUA development.

As stated earlier, population of Haryana in 2020-21 is estimated to touch ~29 million, which is ~4 million more than that in 2011. Twenty-one districts out of 22 inhabit >1 million persons. It means to fill the rising demand of fresh produce, there is an obvious need to expand PU vegetable production. Boost in production will also be necessary to maintain price and keep the entire population nutritionally secure. Hence, along with focusing attention on improving PUA in areas juxtaposed to Delhi National Capital Region, it must also be a priority to strengthen fresh

produce cultivation across all the peri-urban regions of State's big cities and towns. No doubt, choice of crops to be cultivated must be delineated suiting local bio-physical attributes and consumer preferences/market demand. Department of Horticulture Haryana (undated document) has suggested a few crops cluster groups for some districts.

A. Districts and crop-cluster groups to primarily capture customers belonging Chandigarh, Mohali, Panchkula, and some other regions are as follows:

Panchkula	:	Tomato, Ginger, Mushroom and Cucurbits
Ambala	:	Potato, Tomato, Chilies and Onion
Yamuna Nagar	:	Mango, Tomato, Cauliflower, Cabbage, Capsicum, Sapota, Garlic, Turmeric, Cucurbits, Flowers
Kurukshetra	:	Mango, Cauliflower, Potato, Peas, and Celery

B. To capture the markets in New Delhi National Capital Region and its surrounding cities like Gurgaon, Faridabad and Noida, the Department of Horticulture has suggested following districts and crop-clusters:

Sonipat	:	Potato, Carrot, Okra, Marigold, Mushroom, Cabbage, Cauliflower, Capsicum, Sweet Corn, Baby Corn
Faridabad	:	Potato, Cauliflower, Cabbage, Carrot, Cucurbits, Tomato
Mewat	:	Guava, Ber, Onion, Tomato, Carrot, Brinjal, Marigold, Okra, Bottle guard
Gurugram	:	Ber, Peas, Cucurbits, Tomato, Cauliflowers, Cabbage, Brinjal, Onion, Marigold, Chilies
Jhajjar	:	Guava, Kinnow/Kino, Mushroom, Bottle guard, Onion, Carrot, Tomato, Marigold, Cauliflower, Cabbage.

C. It is proposed that guided by the biophysical strengths and market-based criteria adopted for the districts listed above, the Department of Horticulture may expand the crops cluster listing corresponding to the remaining districts. However, the suggested crop-clusters, as done above, must also include the participation of district level farmer producer organizations (FPOs)/federations/companies. This will provide space to include farmers' needs and perceptions while making improvements in designing crop clusters. Joint planning of this kind will find easy acceptance and adoption.

Based on the brief presented above, listing achievements in fresh produce production, irrefutably backstopped by pro-horticulture development policies of the Haryana government, the Department of Horticulture has put the State in a commendable position. Over the last six decades or so since the formation of the State, the vegetable and fruit production has increased a whopping 50 folds (Fig 4). Haryana currently occupies 3rd position in the matter of mushroom production. The question arises whether these accomplishments are adequate to sustainably enhance farmers income by capturing market in the New Delhi National Capital Region and vast number of consumers living in the towns and cities. To answer this question, a set of performance indicators/elements were selected information on which is given in Table 2.

Table 2: Performance indicators/elements of vegetable production: Haryana vis a vis India (Data source: Vanitha *et al.*, 2013, GOI, 2018 and Department of Horticulture, Haryana, 2022)

Indicator/element	Haryana	India
Yield t/ha (2017-18)	16	18
Vegetable availability kg/capita/year (2017-18)	254	133
Cold storage capacity index (capacity/requirement) (2012)	0.49	0.40
Cold storage capacity number (capacity tons)	359 (749830)	8186 (34956991)
Percentage of vegetables stored in cold stores (2017-18)	10	19
Grading facility number (% of total produce)	82 (55%)	956 (1%)
Marketing facility		
Food Parks	2	56
Pack houses (2021)	7	216
Agri-export zones	0	62
Food processing units		
Number	176	4533
Installed capacity (000 tons)	102	26808
Share of protected agriculture in total production (% of total)		
Tomato	6	NA
Capsicum	14	NA
Cucumber	32	NA
All vegetables	0.3	0.7

Performance indicator/elements of fresh produce farming in Haryana.

Data in Table 2 compares Haryana performance with the average performance data of India. In case, the numbers for Haryana are inferior, it indicates progress is slow. It then necessitates that lot more needs to be done to improve productivity and profitability of and income from fresh produce farming. Focus is on vegetables, which is the niche activity of the State.

I. **Productivity**: Productivity or yield - an outcome of crop variety and growing environment interaction is governed by the efficient use of inputs and application of right management. It is the higher productivity/unit of inputs that makes the farming enterprise competitive and in the long run facilitates dominance in marketplace. Yield figures show that productivity of vegetables in Haryana is 2 tons/ha less than the country's average (2017-18 data). It means specific strengthening of yield performance is necessary.

Based on the responses of farmers during a formal interaction it came to light that to improve productivity and profitability of PUA timely availability of inputs and their supply at reasonable rates, particularly seeds must be assured. Also, the technology transfer system must become more responsive in extending real-time advice on new technologies. Strengthen further the effectivity of weather forecasts will be necessary in the light of ongoing climate change.

