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**On Critical Policy Issues in India's Agricultural Economy**

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For kind attention of:

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# Futures Market for Agriculture Commodities in India

**Brajesh Jha and Sangeeta Chakravarty**

## Introduction

- Futures market is an essential element of a liberalized economy. A well-functioning futures market in agricultural commodities has the potential to guide farmers about their resource allocation. This guidance, unlike the one based on historical trend in prices, will be forward looking based on the current and likely events in the future.
- With such an expectation, the futures market for many agriculture commodities was initiated in 2003. However, futures trade of certain agriculture commodities is often suspended on the apprehension of speculation. However, the proponents of futures market express dismay on such uncertainties as an effective futures market can provide multiple benefits to stakeholders.
- The present study analyses futures trade of agricultural commodities in historical years and assesses reasons for specific kind of distribution. The study subsequently analyses some of the benefits that the futures market can provide in the case of wheat, gram, soybean, maize (kharif and rabi). The benefits are analyzed in terms of volatility in price, transmission of information, and price integration in the markets. Finally, it also addresses inflationary role of the futures market.
- It is an all India study based on secondary information from important national (not regional) commodity exchanges of India namely Multi Commodity Exchanges (MCX), Mumbai; National Commodity Derivatives Exchanges (NCDEX), Delhi; National Multi-Commodity Exchanges (NMCE), Ahmedabad. The data from different secondary sources suggest that futures trade in agricultural commodities has increased in the initial years after 2003, but, after many ups and downs, it now accounts for less than 10 percent of futures trade in India.
- Among various futures exchanges in India, futures trade in agricultural commodities happens primarily in NCDEX, followed by MCX and NMCE. The other exchanges account for a miniscule proportion of futures trade in agriculture. Another important feature of futures market for agricultural commodities is the low participation of farmers in futures trade.
- Although futures trade is allowed for many agricultural commodities, yet it happens for some selected commodities only such as guar, castor, gram, crude palm oil, soya complexes and mentha oil. In some of the years, the trading for guar, castor oil and soya complexes together accounted for more than one-fourth of the futures trade of agricultural commodities.

## Findings

- An investigation into the likely factors responsible for patterns in futures trade shows that the aforementioned commodities are not very important in an average consumer's basket. In many of the commodities, production and distribution is highly concentrated, and the futures market provides a platform for price discovery. Top agricultural commodities traded at futures exchanges are given in Table 1. Some of the commodities, namely castor oil, guar seed, soya and similar oil complexes, cotton, barley, traded are of intermediate nature and have industrial usage. India has been an important trader (exporter or importer) of many commodities, most of which are free from government regulation in the domestic market.

**Table 1: Top Agricultural Commodities Traded at Futures Exchanges**

| S. No. | Commodities | Share in Total Agriculture Turnover of All Exchanges (%) | | | | |
|---|---|---|---|---|---|---|
| | | 2018-19 | 2017-18 | 2016-17 | 2015-16 | 2010-11 |
| 1 | **Guar seed** | 18 | 18.1 | 11.8 | 9.9 | 17.5 |
| 2 | Castor seed | 10.9 | 6.2 | - | - | - |
| 3 | **Soybean** | 9 | 10.3 | - | - | - |
| 4 | **Guar gum** | 8 | 8.7 | - | - | 3.4 |
| 5 | **Chana/Gram** | 8 | 7.6 | - | 13.8 | 8.7 |
| 6 | **Soy Oil** | - | 10 | 16.6 | 12.3 | 23.7 |
| 7 | Rapeseed/Mustard seed | - | 5.7 | 11.8 | 0.6 | - |
| 8 | Crude Palm Oil (CPO) | - | 5.7 | 7.6 | 3.8 | - |
| 9 | Cotton | - | 5.6 | - | - | - |
| 10 | Jeera (Cumin seed) | - | 4.4 | - | - | 4.2 |
| 11 | **Mentha Oil** | - | 4 | - | - | 4.2 |
| 12 | Pepper | - | 0.02 | - | - | 5.8 |
| | **Total** | **53.9** | **86.32** | **47.8** | **40.4** | **67.5** |

**Source:** Compiled from websites of futures exchanges.

- The commodities specifically studied for assessing the benefits of futures market are chana (gram), wheat, soybean, maize (kharif and rabi). This selection is based on the diversity of government policies and also on the availability of desired information about the commodity. Specific information on the above commodities were collected from National Commodities and Derivative Exchanges (NCDEX) Website. The futures and spot prices were extracted from NCDEX Website. The data for the present analysis consists of daily closing spot and futures price of the commodity, and the price is assumed to continue till a new one is declared. If multiple prices are reported within a day, it is averaged to generate the daily price. For analytical convenience, the contract with the nearest maturity at each point of time is considered. Thus, the futures prices do not relate to a single contract, but it is a transit from the first contract to the latest through a series of intervening contracts. The present analysis considers data for the certain time periods which are given in Table 2.

