

TECHNOLOGY ADOPTION IN FARMER PRODUCER ORGANIZATIONS

A THESIS

SUBMITTED IN FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE

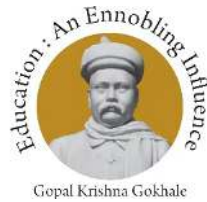
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IN

ECONOMICS

AT



GOKHALE INSTITUTE OF POLITICS AND ECONOMICS

By

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Under Guidance of

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GOKHALE INSTITUTE OF POLITICS AND ECONOMICS

2025

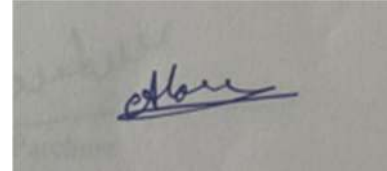
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DECLARATION

I Anirudha More hereby declare that this thesis on the topic entitled, "*Technology Adoption in Farmer Producer Organizations*" is submitted for the award of Degree of Doctor of Philosophy in Economics to the Gokhale Institute of Politics and Economics, Pune 411004. It is an original contribution and was completed during my tenure as a research scholar at Gokhale Institute of Politics and Economics, Pune.

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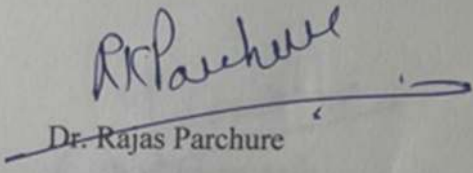
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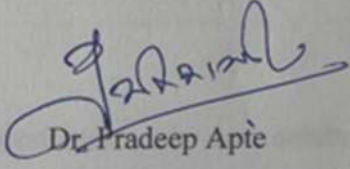
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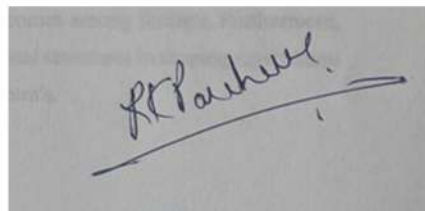
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Abstract

This study delves into the underlying dynamics of technology adoption and diffusion within the farming communities, focusing specifically on the role of producer organizations. It focuses on two primary channels through which technology is adopted: firstly, via organizational platforms such as farmer producer companies/organizations (FPOs); and secondly, through producer organizations active within the grape exporting community of Maharashtra.

The primary objective of this research is to comprehensively analyze how technology adoption influences productivity, costs, and income changes among FPO members and non-members. Within the context of grape growers, the technological landscape has undergone significant evolution since the 1980s. This study rigorously examines the factors that contribute to the adoption and diffusion of technology among grape growers, with a specific focus on how evolving export quality requirements have influenced the spread of technology adoption within this sector.

Moreover, this study documents the evolution of information flow within farmer networks, which initially emerged out of the necessity to address challenges in the export of grapes. Over time, these informal networks have transitioned into formalized producer organizations. The transformation from informal networks to structured entities is analyzed to understand how these organizations have played a crucial role in facilitating technology adoption and diffusion among grape farmers.

By exploring these dynamics, this study contributes to a deeper understanding of how producer organizations contribute to technological advancements in agriculture, particularly in enhancing productivity, reducing costs, and improving incomes among farmers. Furthermore, it underscores the broader implications of these organizational structures in shaping agricultural development and sustainability in the context of Maharashtra's.

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List of Acronyms

| | |
|---------|---|
| FPO | Farmer Producer Organization |
| OFPO | Organically Evolved Farmer Producer Organization |
| PFPO | Promoted Farmer Producer Organization |
| FPC | Farmer Producer Company |
| MACP | Maharashtra Agribusiness Competitiveness Project |
| SFAC | Small Farmers Agribusiness Consortium |
| SHG | Self Help Group |
| SPS | Sanitary and Phytosanitary |
| MRDBS | Maharashtra Rajya Draksha Bagayatdar Sangh |
| RPM | Rounds per minute |
| ICAR | Indian Council of Agricultural Research |
| KII | Key informant interviews |
| NHB | National Horticulture Board |
| MRL | Maximum Residue Limit |
| FAO | Food and Agriculture Organisation |
| FAOSTAT | Food and Agriculture Organisation Statistics Resource |
| OIV | International Organisation of Vine and Wine |
| GAP | Good Agricultural Practices |
| GoI | Government of India |
| HIDs | High Agricultural Income Districts |
| ICAR | Indian Council of Agricultural Research |
| IFFCO | Indian Farmers Fertiliser Cooperative |
| IFPRI | International Food Policy Research Institute |
| INR | Indian Rupee |

| | |
|---------|---|
| IPM | Integrated Pest Management |
| IVs | Instrumental Variables |
| KVK | Krishi Vigyan Kendra |
| LIDs | Low Agricultural Income Districts |
| MACP | Maharashtra Agricultural Competitiveness Project |
| MAHAFPC | Maha Farmers Producer Company Limited |
| MH | Maharashtra |
| MIDs | Medium Agricultural Income Districts |
| MPCE | Monthly Per Capita Expenditure |
| MSAMB | Maharashtra State Agricultural Marketing Board |
| MT | Metric Tonnes |
| NABARD | National Bank for Agriculture and Rural Development |
| NGO | Non-Government Organization |
| OBC | Other Backward Caste |
| OLS | Ordinary Least Square |
| SC | Scheduled Caste |
| ST | Scheduled Tribe |
| ICT | Information and Communication Technologies |
| KCC | Kisan Call Centre |
| FTA | Farmer Tele Advisors |
| HYVP | High Yielding Varieties Programme |
| ICAR | Indian Council of Agricultural Research |

Chapter 1: Introduction

1.1 Introduction

In the 1960s, when food security became a major challenge for the country, the government went on overdrive to establish research and development capacity with massive scaling of extension system under the Indian Agricultural Research Institute. The hybrid technology developed by Norman Borloug was promoted through the extension system. The nature of hybrid technology demanded higher inputs such as seed, irrigation, electricity, credit, fertilizer, tractors, etc. And various line departments focusing on these specific activities came up. The public extension system played a pivotal role in provisioning of public goods necessary for the success of the hybrid technology. The governmental push led to significant increase in aggregate food grain production. In recent times, the adoption of technologies from the Israel agriculture are the most prominent in India. Many technologies like drip and sprinkler irrigation, polyhouse, high density plantation was adopted during the push for high value agriculture in the 1990s. The water use efficiency achieved through it has substantially increased area under crop and yields. The yield gaps among farmers have reduced due to homogenous application of water and nutrients. These technologies are being brought in India through private entities as well as inter-government technology transfer initiatives. The exposure visits of government officials and progressive farmers to Israel, arranged by the Government of Maharashtra have been instrumental in bringing new techniques and perspectives in agriculture. These technologies have seen wider adoption in the agriculture areas. And it has led to major value addition in the agriculture sector.

The agricultural households' access to modern technology and technical advice is an important aspect which positively affects the preferences and practices of the farming community resulting into better output in the respective agricultural activities. But the outreach of the public extension system shows inadequacies to meet the requirements of the agriculture sector as found in the Situation Assessment Survey of Agricultural Households in India, 2013 (NSSO 70th Round). The survey round collected information on the technical advice accessed and adopted by the agricultural households for the purpose of crop production. From a given list of sources, the households were asked to report 'whether they have accessed any of these agencies for any technical advice'. At all India level, only around 41 percent of the cultivating households accessed technical help from any of the listed sources during the period July 2012 - December 2012. The farmers report extension agent (6%), KVKs (3%), agricultural university

(1%), private commercial agents (7%), progressive farmer (20%), radio/TV/newspaper/internet (20%), veterinary department (8%), and NGOs (1%) being the sources for technical advice.¹ This underscores the role of demonstration effect generated by farm plots of progressive farmers in adoption of new technology. Here, the information exchange among the farmer network plays an important role in spread of technology. Also, with the growing presence of information and communication technologies (ICT) the access to information about better production practices is spreading rapidly among the farmer communities. Further the Situation Assessment of Agricultural Households and Land and Livestock Holdings of Households in Rural India, 2019 (NSSO 77th Round) came to the similar conclusions.