II. **Vegetable availability on per capita basis**: Current vegetable availability of 254 kg/capita/year is far ahead of national average (254 vs 133 kg). Also, per day fresh produce availability of 696 g/capita apparently excels the prescribed 500 g/capita/day. However, as is well known that Haryana at least exports 40% of its produce to Delhi, the consumption falls below the prescribed optimum.

III. **Cold storage**: According to FAO, in India post-harvest losses amount to 40% of agricultural produce. Because of limited shelf-life, fresh produce suffers bigger setback. Lack of cold storage infrastructure (and processing) forces farmers to sell their produce at throw away prices. Based on the cold storage capacity index (ratio of existing capacity and required storage capacity), Haryana falls short by 51% (index 0.49 or 49%). Presently, only 10% of the fresh produce is cold stored; against India's 19% (Table 2). Strange it may sound, 359 cold stores in Haryana, primarily are utilized to store potato (Ezekiel *et al*., 1999). There are several causes of dismal performance of cold storage facility. Firstly, and top-ranking constraint to India's cold storage solutions (Haryana included) (Social Alpha Agri-Tech Team, 2021) is the emphasis on 'one-size-fits-all' approach'. The cold storage facility to be efficient and acceptable must meet the local needs – a combine of biophysical (chiefly climatic) and social aspirations of farmers' needs; but above all depends on what product is intended to be stored. For instance, storing temperature for fruits and vegetables ranges between +1 and $+14^0$ C. In comparison. temperature range for processed produce is -18^0 C and $+10^0$ C. Secondly, exclusive dependence on electricity whose supply remains generally erratic and of poor-quality cause more damage to produce than the cold storage saves it. Thirdly, cold stores are largely owned and operated by private sector, who charge a hefty fee. For instance, the charges for storing a 50 kg bag of potato is Rs 10 to 15/month (Paul *et al*., 2016). Fourthly, cold storage facility must be close to a production catchment or a crop cluster area. Integration of cold storage and a pack house will enhance efficiency in terms of longevity to produce life and overall farmers' income.

According to Social Alpha Agri-Tech Team (2021) need is obvious for decentralized sustainable solutions to cold storage suiting local requirements (https://yourstory.com/2021/07/tan90-warming-up-decentralised-cold-storage

solutions/amp). Replacing grid electricity with renewable and alternative energy options, such as solar PV systems, solar thermal systems, biomass gasifiers, and phase change materials (PCM) need to be explored vigorously. There are a couple of developments on these lines. An FPO in Uttar Pradesh has set up its own cold storage and a silo, providing a safe storage facility for member farmers to store vegetables. The capacity for cold storage is 10 tons (cost Rs 15 lacs/structure) and the silo has been built with a capacity of 100 tons (cost Rs 10 lacs/structure). The cold stored vegetables (holding time 7-10 days) are moved to market when prices go up. It is an example of pro-farmer and pro-environment solution for minimizing distress sale and harvesting more income.

IV. **Grading of fruits and vegetables**: After sorting out damaged, diseased, and overripened produce, the fruits and vegetables are graded. This is necessary to obtain a pack of uniform quality as regards size, color, shape etc. It is done manually or with the help of grading machines. In Haryana, there are 82 sorting centers with a capacity to grade 55% of the total produce. Although Haryana is doing better in the area of grading of vegetables than India as a whole, there is, hardly any credible information on what is done with the leftovers. In fact, this part of the produce, which is under- or over-sized and is not of right shape can be used for creating another industry – the cut vegetable industry. After chipping of the unwanted parts, the clean segment is cut as is the practice before cooking. Normally it is done by vegetable cutting (leafy vegetables) or dicing machines (root and stem vegetables). The cut/diced vegetables are packed to be used directly for one time cooking. Working housewives have preference for cut vegetables as they are in constant need of easy solutions in cooking. Provisioning cut vegetables is the answer. This approach will create additional income and employment and reducing environmental pollution and add another dimension to this business. Cut vegetable industry may begin as a start-up or as a micro-enterprise as in Kerala, where it is running with roaring success (The Hindu, 13 July 2021) thehindu.com/life-and-style/food/cut-vegetable-units-kerala-lockdown-vfpckkudumbashree/article35279201 https://www.thehindu.com / life-and-style/food/cut-vegetable-units-kerala...

V. **Food parks:** A Food Park is established to provide a "direct linkage from farm to processing and then to consumer markets through a network of collection centers and primary processing units. Apart from minimizing fresh produce wastage, increasing opportunities for employment, and income, food parks help creating a specific niche for global trade. Haryana has 2 mega food parks in operation: one at Rai (Sonipat) and another at Saha (Ambala). There are plans to create more food parks, which seems justified. Haryana is strategically located: (i) covering national capital market from three sides, and (ii) serving the gateway for transporting the fresh produce from neighboring states like Punjab, HP, western UP, J&K to various national and international markets. Haryana food parks with the application of food modern processing technologies will be in a position to handle large quantities of fresh produce of which almost one third gets wasted every year in the absence adequate post-harvest management.