**Table 2: List of Selected Commodities and Specific Period for Analysis**

| Commodities | From | To |
|---|---|---|
| Chana/Gram | July 14, 2017 | October 16, 2018 |
| Soybean | January 1, 2014 | April 20, 2018 |
| Wheat | January 1, 2014 | March 12, 2018 |
| Maize (Rabi) | July 1, 2013 | March 28, 2018 |
| Maize (Kharif) | January 2, 2014 | June 20, 2017 |

**Source:** Survey study.

- The commodity specific benefits of futures market were analyzed for the volatility in futures and spot market of the commodity. Volatility is the ratio of standard deviation of prices in both the markets of a commodity. A ratio of more than one suggests that instability in the futures market is higher than that in the spot market. As is apparent from results given in Table 3, in case of gram (chana), volatility in futures market is higher than in the spot market. In other commodities, it is less than one. It is significantly less than one (around 0.80) for wheat and maize (rabi and kharif) crops. The present findings thus refute the general impression that futures market for agricultural commodities is more volatile with speculation activities.

**Table 3: Ratio of Standard Deviation of Futures to Spot Price of the Commodities**

| Commodities | Standard Deviation (Futures Price) (I) | Standard Deviation (Spot Price) (II) | Ratio (I/II) |
|---|---|---|---|
| Chana | 787.60 | 738.11 | 1.07 |
| Soybean | 460.53 | 463.02 | 0.99 |
| Wheat | 119.16 | 146.32 | 0.81 |
| Maize Rabi | 125.02 | 148.98 | 0.84 |
| Maize Kharif | 143.13 | 173.45 | 0.82 |

**Source:** Computed.

- An active futures market can be a signal of scarcity of the commodity. The same is studied as a comparison of the futures and spot price of a commodity for particular dates as contango (futures price>spot price) and backwardation (spot price>futures price) given in Table 4. Findings suggest that backwardation prevails in wheat, soya, maize (kharif and rabi) crops. The exception to this is gram (chana), where it is inconclusive as the frequency of backwardation and contango are similar. The prevalent pattern suggests that demand in the spot market is higher than the supply of majority of commodities (wheat, soya and maize).

**Table 4: Backwardation and Contango of Commodities**

| Name of the Commodities | Backwardation (%) | Contango (%) |
|---|---|---|
| Gram/Chana | 150 (50.2) | 149 (49.8) |
| Soybean | 754 (71.9) | 295 (28.1) |
| Wheat | 823 (82.1) | 180 (17.9) |
| Maize Rabi | 471 (63.8) | 267 (36.2) |
| Maize Kharif | 453 (86) | 74 (14) |

**Source:** Computed.

- Efficiency in futures market is achieved when variance in both the markets (spot and futures) is equal, and prices are co-integrated. The present study assesses price efficiency in futures market by ascertaining the co-integration of prices in both the markets of a commodity. Since the analysis is based on historical data, Augmented Dicky Fuller (ADF) test was performed to check the stationery of data. It was found that price series was non-stationery at the level but the first difference was stationery.

- The long run relationship between futures and spot prices was assessed by the Johansen co-integration test, which was based on trace statistics and eigenvalues. The estimates suggest the existence of a long run relationship between futures and spot prices of most of the referred commodities.

- The direction of causation between the futures and spot price is assessed with the help of Granger Casualty test. The prices are assumed efficient if the futures price Granger causes the spot price of a commodity. The estimates show that in gram (chana) and soya, futures price Granger causes spot price. Whereas, for maize (rabi) futures price does not Granger cause spot price significantly. The relationship between futures and spot price is bidirectional in wheat and maize (kharif). The analysis suggests that

futures market is efficient in gram, soya, wheat, maize (kharif).

- Despite the above benefits, futures market for specific agricultural commodities is suspended frequently on the apprehension of speculative activities. The review suggests that the chances of speculation in futures trade of a commodity increases if futures multiplier is high. The futures multiplier is the proportion of a commodity traded through futures market which has been more than 80 percent for some commodities (pepper, mentha oil, guar gum and guar seed). The evidences suggest that instances of speculation do not arise if the futures multiplier is less (around 20 to 30%). Speculation is more in cases of few commodities where the futures multiplier has been high (more than 60 %).
- The role of futures on inflation is studied using the Granger causality test between the trading volume in futures and spot price of the commodity given in Table 5. The analysis shows that in maize (kharif), causality runs from volume traded to spot price, i.e., trade in futures market of maize (kharif) appears to have a positive effect on the rise in spot prices of the commodity. However, this is not the case with other commodities (gram, soybean, maize (rabi) and wheat) where suspension of futures trade based on the apprehension of inflation introduces uncertainty in futures trade causing different effects.