The relatively small size of the local markets, their structure of concentration, as well as the relatively smaller size of farms, are key factors that shape the innovation process in developing countries. Not only is the small and medium farm enterprise significant in terms of contribution to the agricultural sector, but farm enterprises considered as 'big' usually operate at suboptimal production scales. With higher unit costs and far from optimal efficiency, this influences the viability of agri-business. Flows of information within national systems of innovation are fragmented, and many a case there is an absence of linkages between science, and technology actors. Weak or absent linkages challenge the capacities of farms to overcome technology related problems. Usually minor or incremental changes undertaken by farmers is the most frequent type of innovation activity in farm enterprises.

The adoption of technology introduces new approaches to solving problems, which improves the production economics, making agriculture remunerative for the farmers. The improvement can be a new technique which optimises the physiological processes of the plants, and result in reduced inputs or increase the effectiveness of targeted inputs and get them translated to better or higher output. The farmers' choice of technology depends on many factors affecting the cultivation of crops. Often, real or perceived risk drives the farmers to search for new methods of risk mitigation. While doing so they either minimise the cost or maximise the profit.

The farmers adopt technologies through various channels. These channels can be public extension services, government seed companies, technology transfer programmes with other countries, Agrowon (marathi daily agriculture newspaper), farmers magazines, private

¹ http://mospi.nic.in/sites/default/files/publication_reports/KI_70_33_19dec14.pdf

companies in agriculture, farmers own initiative for information, exposure visits, input suppliers, agricultural boards of various crops, television, radio, internet, mobile applications, etc.

The present study focuses on two channels of technology adoption - through platforms such as farmer producer companies and producer's organizations evolved among export oriented grape growers of Maharashtra.

A) Farmer Producer Company/Organization

Among the various channels of technology adoption, Farmer Producer Company (FPC) is a new entrant and with a growing presence. Along with the said objective of market linkage many FPCs are acting as platform for introduction of new technology among member farmers. New production protocols are being introduced among members for catering the demands of ecommerce marketplaces. The nature of consumer demand in urban agglomerations is undergoing major change. The supply chains are being freshly thought off, restructured and new markets are being created. These markets demand continuous and consistent supply of good quality standardized products. This implies that production management needs to ensure quality produce throughout the demand period. To address these issues new production technology is being used by producer organisations in its quest to improve farmer incomes.

Since, the farmers following traditional practices find it difficult to manage the rise in input cost over years, the initial focus of FPC farmers seems to be on buying inputs in aggregate at bargained costs and simultaneously follow new protocols which increase productivity substantially. They find it relatively easy to achieve production goals in the short term than spend time on market discovery. If the leadership is proactive and well-connected then we see market clues being used in rearranging the production activity. Primarily, FPCs are being formed for the purpose of marketing input and output. In maximum cases they act as input aggregators reducing the cost on an immediate basis. Sometimes, farmers come together to aggregate the produce and benefit from the scale effect while dealing with the distant markets. At times they sense a captive market for their commodity and form FPC.

The role of farmer producer organizations becomes important as adoption of crop management techniques at collective level can significantly affect the net returns of individual farmer. The propensity to imbibe technology also enhances a lot with FPCs. Doing work in a group rather than alone generates different kind of learning curves in members. Peer effects increase

significantly due to collective activity reinforcing economic and social attitudes, transforming the nature of farming. Making relevant technology available in a scaled down manner, especially customizing mechanization and making it available for small holder is a major challenge. Many FPCs have actively taken up to working as custom hiring centres for member as well non-member farmers. The study focuses on if, why and how the technology adoption happens in FPCs. Since ‘producer company’ is also essentially ‘producer organisation’, we use the terms Farmer Producer Company (FPC) and Farmer Producer Organisation (FPO) interchangeably in this study. FPO is a generic name, which means and includes farmer-producers’ organization incorporated/ registered either under Part IXA of Companies Act or under Co-operative Societies Act of the concerned States or as a Mutually Aided Co-operative Society (in States that have passed a liberal co-operative law on the principles of mutuality), for the purpose of leveraging collectives through economies of scale in production and marketing of agricultural and allied sector.

B) FPOs evolved among Grape Growers

FPO’s are usually viewed as a vehicle for better market access operations and management. However, it is important to note that FPO is simultaneously a commercial platform for the producers themselves. As a consequence, it also functions as an agency that can disseminate technical know-how of cost-effective, productivity enhancing techniques pari passu adherence to SPS and customer requirements. In other words, it is an institutional arrangement which breeds the kind of technical innovations, standards and practice that are consistent with market demand. Though FPO’s are formed with market-access/operations and marketing capacities, one of its unintended consequence is that they also become a natural channel of technological dissemination and diffusion. This apparently unintended consequence usually remains less noticed. We have therefore highlighted this through the case of exportable grapes produced and marketed by grape-growers. It demonstrates that FPO is equally important arrangement that influences a gamut of technologies from production to packaging and marketing.

India is one of the leading producers of fruits and vegetables in the world. In 2018, India contributed to about 11% of world fruit production and was the second biggest producer of fruits after China, producing nearly 98.7 million tons of produce (FAO, 2018). Similarly, India also contributes to about 12% of world vegetable production. In 2018, it was the second largest vegetable producer after China, at around 128 million tons. At the same time India is a relatively small horticultural exporter. According to the World Bank report on Indian

horticulture, India is a competitive producer of horticultural products on farm but owing to off-farm disadvantages, she fails to compete abroad. India's share in world trade in fruit and vegetable was just 1.1% in 2018, a figure disproportionate to its share in global production. Diversifying into high value fruits and vegetables is often seen as an opportunity for uplifting incomes for the small farmers. Additionally, if rich country markets are accessible to farmers, it would result in a significant increase in farm incomes.

In 2016, India produced 2.81% of the world grape production and its world export market share increased to 2.48% (rank 10) from 0.7% (rank 17) in 1996 (FAOSTAT). The rise in exports since the 1990s has given Indian farmers unique market access to the high value EU markets. The country earned revenue of Rs.2298 in 2020-21 export season. This was achieved despite the increasingly stringent quality requirement of the EU markets. The expansion of exports was achieved with rapid upgradation of production technology by the grape farmers. In 2017-18, Maharashtra produced 78.3% of the total production in the country and its share of exports was at 90%. The growth in grape sector of Maharashtra is essentially product and process innovation arising out of necessities of adjusting to evolving export market scenario. This makes grape farmers unique in terms of technology adoption in the agriculture sector.