Mega food parks are necessary to handle big volume of perishable produce. However, because farmers located in far flung places in backward area may remain deprived of this

development. Rising transport cost will be a discouraging factor as it is seen to cut their profit. To address this question, the Government of Haryana has formulated a Mini Food Park Scheme to be applicable to area located in 'C' and 'D' category blocks (C category means blocks of intermediate development and D category means industrially backward blocks). Except size of operation and reach Mini Food Park Scheme likewise aims at development of state-of the-art infrastructure to inspire entrepreneurs to establish food processing units based on crop-cluster approach. These mini food parks will help in reducing the wastage of the surplus produce and add value to horticultural (and agricultural) produce. This approach is projected to increase income of the farmers and create employment at the local level. In order to make the scheme providing holistic solutions in fulfillment of loss-free produce handling for value-adding processing, government will set up some common capital intensive facilities like vegetable cutting and dicing machines, cold-storage, blast freezers, specialized packaging, individually quick frozen (IQF) method or flash-freezing method, ware-housing…Facilities of this kind will not only seen to attract investment inspiring entrepreneurs to set-up more fruit and vegetable processing units but will also add speed to development of fresh produce processing in economically backward areas; need vigorous pursuing.

VI **Pack houses**: After harvest vegetables are covered with dirt, dust, and debris. These are taken to a pack house and are subjected a cleaning process to remove any foreign matter. Cleaning diminishes any further entry of soil contaminants and decreases chances for any harmful infection. Cleaned vegetables attract buyers who will be willing to pay more price. Above all, cleaning helps quickly reducing the heat, which is favorable for maintaining freshness and flavor. After sorting, cleaning, and grading, the produce is packed and stored in refrigerated area. From that angle, a pack house is a kind of cold storage also. Normally in Haryana, produce after cleaning is immediately transported to destined market. Also, transport is in open vans since need for ferrying in refrigerated vans seems redundant. It is because maximum distance from any part of Haryana to a far flung Azadpur mandi is less than 300 km and the fresh produce reaches there in no more than 6 hours. Hence, refrigeration and transport in refrigerated vans becomes unnecessary. However, downside of selling produce immediately after harvest during peak production season reduces profitability income. As explained earlier, holding excess vegetables in cold storage till prices improve necessitates integration of a pack house and cold storage. Currently, there are only 7 pack houses in Haryana. Plans, no doubt, are afoot to increase this number substantially (see above). According to the Haryana State Agricultural Marketing Board (HSAMB), the specialized fruit and vegetable market having high-tech and ultra-modern infrastructure for cleaning, packing, and longer preservation of perishable crops is being established at Ganaur in Sonipat district of Haryana.

VII. **Fruit and vegetable processing**: Fruit and vegetable processing includes all the modifying treatment these crops receive from harvesting until it reaches the consumers' table. The list of produce processing steps are divided into: (i) a preliminary/primary stage includes sorting, cleaning, grading, and packing, (ii) secondary treatment either alters the produce (making tomato puree) before the third step or the produce after

primary treatment is preserved as pickle and it is not processed further, and (iii) the altered produce like puree of the second step passes through a tertiary processing stage whereby it is converted into a value added product like juice. Currently, only 1.4% (~100,000 tons) is processed. It is, however, not clear from the available data as to what proportion of produce is subjected to primary, secondary, or tertiary processing. We, however, surmise that pickling – an age-old process to preserve fresh produce, seems to dominate. Making ghee from milk is another pristine practice, which is very common in Haryana. Drying of fruits, vegetables, meat…to elongate shelf-life for maintaining year-long supply was normal. Also. in yester-years when transport was less and limitations to grow out of season were more these practices were common as a household industry

Development of processing industry is necessary because it helps stabilizing farm income. It is a kind of another marketing avenue for sale of fresh produce as it helps maintaining a check on its oversupply to regular markets. With that control, common peak season price fluctuations are minimum. Another dimension of diverting produce to processing factory is the minimum post-harvest losses, which happen due to heaps of produce lying unsold on the day of its arrival. It also occurs because unlike native produce, processed products have least chance of spoilage in transport, storage, and trade. Above all, not only do the farmers get fair price for their produce but processing generates a second wave of employment. According to FAO processing allows to customize products from fruits and vegetables suiting nutritional needs of pregnant women, infants and children, young athletes, elderly etc. Haryana, irrefutably, has put together several plans supporting speedy development of this sector. Details can be found in Haryana Agri-Business and Food Processing Policy 2018 https://investharyana.in/content/pdfs/Haryana%20Agri%20Business%20and%20Food%20Processing%20Policy%202018%20.pdf Need is to accelerate the implementation of strategic food processing initiatives into a happening action plan.

VIII. **Protected agriculture.** Conventional roofless agriculture is exposed to physical forces of nature. Without any control on temperature, rain, humidity…the agriculture enterprise is a risky business – at least 2 times riskier than any other venture. Being eternally exposed to nature places severe limitations on stretching growing season. In contrast, 'protected agriculture' provides stability and helps farming become an year round activity. This is the farming method, which allows crops to grow under regulated environment. Nevertheless, the environment is ether fully controlled or at times partially, as only most critical environmental factors are controlled. For instance, environmental factors such as humidity, temperature, light…are regulated by providing specialized tools and tackles or employing created conditions as per a crop's growth needs. Also, standard agronomic practices as are necessary are imposed rigorously. Hence, crops grown with protected agriculture method of farming yield more and generate even quality and healthier produce. Based on strict and natural environmental control there are many structures suggested to shelter protected agriculture. Some examples are forced ventilated greenhouse, naturally ventilated polyhouse, insect proof net house, shade net house, plastic tunnel polyhouse (low/high), plastic mulching … More sophisticated versions of protected farming are:

- Vertical farming represents growing crops in vertically stacked layers having little impact on land and water resources.
- Hydroponics involves growing crops in nutrient and water solution without soil.