**Table 5: Grangers Causality between Futures Trade and Spot Price of Commodities**

| Commodity | Null Hypothesis | F Statistics | P Value |
|---|---|---|---|
| **Chana/Gram** | Spot does not Granger cause future | 0.693 | 0.500 |
| | Futures does not Granger cause spot | 10.911 | 0.00 |
| **Soybean** | Spot does not Granger cause future | 0.572 | 0.564 |
| | Futures does not Granger cause spot | 66.882 | 0.00 |
| **Wheat** | Spot does not Granger cause future | 14.695 | 0.00 |
| | Futures does not Granger cause spot | 4.341 | 0.013 |
| **Maize (Rabi)** | Spot does not Granger cause future | 6.665 | 0.001 |
| | Futures does not Granger cause spot | 0.111 | 0.895 |
| **Maize (Kharif)** | Spot does not Granger cause future | 5.400 | 0.005 |
| | Futures does not Granger cause spot | 4.727 | 0.009 |

**Source:** Computed.

- The above commodity specific analysis shows that the volatility of prices in futures market is less than in the spot market for the majority of commodities. The prices in spot market are greater than in the futures market on majority of dates. The futures and spot prices are co-integrated and futures trade has not caused inflation in the spot market for majority of the commodities. The futures market helps in price discovery without any significant assistance from the government.

## Conclusion and Recommendations

- Futures trade in India has been successful in case of commodities where the production and distribution was highly concentrated. The commodities are of intermediate nature and have industrial usage (castor oil, guar seed, soya

and similar oil complexes, cotton, barley). The commodities are heavily traded (exported or imported) but not regulated in the country. The commodities are not observed important in an average consumer's basket.

- Given the different benefits and efficiency of futures market, it must be strengthened as an important institution for development via policies for futures trade. Besides suspension of commodities for futures trade, there is an uncertainty on account of alteration in futures margin of the commodities owing to different kind of regulations in the domestic market.
- The suspension of futures trade on apprehension of speculation is incorrect. It was observed that speculation is not a general but particular in case of agricultural commodities. Therefore, suspension of commodities must be avoided. The futures trade in the beginning may be initiated for a limited number of commodities which are not sensitive for consumers and thus, the futures policies can remain consistent for a significant period.
- The uncertainties in futures market constraints the development of it as a reliable and serious institution. It affects participation of farmers in the futures market. Building seriousness requires participation of the government parastatals (state trading enterprises) in working on mandatory delivery of the commodities in any futures trade of agricultural commodities.
- The mandatory delivery of agricultural goods in futures trade is also constrained on account of the state of spot market. Poor infrastructure (storage and warehouse facilities), lack of quality control (assaying), and co-ordination between different markets and market functionaries also pose a negative impact. The central government has been trying to improve the same by involving corporates, more recently with the enactment of the farm laws.

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# Assessing the Change: Re-survey of Village Gulumb in Maharashtra

**Jayanti Kajale**

## Introduction

- The share of rural population in India which was 80 percent of the total population in 1960s has been reducing gradually over the time period, however, a massive proportion of the total population (around 69 percent) still resides in more than six lakh villages of rural India. This population constitutes largely the agrarian population of the country. A large number of studies have been conducted to highlight the socio-economic status of the households and the nature of changes taking place in the institutions, infrastructure and household characteristics over a period of time.
- The literature suggests that the village life in 1950s and in the current scenario has drastically changed. Reduced importance of agriculture as a livelihood source, increasing occupational diversification, unemployment, greater extent of education, fragmentation of landholdings, and changes in aspirations of villagers are noted and the conceptual distinction between villages and cities seems to be fading (Simpson, 2016). Trends observed in villages would influence status of villages in future, and hence, national policies need to be framed keeping this in mind.
- The present study is a re-survey of village Gulumb situated in Wai taluka in Satara district