The grape farmers in Maharashtra have been working often work in informal network groups to exchange tacit and explicit information. These network groups played a constructive role in adoption of modern technology in grape farming. In 1960's, grape growers association or Maharashtra Rajya Draksha Bagayatdar Sangh (MRDBS) came into being. It played a pivotal role in nurturing and fostering farmer networks. The information flows happened via these networks, in which the progressive farmers formed the strongest nodes within the farmer community. The grape plots of these progressive farmers often demonstrate advanced practices to the visiting grapes farmers. Visiting each other's plots at various stages of plant growth is a regular activity among the farmers in the grape growing areas. Sometimes, these networks hire or share the same contractual labour groups to ensure similarity in agricultural practices, to ensure similar plant growth, and achieve similar quality parameters. This approach sometimes helps laggard farmers in marketing the produce to the targeted exporters for higher price realization. This association is mutually beneficial even for the progressive farmers' as bulk buying of input for the group reduces cost for them too. And exchange of machinery tools and implements helps in times of need for all the parties involved. Within these informal networks, the individual farmers are not bound to strictly adhere to what others say or are doing but are

free to fine tune their practices to whatever degree they wish and keep cognizance of their own unique locational needs and environmental conditions. These peer-to-peer exchanges play an important role in enhancing and upgrading the knowledge gaps among the grape farmers.

1.2 Objectives

1. To analyse technology adoption in farmer producer organizations.
2. To assess the role of technology adoption in productivity, cost and income change of FPO members and non-members.
3. To analyse factors contributing to technology adoption and diffusion among the grape farmers.
4. To examine the role of export quality requirements in spread of technology among the grape farmers.

1.3 Outline of the Study

The study is organised into five chapters including this introductory chapter. The second chapter reviews the literature on technology adoption in agriculture considering the objectives of the study. The third chapter delves into aspects of technology adoption in farmer producer organisation. It analyses the primary data of FPC members and non-members. The fourth chapter is a case study of grape growers from Maharashtra. It studies the various issues faced by the grape farmers and the technologies applied to produce the export quality grapes. The fifth chapter concludes with findings from the study.

1.4 Limitations of the Study

One limitation of this study is in cross-sectional research design in Chapter 3, which captures primary data at a single point of time in February 2018. This design limits the ability to establish causality or observe changes over time. Consequently, the study can only identify associations rather than cause-and-effect relationships. To address this issue, Chapter 4 charts the evolution of FPO's among grape growers over time but is limited by its exclusive focus on FPOs in a specific crop. Future research should employ longitudinal designs to track changes and developments over time, allowing for a more comprehensive understanding of the causal dynamics at play.

Chapter 2: Review of Literature

With the increasing fragmentation of land over decades farming has become unviable and loss-making enterprise. To address the problems effectively and reinvigorate the scale economy effects, a new institutional form was introduced by inclusion of Chapter IXA in Companies Act, 1956. The Producer Companies' Act came into force on 6 February 2003 with objective to revitalize the dormant forces in agriculture and come up with strategies to address the problems faced by farming community. The producer company works on mutual assistance principles, namely, voluntary membership, voting right independent of shareholding, elected board from amongst members, limited return on share capital, and distribution of surplus on patronage basis. The list of objects and activities includes eleven items among which, in addition to the core activities of the company such as production, value addition and marketing of the produce, such activities as providing education on the mutual assistance principles to its members and others; rendering technical services, consultancy services, training, research and development and all other activities for the promotion of the interests of its members; and promoting techniques of mutuality and mutual assistance (Nadia Pustovoitova, 2011).

The Small Farmers Agribusiness Consortium (SFAC) acts as the nodal agency at the center and agriculture departments at the state level have taken lead in formation of FPCs. By addressing the bottlenecks in the value chain, the producer companies are thought to be alternative to the inefficiencies ridden cooperative form of organization (Shah, 2010). To protect the farmer organizations from political and bureaucratic meddling as seen in cooperatives and overcome the resistance to new generation cooperatives, made the policy makers to come up with new form of organization which would show flexibility and professionalism as a company, while keeping the mutual assistance principles intact.

Sankri and Ponnusamy (2015) conducted a process analysis of the Erode Precision Farm Producer Company. They find that institutional support from state and private agro companies played a catalytic role in development of managerial and marketing skills through training, demonstrations, exposure visits, awareness, and field experiments. Handholding in the initial years is necessary for the survival of the organization. The initial task of FPO was organizing farmers in groups and inculcating collective action capacities. After that, identifying potential opportunities for collective production and marketing activity was the next logical step taken to make FPO functional.

FPOs can overcome problems faced by small and marginal farmers (small volume, limited bargaining power, limited access, limited access to information, risk of distress sales) and stimulate the competition among the farmer groups thereby raising the overall economic value addition at the primary level (Trebbin and Hassler, 2012). Also, it can be a good platform for pooling of land to achieve scale economy effects. If 5-6 villages with similar cropping pattern aggregate land to form a cluster and manage input and output, coordinate activities and make collective decisions, it will have net welfare effects in the region. Trebbin and Hassler (2012) analysed the evolution of farmer producer companies in the collective action and value chain governance framework. The authors conducted 45 interviews to gather information at different scales of organization in various states. They analyse the potential of the producer company model as a bottom-up approach for smallholder participation in emerging markets. For this, their focus is mainly on the value chain development of the producer companies. They also study the case of Vasundhara Agri-Horti Producers' Company Ltd (VAPCOL) by gathering data on their organizational structure, operations management and marketing mechanism. Many farmer organizations were formed under the 'Wadi Programme' of BAIF Development Research Foundation. These organizations were brought together by BAIF and were scaled into a producer company for marketing of produce with aim of realizing better prices by getting in contract with bulk buyers. The prearranged prices with buyers allowed farmers economic security and reduced dependency on short-term market changes. The increased employment generation improved the economic situation and reduced the labour migration considerably in its area of operation.

Singh (2013) in his study of organization and performance of producer companies in India examined the development trajectories of FPOs in various states. It detailed the status of 24 producer companies in terms of the ownership, the management structure, and their business performances on various parameters for the four states of Madhya Pradesh, Gujarat, Rajasthan and Maharashtra. A majority of producer companies in Madhya Pradesh under District Poverty Eradication Project (DPIP) are showing losses while most non DPIP are profitable. In Rajasthan, NGO supported producer companies are working better and showing profit. In the case of Gujarat most are profitable while all the surveyed producer companies in Maharashtra turned out to be loss making. Most of them were commodity focused which increased their exposure to price volatility in those specific crops. Some major problems faced were lack of working capital, compliance problems, poor marketing and value addition expertise. The study

recommended providing grants during early stages, exemption from corporate tax for a few years, collateral free loans like SMEs, NBFC status, and suggests inclusion of financial agency on the board may help the organisation.

Murray (2009) identified the various growth stages of a farmer producer company. In general, initiatives of producer companies are start-ups, promoted by NGOs/development agencies/sponsoring organizations. Most of them are performing the function of providing technical services and inputs to producers or pooling produce for collective marketing. This may be considered as the first stage of evolution of producer companies. The emergence of producer companies like those promoted by Fab India, where corporates come together with farmers to share prosperity through retailer partnerships and such initiatives may be considered as the second stage evolution of producer companies. Producer companies having their own processing infrastructure and developing their own identity, brands, supply-chain will be the third stage. Only when the third stage occurs at which the producers be able to directly connect with and have command over the markets and thus a greater share in the market pie, then the concept of producer companies will be completely successful in India.

Shah (2016) examines the need for new forms of organization. He observes that most FPOs were formed to do what traders were doing anyways, but with greater presumed efficiency and transparency. Notably, most FPOs were formed under some government programme or the other, which offered to cover the promotional cost incurred by the promoting NGO. Many FPOs formed under the new law do not have the organizing logic like the value-addition model. Lack of which is the prime reason for the failure of many cooperatives. Shah also points out that IRMA studies suggest that the design of cooperative enterprises should be about constantly reimagining how members will interact with cooperatives in ways that will impart strength and vitality to the cooperatives. Failure of cooperatives was often rooted in inability of their promoters to master this interaction. He suggests design thinking as an essential component if producer organisations expect a turnaround in their businesses.