Research, Technology Transfer, and Development

1 Research

- Need is absolute to generate primary data on the present state of U&PUA and assess its future potential in Haryana. Such data, once available, will convince relevant administrative departments (agriculture, horticulture, fishery, livestock) while formulating technical and infrastructural interventions, inspiring formulation of needed financial policies.
  Farmers' feedback on their needs and perceptions must be a component while defining state of U&PUA and its development. Also, it would be appropriate to involve private sector while listing infrastructural items and incentives to attract their participation.
  Baseline data and survey must include extent and structure of U&PUA; demand and supply scenario; inputs and output markets; efficiency of the ongoing practices and environmental impacts.
- There is urgent need to innovate tools and tackles that will minimize impact of constraints hindering U&PUA's development and solve the problems associated with the conventional farming practices. Structured dialogue with primary stakeholders will help understanding constraints and solutions. Designing problem-solving research to develop a mutually agreed upon plan of action to remove the hinderances is the suggested format. Research of this genre must be an action-oriented pilot, which is run with farmers' participation. Number of such pilots must be in hundreds and spread across peri-urban areas representing diverse agro-eco-zones.
- It is proposed to launch market intelligence research to inform growers what to grow and its quality, its presentation and packing. Research on market-driven alternatives or product positioning must be designed and told to farmers before the crop planning takes place.
- There is growing need to grow fully organic produce because growing market demand. Productivity of going fully organic is less than conventional use of inputs. It is proposed to shift instead to generation of 'safe produce' (containing non-harming chemical contaminants and pollutant elements)*. Safe fresh produce is possible to generate by an integration of small industrial inputs and organic inputs. Research must generate information on how small the chemical input and its time of application must be. Use of untreated sewerage water must be contained. *Safe produce means, 'the produce/food that contains any health degrading factor (hazardous elements and chemical residues) within the prescribed safety limits. Safe produce is also free from microorganisms that may render such food injurious to human health'.
- A most pressing research need is to increase productivity, including both quantity (yield) and quality (nutritional value) of produce in an economically favourable and environmentally benign way. While doing that research focus must also be there to improve market-relevant looks, shape, colour, size, aroma… of the produce.
  Specifically, (i) designing smart agricultural practices that generate optimum but safe produce is necessary, (ii) inventing varieties that maintain yield advantage, produce biofortified output, and are nutrient use efficient is need of the hour. Application of high-end genetic manipulations, specifically employing gene editing technology, would be relevant to produce more nutrient rich yield with less resources, and (ii) genetic enhancement for

improving produce quality by building features like looks, shelf-life, taste, flavor, culinary/processing value, nutrition, health, and human safety is another area of research that must be pursued.

- U&PUA is a multifunctional activity, i.e., involving integrated farming (crop + livestock) and multilayer or multiple cropping (fruit trees and vegetable crops) enterprise. To enhance production efficiency, research is needed to invent ways and means so that system components compliment the performance of the companion constituent instead of competing.
- U&PUA is a sunshine enterprise but is performed by small-scale farmers. Research must define its methods of conduct and parameters of success of accruing output. First ranking indicator of its outcome and impact would be sustainable rise in farmers' income. In pursuance of that, research needs to focus on developing sustainable relay cropping models or what is known as SPIN farming (small plot intensive farming). The objective to be accomplished would be to produce a higher-than-average volume of produce from a tiny area of land (say small kitchen garden bed or even a pot kept on the roof). The emerging high intensity practices must be sustainable economically, secure environmentally, and acceptable socially. Relay cropping or SPIN farming are specifically suitable for improving the output of urban farming as it is conducted with little resources (space) and investment.
- To cut the cost of inputs, particularly fertilizers, requires research to identify efficient microbes (helpful endophytes) and evolve 'good at below- and above-ground nutrient mining job'. Additional research is needed to identify microbes including earthworms that hasten the process of composting. Incidentally, fresh produce generates high volume of leftovers, which must be composted to be ready for application in the shortest possible way. Research may involve earthworms to do that. It is a fact that compared to in-vogue methods of composting, vermicomposting yields better quality manure with less composting time. Identification of right earthworm and their quick multiplication should be integral part of this research.
- Advancing high value low volume production systems (protected agriculture) and not just the diversification of farming is promising for small holder farming. Currently, installation costs of the protected agriculture infrastructure are high and beyond the means of small and marginal cultivators. There are design imperfections, which necessitate repeat investments. Also, energy cost to run the temperature/humidity control system (like vertical farming) is prohibitive. To be relevant, research need to aim:
  - suggesting low-cost, insect-proof but lasting polyhouses,
  - fabricating investment effective vertical farm infrastructure, including designs that provides environment control with efficiency and effectiveness of equipment. Most relevant will be structuring appropriately training modules for awareness, education, and skills of adopters for running and maintaining vertical farms.
- With fresh produce, losses before-marketing (harvesting, cleaning, storage, transporting etc.) and damages after that (marketing, retailing, consumption etc.) are typically high. Research must innovate solutions that minimize pre- and post-harvest wastage along with solutions that follow key principles of 'circular economy'. The aim will be developing interventions supporting: (i) reducing food losses at different stages of the food value chain,

(ii) infusing nutrient cycling opportunities at farm, market, and household levels i.e., 'transforming waste into produce', and (iii) producing more with less bought inputs. Actions to be developed will nucleate around infusing primary processing (sorting, cleaning, grading, packing etc.), transforming the leftovers after grading into cut vegetables, safe storage, and loss free transport; secondary processing etc.