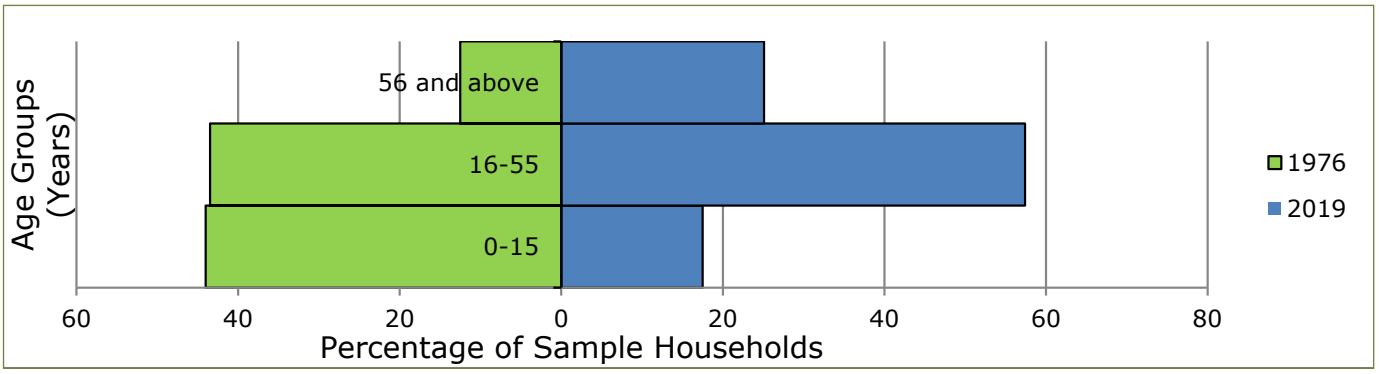
of Maharashtra which was conducted in the year 2019-20. Over a period of time, the isolated and self-sufficient nature of Gulumb went on changing. By 1976, when the earlier survey was conducted, the dependency of the village on the outside world and monetization of transactions had increased.

- Cultivation of commercial crops like sugarcane and availability of credit for agriculture have been traditionally the two major features of the village and provided the needed stimulus for remaining integrated with the urban centres like Pune and Satara. On this backdrop, the study makes an attempt to understand major changes that have taken place in the structure and features of the village and the households during last 45 years, i.e., after the last survey was undertaken in the year 1976. It also analyzes household level responses to capture demographic and socio-economic status of various categories of sample Households (HH) and their perceptions about problems and challenges faced and the changes they have experienced.

## Findings

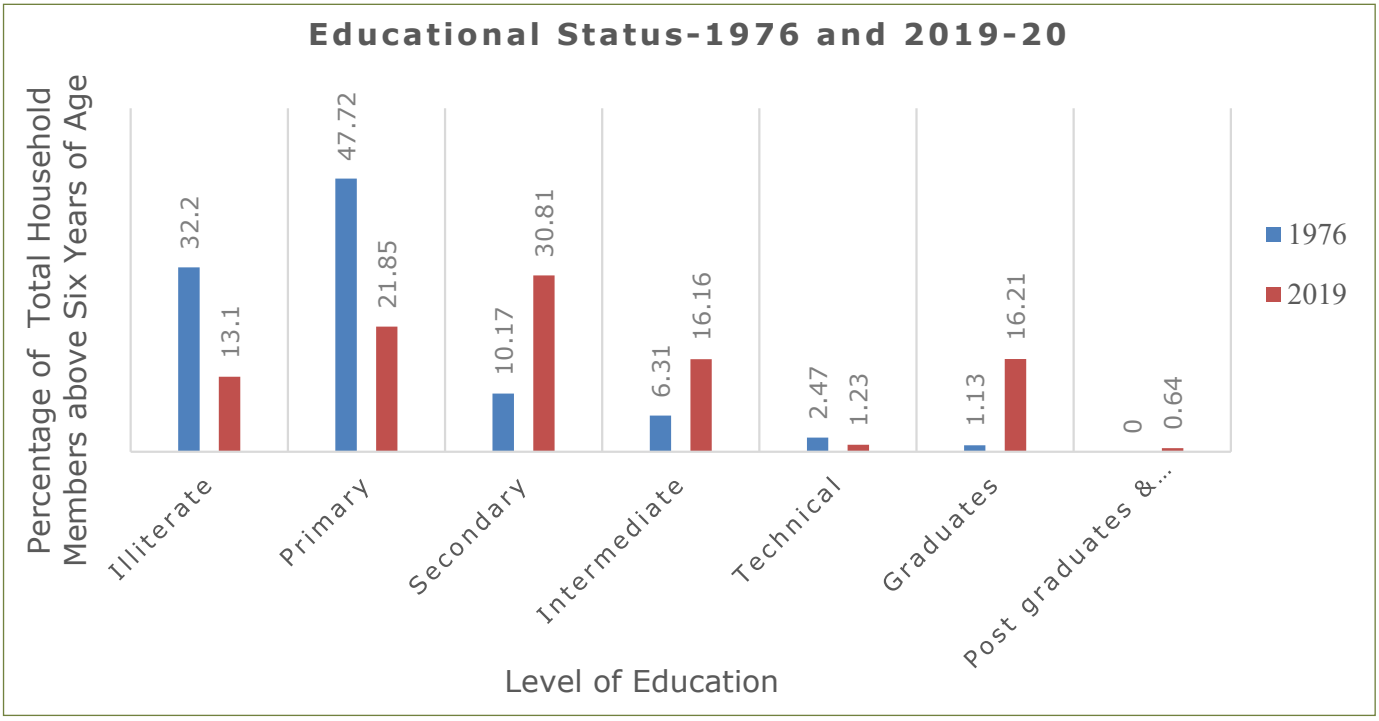
- The study observes considerable progress in terms of proportion of households with access to basic civic amenities, infrastructure available, technology used in the village for communication and construction. The village had basic infrastructure such as water, electricity, transport, communication, education, and credit facilities in 1976 which further got expanded along with basic health facilities. The village got *pucca* approach road. The village now has a ration shop, anganwadis, sports ground, and a public library which did not exist in 1976. A number of women Self-Help Groups (SHGs) are also active in the village.
- Over the period, percentage of irrigated land expanded from 15 percent in 1976 to 52 percent in 2018-19. The villagers started cultivating new crops such as soybean, maize, ginger, green peas, fruits along with traditional crops such as sugarcane, beans and jowar. The data reveals yield increase in case of jowar, gram and summer groundnut during the two survey years.
- The social structure of the village has remained more or less the same with Marathas as the dominant social category consisting of more than 70 percent of the total HH. The settlement pattern of the village also is based on social status.
- The village has received a number of awards such as Vanashree Puraskar, Nirmal Gram Puraskar, Sarva Shiksha Abhiyan Puraskar, etc. It is also an open defecation and *tantamukta* village, and there is no liquor shop in the village. The unique feature of Gulumb has been the collaborative project of stream linking which was recently undertaken and completed for overcoming the problem of recurrent droughts.
- A comparison of various demographic characteristics and age structure in the sample HH indicates a higher share of productive population (Figure 1), reduced size of families, decline in birth rates, increased life expectancy, increase in the age of marriage (especially for females), and withering away of the practice of having co-wife during the concerned period. It also showed an overall lower share of illiterates and higher percentage of family members taking higher education during the current survey (Figure 2). The analysis also revealed higher share of school enrolment of female children.