With the rise of producer companies, it will be interesting to see how the free rider problem is handled. One of the primary reasons for the inefficiencies of cooperatives stems from the burden of free riders eating into the profits generated. The free rider problem refers to the situation where a non-member receives benefits associated with the provision of public goods by the cooperative (e.g., higher commodity prices), but avoids becoming a member—and thus eschews contributing to the costs associated with this provision, which are incurred by

members alone (Iliopoulos and Theodorakopoulou, 2014). The Producer Companies' Act gives enough freedom to choose its members based on certain criteria. It needs further probing how promoters are proactively selecting members while expanding the organization. In a way this determines if the producer company is prudently managing risks and focusing on its core functions. Marzena Puzniak and Paul Cegys (2011) find many capacity and governance challenges for producer companies like instilling ownership, motivating and facilitating collective action, achieving effective participation, finding the right leadership, managing governance over large and varied membership and ensuring effective communication between all institutional levels.

When it comes to cooperatives the role of leadership and its importance in their success is pivotal. The producer company board is expected to induct professionals from the field. Does this make them more effective in understanding market clues, competitive behavior, capital constraint problems and service orientation? It is a matter to be probed further. Along with the quality of leadership, commitment of member farmers to the collective cause is also an important determinant of its success. Leadership which encourages active member participation in day-to-day activity for handling particular domain builds positive learning curves. Identifying new ways in which an organization can work, expand and excel in its activity depends on the quality of leadership. When the constituents have no prior exposure or experience in remaining cohesive as a group for performing business function it becomes incumbent on leadership to identify ways to address the problem.

In developing countries like India, poor transport and communication networks restrict farmers from accessing remunerative markets and result in opportunities for rent seeking by local traders and middlemen. Lack of adequate local markets and costlier transport for the small quantities, force farmers to sell their produce to local traders at low price (Hegde, 2010). In the absence of large produce, small farmers have low bargaining power in input procurement as well as in sale of output (Kirsten and Sartorius, 2002).

Emran and Hou (2013) provide robust evidence from China that better access to markets leads to substantial benefits for rural households and the effects of domestic market access are significantly larger. With the formation of FPOs, the role of middlemen is significantly reduced (Fafchamps and Hill, 2005). Hence, farmer organizations create opportunities for small and marginal farmers to participate more effectively in markets (Stockbridge et al. 2003). The entry barrier of small farmers is also reduced because of enhanced bargaining power (Kherallah et

al., 2002; Thorp et al., 2005). Towards this, farmer organizations lower information cost for better market timings, clues as well as access to technologies. Further, small farmers' access to better machinery and equipment, timing of operations such as sowing, spraying and harvesting is also possibly improved through FPO.

The Agricultural Household's Situation Assessment Survey of 2003 (NSSO 59th round) show that only about 41% farm households in the country access information on modern agricultural technologies and farming practices. And 75% of them use it in their farming and other decisions related to it. Farmers mostly rely on other information sources like mass media (radio, television, newspaper) and social networks and progressive farmers for their information needs. They find formal information sources though limited in their outreach have a larger impact compared to the informal information sources and enhances net returns from farming by 12% on an average. The effect varies across cropping systems and is larger in the diversified farming systems (BIRTHAL et al., 2015).

The immediate access of formal advice is through the Kisan Call Centres (KCC). The KCC toll free number was launched in 2004 to provide technical advice in 22 languages to the farmers over the mobile phone or telephone, from 6 am to 10 pm, on all seven days of the week. During the working hours the query is immediately answered, but beyond working hours the calls are recorded and the queries are answered later by post. The KCC responds to any issue that concerns the cultivation of crops. The technical advice is dispensed by the Farmer-Tele-Advisors (FTA), who are agriculture graduates. In case the FTs is not able to answer the query adequately the call can be escalated to agriculture department from block to state level; or state agriculture universities and KVKs and KCC FTAs connect through call conferencing to resolve the queries. In an evaluation study by Shroff (2018), it was found that for Maharashtra and Goa only 69 FTAs were employed to handle the queries. They worked in 2 shifts and at any given time 30 FTAs were able to respond. In 2017-17 over 6.8 lakh calls were received from Maharashtra alone. These shows the very high demand of such services required by the farmers. But about 60% farmers report the call being continuously on wait to gain access to the FTAs. Also, the FTAs are fresh graduates, so the attrition rate is very high leading to loss of expert personnel and significant training costs.

The scale of outreach of any other government information dissemination mechanism remains abysmally low. Given this scenario farmers mostly learn from the progressive farmers or within farmer communities. The farmer social networks have been much studied in this context

(Bandiera and Rasul, 2006; Conley and Udry, 2010; Foster and Rosenzweig, 1995). The adoption of new technology depends on the local context and the strength of the farmer network in the crop region. If the farmer networks are fragmented geographically, it might result in low adoption of a proven technology (Munasib and Roy, 2012). In this context, the farmer organisations are kind of natural network economies, transmitting information regarding the production practices, with objective of gaining market access to new markets by establishing flexible linkages to highly specialised demands. The demand is met through customizing the production management and operations to comply with the specific needs of the buyers. Given the fragmented land holding farmer producer organisations are a means for member farmers for transforming into more market-oriented and business-oriented agriculture.

The term 'green revolution' refers to all crops where there has been a yield breakthrough. India's High Yielding Varieties Programme (HYVP), initiated in 1967, included wheat, rice, maize, jowar (sorghum) and bajra (pearl millet). The yield revolution in wheat in India, was result of modification in plant architecture and physiological rhythm. The changes in plant architecture involved the introduction of the dwarfing genes procured from Dr. Norman Borlaug from Mexico, which helped to prevent water logging in plants under conditions of good soil fertility and irrigation, thereby promoting greater translocation of photosynthates to grain formation, i.e. higher harvest index. In the national demonstration plots, laid out during 1964-65, small farmers harvested 4 to 5 tonne/ha of wheat in contrast to less than 1 tonne/ha in the control plots. The success of these farmer plot demonstrations unleashed the enthusiasm of farmers and subsequently a small government programme became a mass movement. The Indian Agricultural Research Institute (IARI) came up with new semi-dwarf wheat varieties like Kalyan Sona and Sonalika suitable to Indian palate. Since then, hundreds of high yielding varieties have been released by wheat scientists working under the All India Coordinated Wheat Improvement Project sponsored by the Indian Council of Agricultural Research (ICAR). The wheat production reached a level of 17 million tonnes in 1968, in contrast to 12 million tonnes 4 years earlier. In 1967-68, the public procurement at uniform minimum support price of Rs. 65 per quintal for all wheat varieties further played a catalytic role in widespread adoption of new wheat varieties (Swaminathan, 2013).

It must be emphasised that the green revolution became possible only because of synergy between technology, public policy and farmers' enthusiasm. Public policy with reference to input and output pricing and assured and remunerative marketing was essential to get the

economics right and thereby sustain farmers' interest in producing more. This also became clear from the somewhat disappointing results of Dr. Norman Borlaug's efforts in Africa, where there was no arrangement for procuring the surplus grains from farmers at an assured minimum support price, thus under scoring that high yielding varieties alone would not help to accelerate production, unless coupled with the other essential inputs, particularly remunerative prices for the produce and assured marketing opportunities. Similar efforts were done in other important crops to increase the yields by adoption of hybrid technology.

Chapter 3: The Role of Farmer Producer Organizations in Technology Adoption

3.1 Introduction

Since the 1990s, with the advent of liberalization, policy makers and cooperative sector leaders started rethink on how to reorganize the FPOs and infuse professionalism in the sector. With this objective, the Government of India formed a ‘High Powered Committee for Formation and Conversion of Cooperative Business into Companies’ under chairmanship of Prof Y.K. Alagh on 1st November 1999. The stated terms of reference were a) examine and make recommendations with regard to framing legislation which would enable incorporation of existing cooperative into companies; and b) ensure the proposed legislation accommodates the unique elements of cooperative businesses within a regulatory framework similar to that of private limited company.