2 Technology transfer (TT)

Whether it is urban or peri-urban agriculture, the major focus is on growing vegetables and greens, herbs, mushrooms, flowers etc. Farmers are, however, faced with unique cultivation issues because of limited access to new knowledge on scientific farming practices. During our interaction with farmer groups, we learnt that extension support was very weak. They suggested need for appointing expert TT agents for the development of science driven PUA. Following recommendations are made to strengthen growth of this sector:

- Create a dedicated group of vegetable farming experts, who will be responsible for organizing farmers into producer groups and extending advise on all aspects of successful PUA. The group may associate dairy and meat experts and fishery scientists as per need and appropriateness.
- From a technical angle, farmers must be updated and trained regularly in new and precision of farming.
- On strengthening input supply, specifically affordable price and quality seeds must be the focus. Since hybrid versions of improved varieties are preferred, many farmers are not able to use them because of price. As hybrid seed production is with the private sector, State Department of Horticulture may purchase from private organizations in bulk and facilitate supply to intending farmers at no profit. Alternatively, some other arrangement may be worked out to minimize farmers expenses on seed. Our suggestion is to work with ICAR-Indian Vegetable Research Institute, Varanasi, who are known to have generated seed of high yielding vegetable varieties, which is relatively cheap. Similarly for supply of high-quality planting material of fruit crops, ICAR-Indian Institute at Bengaluru may be contacted.
- Information on good agricultural practices needs to be a regular feature of TT.
- Advice on over-use and misuse of pesticides and other hazardous practices must be constantly emphasized.
- Knowledge and skill-building training on safe produce generation and minimizing pre- and post-harvest losses is necessary.
- Since PUA is alleged to produce bio-chemical contaminated produce and is a source of environmental degradation, farmers need to be constantly supported on producing and making available high quality and "safe" fruits and vegetables to serve the combined interest of the producer, the consumer, and the environmentalist. Emphasis on maximizing use of farm-generated organics and their conversion into high quality manure/vermicompost before use is a first ranking strategy to sustain health of soil/water and enhance quality of produce.
- It is important to help establishing the role of profitable market links in that farmers get maximum for their produce and consumers pay minimum for what they buy. From that angle PUA must represent an 'economic surplus model' in operation.

- It is emphasized that before application of above suggested elements, covering TT, must be described defined and refined with the participation of the farmers. Advisories on mutually agreed issues will have ready ownership, willing acceptance and lasting adoption.

3 Development

Production environment of PUA is changing fast and influencing the health of very resources like soil, water, and air on which the sustainable fresh produce production depends. There are multiple factors contributing to peri-urban environmental degradation, like:

- Expanding cities endanger the very of existence PUA extent and area.
- Relocation of polluting industries from the city core to the transitional zones,
- Flows of urban waste from the city's core to the peripheries in the form of landfill sites and waste treatment facilities, and
- Illegal extraction of groundwater by industries and disposal of untreated industrial and domestic waste in open spaces, thus exposing cultivation of vegetables with polluted waters.
- Pollution of groundwater due to industrial and municipal wastewaters is of a rising concern in many cities and industrial clusters of India. Faridabad - a peri-urban agricultural area is one such industrial site. Health hazards from polluted PU ecosystems also extend to those who might consume the produce grown by the local farmers. It is recommended that PUA must be recognized as a formal sector for development by integrating it with agricultural policies on urban planning. The issues may primarily include:

- City waste management: inviting private sector to participate with public agencies (PPP) for effecting holistic solutions with focus on improved services and efficiency gains by bringing in best practices in operations and handling of municipal solid waste management. The goal must be to generate wealth from waste for farmers and maintaining clean environs for the urban and peri-urban populace.
- Sewerage wastewater management: Sewerage wastewater management are critical because it is both a cause (if used untreated) of contaminated produce and source of high-quality produce (if used after treatment). In pursuance of this goal the action plan needs to nucleate around activities such as: (a) treating entire volume of wastewater, (b) launching pilots to arrive at cost-effective treatment technologies, (c) starting education and training on science-driven generation of safe water for irrigation, and (d) developing decentralized wastewater market by inspiring private sector investment.
- When the focus is on generating safe produce, it would be essential to establish a state-of-the-art facility at CCS HAU on the lines suggested by the National Accreditation Board for Testing and Calibration Laboratories. Its specific objective would be to analyze fresh produce and processed items developed from it. This may serve as statutory lab. Grant of this power would have to be backstopped by an Act of Legislative Authority. The proposed facility will perform the functions of a referral laboratory for any disputed analytical results. It will also mentor and guide the two public sector and 12 private sector food quality testing labs in Haryana. Currently, these labs provide services for quality testing of all agricultural output covering fresh produce, fish, dairy, meat, food products, water etc. From time-to-time CCS HAU lab may work as a watch dog to monitor and

evaluate the analytical quality of services being extended by the public and private sector food quality labs. State may also consider providing services of a few mobile produce quality testing labs for on-the-spot testing. Confirmation of the findings, however, would be necessary to be made in the static labs.