**Figure 1: Age Structure of Population in Gulumb Village**




**Source:** Dandekar et al. (1978), Field Survey-2020.

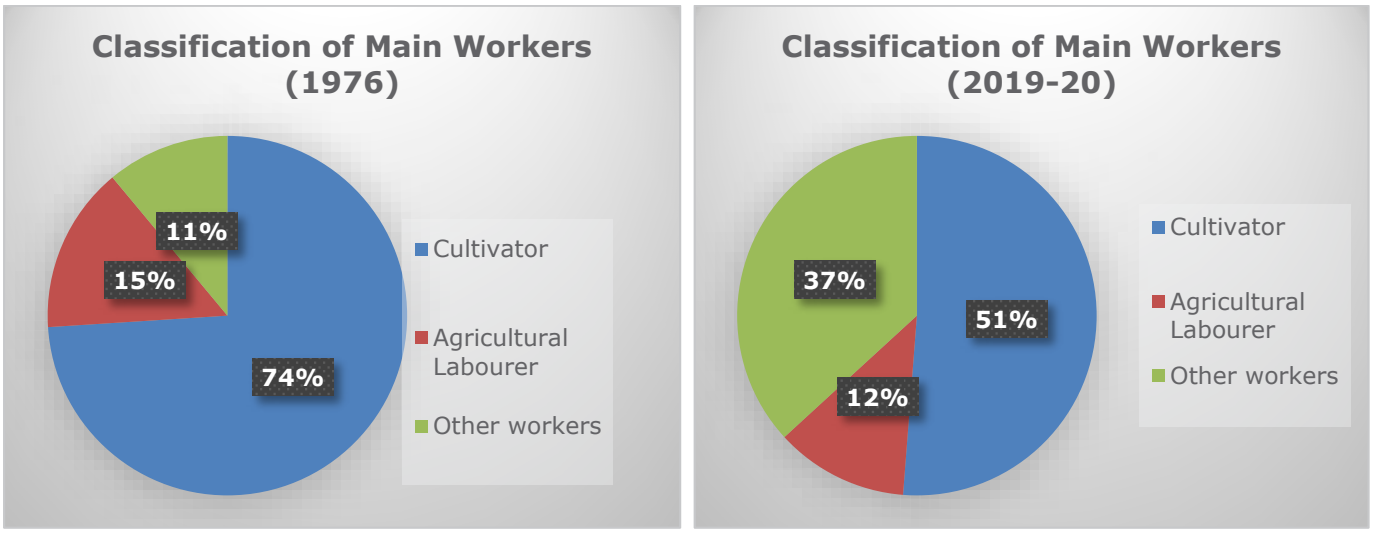
**Figure 2: Educational Status of Households Above Six Years of Age**




**Source:** Dandekar et al. (1978), Field Survey-2020.

- The classification of total main workers in 1976 shows the combined share of cultivators and agricultural laborers to be around 89 percent, remaining 11 percent being other non-farm workers. In 2019-20, however, it was observed that around 63 percent of the total main workers were agricultural workers and share of other workers was 37 percent. This can be observed from Figure 3.