The committee submitted its report in March 2000, in which it noted the need to transform the cooperative structure, especially its dependence on the government support and the engagement with bureaucracy and suggested a new organizational structure of Farmer Producer Company (FPC). This was aimed to promote organizations with minimum government interference and offer space to evolve for farmer organizations. The Department of Agriculture and Cooperation, Ministry of Agriculture, identified farmer producer organization registered under the special provisions of the Companies Act, 1956 as the “appropriate institutional form around which to mobilize farmers, build their capacity to collectively leverage their production and marketing strength”. Farmer Producer Company works on mutual assistance principles, viz. voluntary membership, voting right independent of shareholding, elected board from amongst members, limited return on share capital, and distribution of surplus on patronage basis.

In aftermath of passing the amendment to the Companies Act (2003), it was expected that cooperatives would convert into companies. But hardly any cooperative turned into the farmer producer company. This has happened, despite the said objective of the Act to open gateways for conversion of existing cooperatives into companies. Even Verghese Kurien of AMUL, who was at the forefront advocating for the Act could not initiate process for converting Gujarat Cooperative Milk Marketing Federation (GCMMF) into Farmer Producer Company, due to entrenched government controls in the organization.² The initial objective of converting

² <https://www.rediff.com/money/report/interview-amrita-patel-on-kurien-ideologies/20120912.htm>

cooperatives into producer companies have not taken roots even in the case of FPOs represented by the committee members. Vinay Kore of the oldest producers cooperative Warana Rural Cooperative Complex was a member of the Alagh Committee but even he could not initiate process for the conversion to company. Despite these happenings, the organizational dynamism found in Maharashtra, due to its cooperative's culture has spill over in its newly formed FPOs.

While the cooperatives as a means of value addition and income change medium is on the decline, with the view of reorienting agricultural organizations as a profit-making enterprise, the government is promoting FPO's vigorously, particularly since 2013 when Food and Agriculture Organization (FAO) declared it a year of FPOs on India's request. As a result, increasing number of farmers' enterprises have been emerging in the form of FPOs across India, and Maharashtra is no exception. The government of Maharashtra is promoting FPOs with the objective of strengthening value chains to make agriculture viable for the smallholders. The primary rationale of such efforts has been that scale economy effects will bring in efficiency and result in higher net income for the farmers. With this objective Small Farmers Agribusiness Consortium (SFAC), Maharashtra Agricultural Competitiveness Project (MACP)³, Convergence of Agriculture Initiatives in Maharashtra (CAIM)⁴, National Bank for Agriculture and Rural Development (NABARD) and other organizations have promoted and invested in formation of FPOs. These initiatives have led to formation of market-oriented organizations with objective of leveraging their natural endowments to improve the economic condition of its member farmers.

In 2011, NABARD started a "Producers Organization Development Fund" (PODF) with an initial corpus of Rs. 50 crores to meet the needs of producers. The PODF provided the loan-linked grant support for promotion, capacity building & market interventions. Also, grant assistance to eligible agencies for conducting special studies, stakeholders' meeting/conference, round table discussions, building specialized capacities for existing FPOs, ICT interventions for improving marketing/operational efficiency and such other critical interventions necessary for building sustainable FPOs. This gave an impetus to the public policy initiatives in subsequent years.

³ MACP was a World Bank Project in partnership with government of Maharashtra to increase the productivity, profitability, and market access of the farming community in Maharashtra.

⁴ CAIM was an IFAD project for bringing about Convergence of Agricultural Interventions in Maharashtra's distressed districts. The project area included 1,200 villages in the districts of Akola, Amravati, Buldhana, Wardha, Washim and Yavatmal.

The Government of India in February 2021 launched a new Central sector scheme titled 'Formation and promotion of 10,000 FPOs' with a clear strategy and committed resources to promote 10,000 new FPOs in the country with budgetary provision of ₹6,865 crores. The objectives laid out were as follows - to provide broad-based supportive ecosystem to facilitate development of income-oriented farming, to enhance productivity through efficient, cost-effective and sustainable resource use and realize higher returns through better liquidity and market linkages for their produce and become sustainable through collective action. To achieve this handholding, support up to 5 years from the year of creation in all aspects of management of FPO, inputs, production, processing and value addition, market linkages, credit linkages and use of technology etc. was provided. The government also aimed for capacity building of FPOs to develop agriculture entrepreneurship skills for them to become economically viable and self-sustaining beyond the period of government support. This initiative gave an immense boost to the FPO ecosystem in the country and spurred FPO formation across the country. The purpose was to collectivise farmers, especially small and marginal producers, across several states, to foster technology adoption, improve productivity, facilitate adoption of good agricultural practices, enable improved access to inputs and credit, develop direct marketing capacity and thereby enhance farmer incomes, thereby augmenting their livelihoods.

Many a times farmers have come together to address issues such as adoption of market oriented agricultural practices, logistic issues and cost-effective solutions for the same. These informal farmer groups started with narrow strategic focus on marketable production and then evolved as independent business entities. They formalised into farmer producer companies. Their experience of working together gave them an edge in handling market challenges such as aggregation, price discovery. We term these farmer producer companies as 'organically evolved FPO' whereas the 'promoted FPO' are formed under some government projects such as MACP. As formation of such FPOs were induced externally, they fall short of the required level of internal cohesion to achieve business goals. This difference we argue is of material significance in differential performance as promoted FPOs come with accompanying policy induced distortions leading to negative selection over the life cycle of FPOs. The negative selection is in terms of the leaders of the FPOs based on their objectives and its choice of members. This is then reflected in the outcomes for the farmers. The time bound support with funds has led to emergence of several FPOs that last for short periods tallying with the funding cycle. Upon formation, emphasis on numbers has also been a bane leading to non-serious and

ineffective membership. The size and composition of FPOs is important for success, a factor that has not been internalized in promotion of FPOs.

This chapter is based on a primary survey conducted in Maharashtra for IFPRI project on Comparative Study of Farmer Producer Organizations in Bihar and Maharashtra. Here, an assessment of farmer producer organizations as a medium of technology adoption among the member farmers is attempted using various statistical methods. We also gather data on farmers not within the fold of farmer producer organizations for comparison purpose.

3.2 Research Methodology

3.2.1 Data Sources

The below Table 1 shows how farmer producer companies as a new form of organization were embraced by the farmers in Maharashtra. Though, the provision for FPO came into existence on 6 February 2003, the FPO registration really caught up pace after 2010. The Table 1 shows the spurt after 2013 that coincides with FPO establishment drive under the Maharashtra Agricultural Competitiveness Project (MACP), a World Bank and Government of Maharashtra project, which alone established 405 FPOs out of 1212 (as of 30 June 2017).