4 Marketing

- Efficient marketing is hallmark of inspiring technology-led productivity enhancement, income and employment for the farmers, customer satisfaction, and overall prosperity of U&PU growers. From farmers point of view, it reflects an unbiased estimate of the true value of the investment he made to generate that produce. Meaning thereby no undervalue but the true value of the produce. Since in the prevailing system of trading vegetables, the produce passes through a chain of intermediaries who cut a slice out of true price as their commission. Every stage reduces the income of the farmer. Then the charge a middleman levies is seldom fixed as it generally varies with the kind, volume, and quality of produce. No doubt, the long-channel marketing system makes efficient marketing an oxymoron. It, nevertheless, seems essential because the more efficient alternative system – direct offering by the producer to the consumer, is found inadequate in handling the entire sale keeping in front its glut of produce that happens during the peak production season. It is recommended to devise a system in consonance with the middlemen so that they make their charges transparent and reasonable. As it is difficult to force the traders to agree on all terms defining efficient marketing (farmers getting a fair deal), Government of Haryana introduced *Bhavantar Bharpayee Yojana* (BBY) in the year 2018. A key objective of this scheme is to reduce the risk of farmers during the low prices of vegetables and fruits, by fixing a reserved value for crops. Under this scheme, the Haryana State Government will fix the base price for all crops, which is grown in the state. Currently, potato, onion, tomato, and cauliflower are covered. In case, farmer is forced to sell these crops at a lower price than the base price, under BBY, the state government will provide compensation, which will be paid within 15 days from the date of application.

  Despite apparent merit, BBY has not kicked of well. Also, in Madhya Pradesh who pioneered the scheme did not get the desired success. Lack of pre-launch discussion with the farmer producer organizations seeking their input to refine content, context, and implementation of the scheme seems a key factor for the debacle of the BBY. Then, fixed reserve or model price is not representative of the cost of production incurred by the farmers. It is recommended to launch a study involving representatives of the FPOs to understand the reasons for failure and needed refinements to make the BBY more attractive.

- Direct marketing of the produce by the producers to the consumers seems to be a win-win system both for farmers and consumers. *Apni Mandi* is the model supported by the State Government whereby vegetable farmers bring their produce for sale to a designated place. From there the farmers' owned outlets sell their produce directly to the intending consumers. This has no doubt benefitted both the farmers and the consumers. Experience

of working of *Apni Mandi* and other similar models of marketing call for some additional improvements to make it more viable for farmers and attractive for consumers. A few suggestions are listed below refer to Fig 3:

- Except registered farmers, ban strictly the entry of local traders.
- Enforce display of rate list and weighment only by digital balances.
- Provide adequate parking space for shoppers.
- Spread by establishing a greater number of *Apni Mandi* outlets. This move will enhance customer footfall.
- Except sale of produce, bar firmly the sale of groceries, plastic items etc. by *Apni Mandi* outlets.
- Provide raised platforms for display and sale of produce, which currently lies on the ground. Also, each outlet owner be encouraged to keep a mini refrigerator for storing peeled (peas) and cut/diced vegetables to maintain fresh looks and to avoid wastage.
- Provide a solar-powered mini (~10-ton capacity) cold store to keep unsold, day produce safe from rotting in the open. The investment can be recovered by levying small charge for using the facility.
- Get maintained the mandi premises clean for shopping joy by getting the litter removed several times a day and by provisioning pucca walkways between rows of outlets for ease of shopping.
- Must provide well-kept public utilities like *Sulabh Shochalaya*.
- Keep a feedback register to facilitate recording complaints and suggestions of consumers.
- Above all, not just focus on establishing but running of *Apni Mandis* in a professional manner with regulations specifying dos, don'ts, and deterrents for all stake holders.

- Big farmers may not be able to sell the entire produce just from an *Apni Mandi* outlet representing 'business to consumer' (B2C) model. They need 'business to business' (B2B) system of marketing. Compared to B2C retail option, B2B fucuses on selling in bulk. In pursuance, it is recommended to establish B2B souks like 'Hadapsar Market' Pune, Maharashtra. Established on municipal corporation land, the market yard is provided with weighing machines that are operated by licensed weighmen. Single lots weighing 100 kg, or 100 numbers are sold to buyers by individual farmers or farmer producer groups without any commission agents/middlemen. However, middlemen or wholesalers can buy the produce and transport to Delhi market or markets of other cities for sale to retailers. By direct selling farmers save themselves from the hassles of packing and transport, besides being free from manipulative market agents to whose ability they are hardly a match. Farmers or FPOs because of large volume are in a better position to negotiate price compared to selling in small lots.

5 Infrastructure

- Cold stores: Cold storage of fresh produce is necessary to minimize wastage and more importantly to regulate supply for sale to maximize income. Presently in Haryana, number of cold stores are few and that too are largely utilized to store potato. Since temperature for storing different vegetables vary, hence, need is to construct cold store with temperature suiting a particular variety of produce. For instance, some fresh vegetables like cucumbers, lady finger require warmer temperatures (4 to 10^0C) whereas

others like carrot, cabbage, cauliflower are stored at nearly 0^0 C. Potatoes are stored at 0 to 2^0 C. Incidentally, for best results many vegetables can be cold (0 to 2^0C) or cool stored (4 to 10^0C) for no more than 10 to 14 days; potatoes can be stored up to 5 months. Apparently, cold, or cool storage must be built according to nature of crop catchment area. Size of the cold store must follow the expected volume of produce to be stored. For instance, a farmers producer company or *Apni Mandi* may require the size varying between 15 to 20 tons storage space. An individual mushroom grower may need no more than 1 ton storage space. It is strongly recommended to build cold/cool stores close to the produce source. Solar-powered cold/cool stores must be preferred over conventionally fossil energy. Uninterrupted function is one reason. Also, solar-powered cold/cool stores generate low or no carbon footprint and are economically advantageous.