**Figure 3: Distribution of Main Workers in Gulumb in 1976 and 2019-20 (%)**




**Source:** Dandekar et al. (1978), Field Survey-2020.

- It was observed that on an average, the HHs earned 78 percent of the income from non-farm activities, 18 percent from farming and three percent from off-farm activities. This reveals diversification of activities and indicates the need to depend upon non-agricultural income despite heavy occupational dependence of HHs on agricultural sector. The comparable figures of HH income were not available in the earlier survey.
- The 1978, the Monthly Per Capita Expenditure (MPCE) on food was 60 percent, and food grains accounted for 50 percent of this expenditure. However, for the year 2019-20, the corresponding shares were 38 and 25 percent respectively. Rest of the expenditure under food items during the latest survey was on livestock and horticultural products, and other food, i.e., processed food. Also, the two major items of non-food expenditure (28%) were education, health and medical services. The analysis not only reveals diversification in occupations but also the ability of an average village HH to spend on variety of items.
- The number of crops grown and net irrigated area seems to be increasing with size of land. It was observed that for larger farms, the area irrigated was 56 percent. The data indicates resource richness of larger land size. The study also revealed difference in yields of crops on irrigated and unirrigated land thereby indicating the difference in the income to be earned.
- Category wise analysis of the HHs reveals higher economic status of larger size land holding HHs and lower economic status of marginal farm size HHs and landless HHs. The analysis indicated that the marginal farmers (82%) and the landless workers (71%) in the village mainly survive on the income earned through non-farm activities. However, in absolute terms, the level of total average income earned by these categories was very low as compared to other categories, especially the highest land size category. The average number of sources of income were the lowest, i.e., three for marginal category and the highest, i.e., six for the landless HH.
- Around five percent of the marginal category and 13 percent of the landless HHs belonged to the lowest MPCE classes (i.e., below Rs.3000). It is indicated that in case of marginal farmers, very small size of landholdings and limited sources of income lead to a lower

income from farming and non-farm sources, lower consumption expenditure and inability to make investments in land. In case of landless HHs, in spite of having relatively more number of sources of non-farm income, the average income level for this category was very low and almost 15 percent of the HH from this category had very low MPCE revealing their vulnerability.

- According to majority of the sample HHs, the village experienced considerable expansion and improvement in infrastructure. More than 80 percent of the HHs perceived that there was improvement in the economic condition of the village and its infrastructure over the years. About 62 percent of the HHs also felt that there was improvement in economic condition.
- Responses of the HHs revealed scarcity of clean drinking water, insufficient water for irrigation purposes, inadequate systems for maintaining cleanliness and sewage (Figure 4), open drainages. The earlier (1978) report also mentions non-availability of proper sewage system to drain out water, and hence, the presence of stagnant water pools on roads and unhygienic conditions. The HH were also concerned about non availability of job opportunities around the village.

**Figure 4: Open Sewage in Gulumb**


**Source:** Survey.

## Conclusion and Recommendations

- The survey data revealed that majority of the cultivating HHs were marginal HHs with a vulnerable economic status. Hence, provisions need to be made for adequate water facilities in order to increase the yield and for imparting market intelligence in order to properly market the produce. In view of the recurring droughts and its adverse impact, the suggestion of villagers to include the village under drought prone areas needs be considered. The villagers need to shift the cropping pattern away from crops like sugarcane to other traditionally grown/new crops introduced during last few years such as soybean, and other high value crops such as vegetables and fruits.
- The villagers receive water from the wells, but, the water needs to be supplied after filtration to avoid incidences of water borne diseases. Thus, a water filtration plant must be constructed.
- Proper systems for garbage collection and

disposal need to be instituted. Awareness programmes about garbage disposal and maintenance of cleanliness need to be organized by the authorities. It is extremely important to have closed drainage system for carrying sewage water. The spread of ongoing COVID-19 pandemic has underlined importance of good health and sanitation related facilities which further emphasizes the need to lay underground sewage pipes in the village.