Table 1: Year wise growth in FPO formation in Maharashtra

| Year | No. of FPOs formed |
|---------------|--------------------|
| 2004 | 2 |
| 2005 | 2 |
| 2006 | 7 |
| 2007 | 2 |
| 2008 | 5 |
| 2009 | 8 |
| 2010 | 9 |
| 2011 | 17 |
| 2012 | 31 |
| 2013 | 53 |
| 2014 | 129 |
| 2015 | 431 |
| 2016 | 321 |
| 2017 | 194 |
| Total/Average | 1211 |

Source: SFAC compiled Registrar of Companies registrations

The major source of Farmer Producer Company data is Registrar of Companies.⁵ But it does not provide information about the ‘promoting agencies’ like government institutions or NGOs. These promoting organisations do not publish data on the details of FPCs either, except for a few success stories on their websites. Though most organisations collect data, the timespan is limited to the project period and the details in public domain are sparse. To overcome this, FGDs/KPI were conducted with representatives of NABARD, Maharashtra Agricultural Competitiveness Project (MACP), Agribusiness Infrastructure Development Investment Program (AIDIP), Maharashtra State Agricultural Marketing Board (MSAMB), Convergence of Agricultural Interventions in Maharashtra (CAIM), Small Farmers Agribusiness Consortium (SFAC), MAHAFPO – the federation of farmer producer companies in Maharashtra.

Though all FPOs are registered as farmer producer companies, these are not homogenous structures. Some farmers’ enterprises are ‘organically evolved in nature’, evolved from informal or formal groups engaged in diverse activities to its natural progression of structured legal business entities.

Around 50% of the total 1211 (as on 30th June 2017) registered FPOs in Maharashtra are promoted under some projects such as MACP, CAIM, and NABARD or by SFAC (See Table 2). Another type of FPO is those promoted under Corporate Social Responsibility (CSR) by corporate entities such as HCL Foundation, Bajaj, Deepak Fertilizer’s, Rallis India, etc. Though, we could get data on promoted and organically evolved FPOs from the respective governmental organisations during the interaction with them, the information from the corporate sector is not readily available. It is possible that the number of promoted FPOs would be larger than the reflected number in the Table 2. We have enlisted all the FPOs as organically evolved FPOs for whom we could not get information from the promoting organisations. We tried to include both types of the FPOs in our study.

Table 2: Number of promoted and organically evolved FPCs across Maharashtra (until June 30, 2017)

| S.N. | Districts | SFAC | MACP | CAIM | NABARD | No. of promoted FPOs | No. of organically evolved FPOs | Total FPOs |
|------|-----------|------|------|------|--------|----------------------|---------------------------------|------------|
| | | | | | | | | |

⁵ <http://www.mca.gov.in/MinistryV2/registrarofcompanies.html>

| | | | | | | | | |
|----|------------------------|----|----|----|----|-----|-----|-----|
| 1 | Mumbai City + Suburban | | | | | 0 | 16 | 16 |
| 2 | Thane + Palghar | 5 | 4 | | | 9 | 17 | 26 |
| 3 | Raigad | 1 | 6 | | 6 | 13 | -1 | 12 |
| 4 | Ratnagiri | | 3 | | | 3 | 11 | 14 |
| 5 | Sindhudurg | | 7 | | | 7 | 8 | 15 |
| | Konkan Division | 6 | 20 | | 6 | 32 | 51 | 83 |
| 6 | Nashik | 5 | 16 | | 15 | 36 | 53 | 89 |
| 7 | Dhule | | 14 | | 3 | 17 | 9 | 26 |
| 8 | Nandurbar | | 6 | | 2 | 8 | 6 | 14 |
| 9 | Jalgaon | 2 | 12 | | 16 | 30 | 3 | 33 |
| 10 | Ahmednagar | 2 | 14 | | 5 | 21 | 55 | 76 |
| | Nashik Division | 9 | 62 | | 41 | 112 | 126 | 238 |
| 11 | Pune | 7 | 18 | | 1 | 26 | 79 | 105 |
| 12 | Solapur | | 14 | | | 14 | 32 | 46 |
| | Pune Division | 7 | 32 | | 1 | 40 | 111 | 151 |
| 13 | Satara | 2 | 13 | | 5 | 20 | 9 | 29 |
| 14 | Sangli | 2 | 15 | | | 17 | 14 | 31 |
| 15 | Kolhapur | | 14 | | | 14 | 26 | 40 |
| | Kolhapur Division | 4 | 42 | | 5 | 51 | 49 | 100 |
| 16 | Aurangabad | 5 | 15 | | 22 | 42 | 19 | 61 |
| 17 | Jalna | | 13 | | 1 | 14 | 20 | 34 |
| 18 | Parbhani | | 14 | | | 14 | 6 | 20 |
| 19 | Hingoli | | 13 | | | 13 | 6 | 19 |
| | Aurangabad Division | 5 | 55 | | 23 | 83 | 51 | 134 |
| 20 | Beed | | 14 | | 19 | 33 | 13 | 46 |
| 21 | Nanded | 3 | 14 | | | 17 | 10 | 27 |
| 22 | Osmanabad | 3 | 14 | | | 17 | 43 | 60 |
| 23 | Latur | 3 | 17 | | | 20 | 37 | 57 |
| | Latur Division | 9 | 59 | | 19 | 87 | 103 | 190 |
| 24 | Buldhana | 3 | 12 | 5 | 7 | 27 | 15 | 42 |
| 25 | Akola | 2 | 13 | 7 | | 22 | 3 | 25 |
| 26 | Washim | | 10 | 1 | 2 | 13 | 9 | 22 |
| 27 | Amravati | 5 | 15 | 6 | 4 | 30 | 24 | 54 |
| 28 | Yavatmal | 14 | 15 | 2 | 1 | 32 | 10 | 42 |
| | Amravati Division | 24 | 65 | 21 | 14 | 124 | 61 | 185 |
| 29 | Wardha | 3 | 7 | 8 | 12 | 30 | 9 | 39 |
| 30 | Nagpur | 1 | 8 | | 1 | 10 | 22 | 32 |
| 31 | Bhandara | 1 | 7 | | | 8 | 12 | 20 |
| 32 | Gondia | 6 | 5 | | | 11 | 8 | 19 |
| 33 | Chandrapur | 6 | 1 | | 5 | 12 | 3 | 15 |

| | | | | | | | | |
|----|-----------------|----|------|----|-----|-----|-----|------|
| 34 | Gadchiroli | | | | 2 | 2 | 3 | 5 |
| | Nagpur Division | 17 | 28 | 8 | 20 | 73 | 57 | 130 |
| | Maharashtra | 81 | 363* | 29 | 129 | 602 | 609 | 1211 |

* - By completion of the project, 405 FPCs were formed.

Source: The table is compiled from year wise data shared by SFAC office, Pune; as well as data shared by MACP, CAIM, and NABARD officials.

The geographical spread of the FPOs formed in Maharashtra shows a peculiar pattern. It was expected the districts having higher density of cooperatives to begin with would shift to this new form of farmer enterprises, but the traditional cooperative belt of Western Maharashtra (except Pune district) has shown tepid response to form the FPOs (as seen in above Table 2). On the other hand, regions of Marathwada and Vidarbha having comparatively poor history of cooperative but more such organisations were formed under the new producer companies Act. This seems initially driven by the government initiatives to formalise clusters of farmer groups under ATMA into farmers organizations. Also, private initiatives by progressive farmers took root when MAHAFPC, a federation of FPC's started procuring pigeon pea for government of Maharashtra.

3.2.2 Sample Design

We use stratified sampling to collect primary data of FPO members and non-FPO farmers. In the first stage we identify districts for collecting primary data by classifying them into low, medium and high-income districts. We do this by calculating the agriculture income per land holding in respective districts (Table 3). The district agriculture income is the sum of income derived from all agriculture activities including animal husbandry. Generally, more the share of high value agriculture in the district's agriculture, higher is the district agriculture income. Hence, in one sense it can be treated as a proxy for crop diversification and market infrastructure such as roads and markets. Also, as shown in Table 3 gross district agriculture income shows high correlation with number of FPOs formed. The districts showing higher crop diversity, such as Pune and Nashik head the list, in terms of number of FPOs registered.