- Packhouses: A packhouse is used to sort, clean, and grade fresh produce before marketing. While development of packhouses in Haryana seems fair, however several of these suffer from 2 deficiencies. Firstly, being devoid of cold storage facility, the produce after grading is transported for sale. As explained in an earlier section, in the absence of this service produce is to be marketed as quickly as possible. This pressure increases supply exceeding demand, which in turn reduces farmers' income. It is, therefore, recommended that invariably a pack house should be supported by provisioning appropriately sized cold store. Secondly, there is hardly any information on a viable economic use of under-, over, and misshaped produce left after grading. Since this produce except suffering from physical form and size challenge is safe to consume, it is suggested to transform this portion of the produce by cutting/dicing in market appropriate shape. After packing a volume suiting an average family one-time requirement, the cut/diced vegetables can be marketed directly. Working women who look for time-saving offerings for cooking will be its primary customers. It is further proposed that their marketing apart from *Apni Mandi* outlets should also be directly to supermarkets.

- Food parks: Food parks facilitate linking farms to customer homes through integration of FPO or an aggregator-managed collection centers and primary processing/value adding units. Apart from big food parks, what Haryana vegetable growers need are small food parks suiting a crop cluster area. Value adding activities must focus largely on primary processing (as in a pack house) and secondary processing. Scheme of secondary processing may nucleate around preservation (pickling) and volume reduction for enhancing shelf-life (tomato puree, juice concentrate). Government must facilitate establishing all aspects covering a modern food park (sorting. cleaning, grading, cutting/dicing… equipment for primary processing and machines for professional preservation, puree/juice concentrate making… for secondary processing). The proposed food park may be operated by an FPO in partnership with a private entrepreneur. Tertiary processing is not recommended because it requires certain capital-intensive units and more strict compliance of quality parameters. In this regard, our proposal differs from the Integrated Mini Food Park Scheme announced by the Industry and Commerce Department, Government of Haryana in 2019.

6 Policy

6.1 As explained earlier, Haryana Government has sustainably been committed to improve state of fruit and vegetable cultivation, in general, and to support the cause of U&PUA in particular. This promise is in line with the country's resolve to double farmers income in the shortest possible time. In this regard, development of horticulture sector comes to the fore. There is a growing market for fresh produce within the State and ample scope of their marketing in the nearby Azadpur Mandi serving the needs of throbbing inhabitants of New Delhi Union Territories. Not only is there special demand for fruits and vegetables but requirements are also mounting for fish, milk, poultry, and meat. In supporting the steady expansion in need for fruits and vegetables and animal products, various state departments are contributing to their growth as per their respective mandates. For instance:

- The Haryana State Agriculture Marketing Board is coming up with a specialized fruit and vegetable market having high-tech and ultra-modern infrastructure for longer preservation of perishable crops at Ganaur in Sonipat,
- Department of Horticulture has established Center of Excellence for Vegetables at Ghronda, Panipat, Protected Cultivation Center at HAU Hisar, Centre of Excellence for Citrus Fruits, Mangiana, Sirsa; Centre of Excellence for Sub-tropical Fruits, Ladwa, Kurukshetra; Integrated Beekeeping Development Centre, Ram Nagar, Kurukshetra, and Potato Technology Centre at Shamgarh, Karnal.
- Fisheries Department has piloted a scheme to carry out fish rearing on 16,000 hectares waterlogged land in Jhajjar and Charkhi Dadri districts,
- Animal Husbandry and Dairying Department plans to promote dairy industry in urban areas is setting up "PG Hostels" for cattle in major towns of Haryana.
- Industries and Commerce Department has formulated a Integrated Mini Food Park Scheme. The goal is to develop agro-processing clusters for reducing wastage of the surplus produce and value to it to increase income of the farmers and create employment at the local level.

It goes without saying that these horticulture and animal oriented development initiatives in one or the other way are part of government's resolve to sustainably improve U&PUA output to positively build income and employability of its primary stakeholders – the small and marginal farmers. To make the contribution of these strategic schemes more meaningful and measurable, it is proposed:

a. Develop a policy instrument on comprehensive and effective land use plans driving smart development of towns and cities in consonance with sustainable growth of PUA. Generation of information on existing PUA area and futuristic projections must be an integral aspect of this assessment. Also, delineating biophysical attributes of a region along with farmers' capability economy will be fundamental to identify suitable crops for cultivation, choosing an alternative farming enterprise or combination of the two. In turn, planning on the basis of identified natural and social strengths and weaknesses is known to be socially sustainable, environmentally secure, and economically viable.

b. Through a policy pronouncement make convergence of working compulsory for overlapping activities undertaken across different development departments. This step is seen to enhance visibility of intended impact with speed and favorable returns from public investment. Additionally, this progressive step yielding complementarity will promote

holistic development instead of development in parts.