- Usage of solar energy for electricity generation and other purposes by the village authorities must be promoted.
- The study revealed the need for employment generating activities like opportunity specific training programmes, capacity development programmes. Also, technology training programmes need be organised and imparted specifically to women involved in various livelihood supporting activities through SHGs. Such training programmes would provide platforms for communication and marketing of the produce and instill sense of empowerment.
- Considering the increasing proportion of population in the higher age groups, special strategies for healthcare of the elderly must be devised.
- The village has progressed during the last 45 years. However, for further improving the standard of living of the villagers, focus must be laid on quality education, vocational guidance, health care, sanitation facilities, usage of environmental friendly technologies, and local area development for creation of job opportunities. Usage of digital technologies especially for agriculture linked activities, communication, and governance would greatly enhance the pace and quality of outcomes, thus, improving the overall welfare of the households.

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# Reviewing the Prospects and Challenges for Promoting Protected Cultivation of Vegetables in Punjab


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## Introduction

- In Punjab, vegetables are grown on over 2.89 lakh hectares of land area producing 57.70 lakh tons with an average productivity of 19.95 tons per hectare. Among vegetable crops grown in the state, about 37 percent of the total area is covered under the potato crop which is raised for fresh market and as seed potato. Other vegetables namely pea, cauliflower, onion, tomato and chilies are grown on about 33 percent area in the state. It is estimated that per capita per day availability of vegetables in the state is less than 200g[1].
- To meet the demand of the increasing population, there is a need to increase the vegetable production. Besides this, the state has to additionally produce to meet the requirement of the processing, seed industry, and exports.

[1] The Status Report of the Department of Horticulture, Punjab (2020).

In view of the increasing population pressure, climate change and to meet the high demand of quality horticultural produce, adaption of modern technologies of crop production like protected cultivation of vegetables takes utmost importance.

- Protected cultivation is one of the answers to most of the burning issues being faced Indian agriculture including adversities due to uncertain and varying climatic conditions, improper usage and low productivity of natural resources, environmental pollution due to pesticide usage etc. It generally refers to providing congenial conditions for better plant growth and enhancing the production level through artificial means. It is made possible by controlling the climatic conditions by providing full or partial coverage surrounding the plant so that the plant does not experience high or low temperatures or humidity while getting enough light for photosynthesis, optimum fertilization and watering, and other factors for best growth and production.

- This technique has the potential of fulfilling the requirements of small growers as it can increase the yield manifold per unit area. The crops can also be grown round the year, including the off-season, with increased profitability. The technology has already been adopted in many parts of the country. On the contrary, increasing trend of entrepreneurship and commensurate opportunities of business among progressive farmers is offering a brighter side to agricultural growth (Bhatnagar, 2014).

- The interventions include polythene covered greenhouses (poly houses), shade net houses, insect net houses, low plastic tunnels, row covers, plastic film mulching, etc. Such interventions have the potential to enhance the productivity and quality of any crop which cannot be expected under normal conditions. It increases the land, water and fertilizer productivity along with the reduction in pesticide use. But, such interventions are associated with a very high initial cost. Although, it is linked with several government schemes in India, many subsidies are provided depending on the intervention, status/socio-economic condition and policies. Presently, the area under protected cultivation in Punjab is about 150 hectares out of which about 125 hectares of area is under vegetables and 25 hectares under flowers[2].

## Findings

### Success Stories of Protected Cultivation of Vegetables:

- Choudhary (2016) found out that poly houses can make small holdings viable by producing the maximum from a limited land, overcoming vagaries of nature and diversification to produce high value vegetable crops. It can also stabilize the production system in addition to quality improvement through utilization of vertical space and precision farming. Further, these structures can facilitate crop production in areas where vegetable production during extreme weather conditions is not possible. In protected cultivation, high-value cash crops, vegetables and flowers are grown and managed under controlled conditions with higher per unit productivity and profitability.

- A study undertaken by Bishnoi et al. (2017) revealed that majority of the adopters of protected technology were quite young. The main reasons behind adoption were the farmer's interest (26.67%), government incentives/subsidies (40%), expected high profitability (20%). It was found that by direct marketing of capsicum, producer farmers could acquire maximum share in consumer rupee,

[2] The Status Report of the Department of Horticulture, Punjab (2020).

i.e., more than 90 percent which might be due to non-existence of market intermediaries between producers and consumers. Least share in consumer rupee were observed in the distant market which was less than 50 percent due to higher transportation cost, existence of large number of middlemen and brokerage.

- A study on protected cultivation of vegetable crops was conducted in sub-Saharan Africa for small land holders by Norday et al. (2017). It was found that profitability of protected cultivation techniques depends on the capacity to balance increased cost of production with higher outputs and higher prices of products.

- Singh et al. (2016) carried out an investigation on comparative economics of protected and open field cultivation of tomatoes in Amritsar district of Punjab. It was found that the production and marketing costs were higher under poly houses but, due to about five times higher productivity and better prices, the net returns under poly house cultivation was about seven times higher than that of open field tomato cultivation. The results revealed further scope of enhancing productivity under poly house technology through better technical and managerial skills. Poly house technology being highly capital intensive and risky due to many constraints related to production and marketing requires constant monitoring and supervision.