Considering above background, we divide the districts of Maharashtra into three groups

- High agricultural income districts (HIDs)
- Medium agricultural income districts (MIDs)
- Low agricultural income districts (LIDs)

Table 3: District wise agriculture income per operational land holding

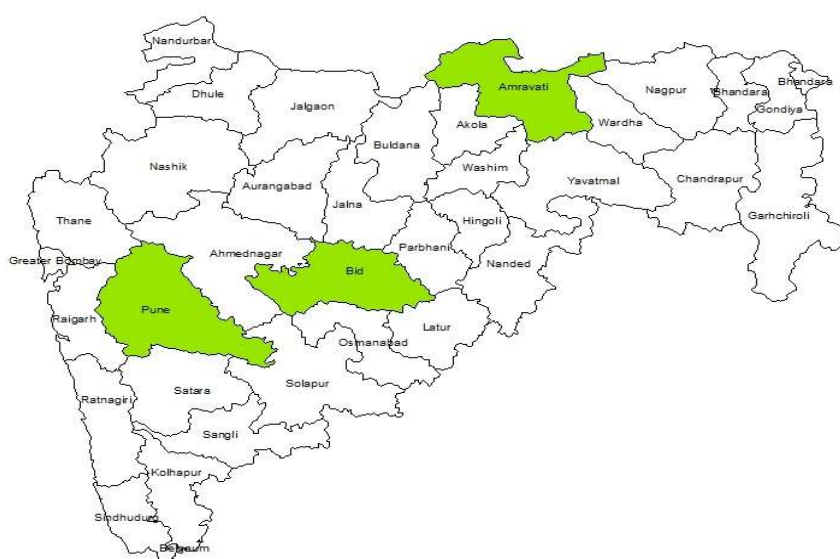
| S.N. | District | Total no. of FPOs in Maharashtra (upto 11 July, 2017) | Agriculture and Allied Activity (Rs.Crore) (2013-14)* | Total no. of operational holdings (Ag census 2011) | Agriculture income / land holding (in Rupees) (in descending order) | District income group classification |
|------|------------------------|---|---|--|---|--------------------------------------|
| 1 | Mumbai City + Suburban | 16 | 5249 | NA | NA | NA |
| 2 | Nashik | 89 | 17648 | 642662 | 274608 | HID |
| 3 | Washim | 22 | 3633 | 196424 | 184957 | HID |
| 4 | Dhule | 26 | 4043 | 235999 | 171314 | HID |
| 5 | Latur | 57 | 6570 | 388916 | 168931 | HID |
| 6 | Jalgaon | 33 | 7397 | 438634 | 168637 | HID |
| 7 | Pune | 105 | 11747 | 743239 | 158051 | HID |
| 8 | Thane + Palghar | 26 | 4206 | 279654 | 150400 | MID |
| 9 | Sangli | 31 | 7728 | 538634 | 143474 | MID |
| 10 | Nandurbar | 14 | 1991 | 147122 | 135330 | MID |
| 11 | Gadchiroli | 5 | 1815 | 134855 | 134589 | MID |
| 12 | Jalna | 34 | 5443 | 410342 | 132645 | MID |
| 13 | Kolhapur | 40 | 8251 | 638284 | 129268 | MID |
| 14 | Akola | 25 | 3082 | 242253 | 127222 | MID |
| 15 | Aurangabad | 61 | 6343 | 529861 | 119711 | MID |
| 16 | Parbhani | 20 | 4159 | 347918 | 119540 | MID |
| 17 | Osmanabad | 60 | 4195 | 356579 | 117646 | MID |
| 18 | Wardha | 39 | 2297 | 196210 | 117068 | MID |
| 19 | Amravati | 54 | 4794 | 415858 | 115280 | MID |
| 20 | Yavatmal | 42 | 4178 | 378684 | 110329 | MID |
| 21 | Nagpur | 32 | 2952 | 268565 | 109918 | MID |
| 22 | Buldhana | 42 | 4699 | 430188 | 109231 | MID |
| 23 | Sindhudurg | 15 | 2985 | 278552 | 107161 | MID |
| 24 | Nanded | 27 | 5554 | 582200 | 95397 | MID |
| 25 | Bhandara | 20 | 2043 | 218672 | 93428 | MID |
| 26 | Solapur | 46 | 6227 | 667910 | 93231 | MID |
| 27 | Ahmednagar | 76 | 8674 | 956094 | 90723 | MID |
| 28 | Chandrapur | 15 | 2747 | 304227 | 90294 | MID |
| 29 | Raigad | 12 | 2761 | 311648 | 88594 | MID |
| 30 | Hingoli | 19 | 1777 | 213103 | 83387 | MID |
| 31 | Satara | 29 | 6536 | 862305 | 75797 | LID |
| 32 | Beed | 46 | 4608 | 651783 | 70698 | LID |
| 33 | Gondia | 19 | 1470 | 237763 | 61826 | LID |
| 34 | Ratnagiri | 14 | 2424 | 453827 | 53412 | LID |

| | | | | | |
|--|-------------|------|--------|----------|--------|
| | Maharashtra | 1211 | 170229 | 13698965 | 124264 |
|--|-------------|------|--------|----------|--------|

Note: * Sector wise Gross Domestic Product of MH - 2013-14 (at current price) (Base year 2004-05); NA- Not available

We select Pune, Amravati and Beed districts based on high number of FPOs concentration within the LID, MID and HID groups. The selected three districts also fall in three different agriculture divisions and geographical regions namely, Beed from the Marathwada region, Amravati from the Vidarbha region, and Pune from the Western Maharashtra region reflecting the variation in their natural resource endowments.

Figure 1: Survey districts of Maharashtra



We see a major increase in FPO formation since 2013, as the government initiatives started supporting such activities. Particularly, Pune district farmers took lead in experimenting with new market linkage approaches by forming producer organisations for direct selling of vegetables to consumers in housing societies. These efforts reflect in the increase in number of producer organisations registered in subsequent years.

Table 4: Year wise growth in FPO formation in the selected districts

| Year | Amravati | Beed | Pune | Total |
|------|----------|------|------|-------|
| 2004 | | | 1 | 1 |
| 2005 | | | 1 | 1 |
| 2006 | | | 1 | 1 |
| 2008 | 1 | | | 1 |
| 2009 | 1 | | 1 | 2 |
| 2010 | | | 1 | 1 |
| 2011 | 3 | 1 | 1 | 5 |

| | | | | |
|-------|----|----|-----|-----|
| 2012 | | 1 | 7 | 8 |
| 2013 | | 1 | 5 | 6 |
| 2014 | 13 | 2 | 15 | 30 |
| 2015 | 19 | 25 | 32 | 76 |
| 2016 | 4 | 9 | 22 | 35 |
| 2017 | 13 | 7 | 18 | 38 |
| Total | 54 | 46 | 105 | 205 |

A detailed list of producer organisations is compiled for each of the districts / income groups. We randomly select two organisations in Beed and Amravati districts and one from Pune to form the first treatment group of promoted FPOs. Simultaneously, one randomly selected organisation from each district forms the second treatment group representing organically evolved FPOs.

In the second stage we select an appropriate sample size per FPO for the member survey. Our talks with the various officials of promoting agencies revealed that the average number of members per FPO in Maharashtra is around 400 (see Table 5). Since 405 of the total 1211 FPOs formed were under the MACP project they ensured the member strength at around 400 per FPO. If we assume the average size of FPO is 400, the sample size at 90 per cent confidence and 7 per cent margin of error gives 124 each for Beed and Amravati and 118 in Pune district (given only 2 FPOs selected). So, we planned to interview around 50 members and 20 non-members per FPO. During the survey we interviewed higher than required in Beed and Amravati districts but lower in Pune district for FPO members due to subdued response. We conducted a primary survey of 403 FPO members and 172 non-FPO farmers, so in total 575 farmers in Maharashtra. The non-FPO farmers belong to the same village as FPO member villages but are not member of any producer organisations and have similar socio-economic characteristics.