c. Launch a special drive to inform about the above listed public initiatives to the beneficiary fruit and vegetable growing farmers. Special focus of this campaign must be on those involved in multiactivity U&PUA enterprise. This segment of cultivators remains largely detached from mainstream extension. Inviting beneficiaries' feedback and its suitable inclusion in the development proposal will be of great value in inspiring acceptance and speedy adoption of various elements of the plan. On a broader policy canvas, what is being suggested is to promote community led PUA for mobilizing stakeholder endorsement of the development initiatives

6.2 Area under peri-urban agriculture is constantly threatened by expanding boundaries of towns and cities. This happens because PUA is treated as an informal sector and is not well integrated into various facets of urban planning. It is, therefore, recommended to mainstream PUA growth along with other items of development while drawing a city's master plan. Influence of shifting industries from city core to outskirts on PUA is an example. The master plan strategy must integrate not only smart city infra subjects but also include sustainable PUA growth, containment of household and industrial contaminants and pollutants, and generating wealth from waste.

6.3 Protected agriculture: Haryana, like rest of India, is dominated by small and marginal farmers. Typically, in peri-urban areas, because of pressure on land due to expanding cities. The goal of doubling farmers income, typically those engaged in PU farming, will remain a distant dream until intensity of farming increases sustainably. Relay cropping or SPIN farming significantly enhance cropping intensity but not necessarily in a sustainable manner. Protected agriculture, on the other hand does that, and that too in a more efficient way. Haryana Development Report (2009) stated, although protected agriculture requires high initial capital, it requires less land, produces high yield, with less inputs, water, and labor. It went on to recommend introduction of protected agriculture in the state on the grounds as (i) it has potential to generate 1.2 M jobs, and (ii) saving in water, land, and agro-chemicals that will subsequently diminish chances of ecological degradation (https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr/_haryana1909pdf

Despite the established advantage, spread of protected agriculture in Haryana is dismally low. As per 2021-22 statistics, merely 0.3% of the total vegetable area is under protected agriculture (http://hortharyana.gov.in/en). Reasons for this debacle are explained earlier in this report. It is recommended that Haryana Government may constitute an expert group to comprehensively review and reevaluate the potential and prospects for sustainable infusion of protected agriculture in the state. It would be essential to provide space for farmers' input on the enterprise before the group drafts recommendations on a successful construct of protected agriculture. Additionally, the group may also assess the potential of vertical farming which has far superior performance record in terms of resource use, productivity, environmental.

Summary of Recommendations

I. Generate primary data on the present state of U&PUA and assess its future potential in Haryana.

II. Innovate tools and tackles that will minimize impact of current constraints hindering U&PUA's development.

III. Launch market intelligence research to inform growers what to grow and its quality, its presentation and packing.

IV. Focus more on generating safe produces rather then centering only on producing organic produce.

V. Establish a state-of-the art testing facility at the CCS HAU on the lines suggested by the National Accreditation Board for Testing and Calibration Laboratories.

VI. Initiate serious research on increasing productivity including improvement both in quantity and quality.

VII. U&PUA being a multi-functional activity, develop and introduce farmer-relevant integrated farming models.

VIII. Launch research to identify efficient microbes (helpful endophytes) that are good at below and above-ground nutrient mining job. Additional research is needed to identify microbes including earthworms that hasten the process of composting.

IX. Create a dedicated group of fruit and vegetable farming experts, who will be responsible for extending advice on all aspects of successful PUA. The group may co-opt, as per need, dairy, meat, and fishery scientists.

X. The State Department of Horticulture may purchase hybrid vegetables seed from private organizations in bulk and facilitate supply to intending farmers at no profit.

XI. Recognize PUA as a formal sector of development by integrating it with agricultural policies on urban planning. City waste management and sewerage wastewater management need to be part of this initiative.

XII. To make *Bhavantar Bharpayee Yojana (BBY)* more acceptable, initiate structured dialogue with farmer producer organizations seeking their input to refine content, context, and implementation of the scheme. Additionally, may consider launching a study involving representatives of the FPOs to understand the reasons for failure and needed refinements to make the BBY more attractive.

XIII. To infuse new life into *Apni Mandi* concept, enforce the implementation of defined regulations in all their aspects. Additionally, provide necessary conveniences for the customers to make shopping experience hassle free and more friendly. Number of outlets per city need to be increased.

XIV. Open *Apni Mandis* incorporating business to business concept (farmers selling produce in bulk directly to traders and retailer) on the lines of B2B Hadapsar market model of Pune.

XV. Facilitate setting up solar-powered mini clod stores for fresh produce (not potatoes), which are run by FPOs or are linked to an *Apni Mandi* yard.

XVI. Open food parks linking farms to customer homes through an integration of FPO or an aggregator-managed collection centers and primary processing/value adding units. Apart from big food parks, what Haryana peri-urban vegetable growers need are small food parks suiting a crop cluster area.

XVII. Develop a policy instrument on comprehensive and effective land use plans driving smart development of towns and cities in consonance with sustainable growth of PUA.

XVIII. Through a policy pronouncement make convergence of working compulsory for overlapping activities undertaken across different development departments.

XIX. Launch a special drive to inform about the various farmer and farm related public welfare initiatives to the beneficiary fruit and vegetable growing farmers.

XX. It is recommended that Haryana Government may constitute an expert group to comprehensively review and reevaluate the potential and prospects for sustainable infusion of protected agriculture in the State.

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Meetings of Working Group

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