- A comparison of cost of cultivation of capsicum cultivation in net house and open fields in Punjab (Kaur et al., 2017) revealed that the total cost of cultivation and marketing cost of capsicum in net house was estimated at Rs.72233 per acre and in open field conditions at Rs.51714. The average yield per acre of capsicum cultivated in net house was about 197 quintals and in open fields it was 98 quintals. On an average the net house vegetable growers fetched lower price at Rs.2125 per quintal and for the open field product it was Rs.2250 per quintal during the study year. The gross returns were estimated at Rs.418625 and Rs.220500 per acre under net house and open field, respectively. The returns over total costs were estimated at Rs.276273 and Rs.168687 in respective situations. Thus, returns from net house capsicum cultivation were quite higher than open field cultivation of capsicum.

- Kaur and Kaur (2020) assessed the profitability of capsicum production under protected conditions in Punjab. The total per acre cost of cultivation of capsicum under poly house was about three and a half times higher than under open field cultivation which was due to higher amortized cost of poly house. The net returns under poly houses were nearly five times higher for capsicum grown in poly house vis-a-vis open fields. The huge difference in cost of cultivation of capsicum in poly house was due to the use of higher number of seedlings, costly seeds, high field and bed preparation cost and requirement of skilled labour. On the other hand, expenditure on weeding and irrigation was found less in poly house cultivation of vegetables. The yield of capsicum in poly house cultivation was almost double as compared to open fields. The cultivation of capsicum under poly house was found to be feasible with subsidy as reflected in higher value of Net Present Value, i.e., Rs.1761916 per 4000 $m^2$ with Benefit-Cost Ratio (BCR) of 1.3 and Internal Rate of Return (IRR) of 24 percent. The results revealed that production of capsicum under non-subsidized poly house cultivation was not profitable.

## Constraints in Adoption of Protected Cultivation of Vegetables:

- The major problems faced by poly house farmers were lack of poly house crop insurance scheme, attack of insect-pest and nematodes, unavailability of good quality poly house material, high prices of inputs like hybrid seeds and pesticides or insecticides, lack of proper guidance by extension workers. Some secondary problems were also found such as lack of knowledge regarding poly house farming, market information about prices, malpractices done by intermediaries, high cost due to highly perishable commodities and improper knowledge regarding grading standards (Bishnoi et al., 2017).
- Kaur et al. (2017) reported that net house vegetable cultivation was adopted by vegetable growers, particularly large farmers who were educated and are members of one or the other farmers' society/club/organization and have more extension contacts. Thus, for the adoption of new technology, better extension services should be geared up to reach a larger segment of the farming population particularly the less educated ones.
- Ghanghas et al. (2018) brought out that the major problems faced by poly house cultivation farmers were population explosion of minute insects like white flies and mites, lack of refrigerated vehicles for transportation of produce, high cost of seed and pesticides, lack of cold storage facilities near villages. It was concluded that for sustainability of poly house cultivation, proper technical guidance for the control of whitefly, proper marketing and value addition should be provided.
- Kaur and Kaur (2020) revealed that high investment cost, lack of technical guidance, costly seeds, non-availability of skilled labour and high cost of maintenance were the major constraints faced by poly house farmers. Due to constant weather fluctuations, damage of polythene sheet was also reported by respondents. Production of capsicum, tomatoes and cucumber under non-subsidized poly house conditions was not found profitable. Farmers in Punjab were getting only 50 percent subsidy on the establishment of poly house which should be increased.

## Conclusions and Recommendations

- Amount of subsidies for the establishment of poly houses should be increased as the financial aid provided to farmers may improve the economic viability and profitability of poly house cultivation of vegetables. It may help in reducing the financial burden imposed on farmers for establishing poly houses as it involves a substantial initial investment cost.
- Research efforts should be directed towards reducing the cost of establishment of poly houses to make it lucrative for adoption by the farmers. Intensive efforts are required to develop cost effective strategies to promote protected cultivation of vegetables and to make it suitable especially for small and marginal farmers.
- Poly house growers may be provided with quality seeds at reasonable prices, and be guided about adoption of latest technology developed exclusively for protected cultivation of vegetables.
- Lack of awareness among farmers pertaining to potential of protected vegetable production is also one of the limiting factors. Farmers must be motivated for acquiring training in net house vegetable cultivation for proper use of inputs.
- The cultivation of vegetables under poly houses may emerge as a profitable venture which can help the farmers generate income round the year growing multiple crops and fetching premium price especially for off-season vegetables.

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