Table 5: Sampling plan

| District | No. of FPOs selected for survey | Average no. of FPO members in MH* | Population frame | Required sample size @ 90% CI and 7% MoE | Sample collected from FPO members (around 50 per FPO) | Sample collected from non-FPO farmers (around 20 against each FPO surveyed) | Total sample collected | Villages covered |
|----------|---------------------------------|-----------------------------------|------------------|--|---|---|------------------------|------------------|
| | | | | | | | | |

| | | | | | | | | |
|----------|---|-----|------|-----|-----|-----|-----|----|
| Beed | 3 | 400 | 1200 | 124 | 149 | 63 | 212 | 10 |
| Amravati | 3 | 400 | 1200 | 124 | 155 | 68 | 223 | 21 |
| Pune | 2 | 400 | 800 | 118 | 99 | 41 | 140 | 28 |
| Total | 8 | | 3200 | 366 | 403 | 172 | 575 | 59 |

Note: CI – Confidence Interval, MoE – Margin of Error;

* - The average no. of members per FPO in Maharashtra is based on the data shared by the promoting organisations.

3.2.3 Survey Area

A total of 59 villages were covered in the survey across areas of the selected 8 FPO's as below. The selected sample FPOs are from different talukas and villages and involved in as varied activities as possible.

Table 6: Survey areas across Maharashtra

| District | FPO (Promoter Organisation) | Taluka | Villages |
|------------------------------------|--|----------------------------|---|
| Amaravati (Middle Income District) | Green Future (MACP) | Amaravati, Chandur, Morshi | Rohankhed, Savanga, Pusada, Brahmanwada Bhagat, Nandura Lashka, Devara, Morshi, Chandur |
| | Baliraja Shetkari (MACP) | Chandur railway, Tiwasa | Salora Khurd, Wadona, Nimla, Amla Vishveshwar |
| | Shubhlabh (Organically evolved FPO) | Anjangaon Surji | Karla, Takarkheda, Bhandaraj, Khirala, Nimkhed Bazar, Turkhed, Dhanegaon, Anjangaon Surji, Padanri |
| Beed (Low Income District) | Nagad Narayan (MACP) | Shirur | Paundul 1, Paundul 2, Paundul 3, Shirapur, Rajmoha |
| | Agro Unnati (MACP) | Ashti | Gitewadi, Dhamangaon, Dohithan, Kada |
| | Creative Agro (Organically evolved FPO) | Beed | Borkhed, Mahajanwadi, Beed |
| Pune (High Income District) | Krushni Vidnyan Mandal (Organically evolved FPO) | Junnar | Kalwadi, Otur |
| | Krushni Jivan Agro (MACP) | Junnar | Narayangaon, Basti, Kolhe aali, Khamgov, Kusur, Pargaon, Dhamankhel, Neemdari, Bhorwadi, Dumbharwadi, Sawargaon, Manjarwadi, Pimpri pendhar, Manikdoh, Sakore, Jimdari, Varulvadi, Ambegaon, Kumshet, Dhangerwadi, Pakande, |

| | | | |
|--|--|--|--|
| | | | Yedgaon, Dhumralwadi, Ozar, Narayanwadi, Junnar |
|--|--|--|--|

3.2.4 Survey Instruments

The farmers were interviewed using a structured questionnaire that contained five modules. Module A gathered information on the identity of respondent that includes household characteristics such as age, education, social group and family composition. This module also collected information on experience in farming, farm and non-farm income, expenditure, primary and secondary occupation. Module B collected information on agriculture such as land size, source of irrigation, crop engagement, area under irrigation, source of information about new technologies, and source of formal and informal credit. Module C collected information about FPO membership such as benefits of being a member, changes in input cost, productivity, income and expenditure. Module D gathered the same information as module C but for the non-FPO members. Besides the structured interviews of the members, we also held focused group discussions with the boards of directors.

We used the Computer Aided Personal Interviewing (CAPI) System for carrying out the survey. Using CAPI basically entails creating a software App which is used by the field enumerators to canvass the questionnaire. The data was automatically uploaded each day to the servers and quality control (QC) was done to correct for any errors in capturing the data.

3.2.5 Methodology

To identify and select the FPOs as representative for different organizational forms we have classified them in 2 treatment groups – organically evolved FPOs and promoted FPOs. And a group of non-FPO farmers from the villages represented by FPOs have been interviewed to represent the control group. We do this to estimate if technology adoption plays a differential role across the FPO types. So, we analyse the surveyed data by comparing across organically evolved FPO, promoted and non-FPO farmers from Maharashtra.

1. Comparative analysis using frequency distributions across organically evolved FPO, promoted and non-FPO farmers.
2. Regression analysis using probit model for determination of FPO membership.

3. Regression analysis using probit model to estimate changes in productivity, cost and income.

3.3 Performance, Outcomes and Discussion

3.3.1 Descriptive Statistics

Table 7 presents the descriptive statistics for the complete sample and for the sub-sample of treated (FPO members) and non-treated (non-FPO members) farmers separately for comparison. On average, FPO members spend about Rs.1559 more per month than non-members – although their household size and farming experience is similar. The higher expenditure of members vis-à-vis non-members may be due to higher land holding and area under irrigation. This could possibly be a result of better access that FPO members have to information about new technologies and market prices. About 54% of farmers in the overall sample belong to the general caste, 39% belong to Other Backward Classes (OBC), and 4% belong to the Scheduled Castes (SC) and 3% to Scheduled Tribes (ST). In our subsample of farmers who are FPO members, the largest numbers belong to the general category, followed by the OBC, and very few belong to the SC/ST category. Better-educated farmers were present in greater proportions in the sub-sample of members compared to the sub-sample of non-members, indicating that better-educated members are possibly more aware of the benefits of FPOs. However, within the sub-sample of FPO members, those with primary and middle school education as well as bachelor’s and above were present in greater proportion than those with high school level. Occupationally, 97% have agriculture as primary occupation among FPO members compared to 95.35% among non-members. The subsample of non-members also shows presence of government officials at 0.58%.

Table 7: Socio-economic profile of farmers

| Variables | FPO Member | Non-FPO Member | All |
|--|------------|----------------|-------|
| Sample size | 403 | 172 | 575 |
| Age of the respondent | 44.44 | 44.13 | 44.35 |
| Household size | 5.64 | 5.42 | 5.57 |
| Female headed households (%) | 2.45 | 2.1 | 2.34 |
| Average monthly expenditure (Rs.) | 12700 | 11141 | 12234 |
| No. of years in farming | 24.16 | 24.8 | 24.35 |
| <i>Percentage of respondent belonging to</i> | | | |
| Scheduled caste | 4.22 | 5.23 | 4.52 |

| | | | |
|--|-------|-------|-------|
| Scheduled tribe | 3.23 | 1.16 | 2.61 |
| Other backward caste | 39.45 | 36.63 | 38.61 |
| Other minorities | 0 | 0.58 | 0.17 |
| General category | 53.1 | 56.39 | 54.09 |
| <i>Percentage of respondents who</i> | | | |
| No school | 10.2 | 8.72 | 9.76 |
| Primary school | 14.93 | 13.37 | 14.46 |
| Middle school | 13.93 | 12.79 | 13.59 |
| High school | 26.12 | 33.14 | 28.22 |
| Bachelors | 18.16 | 16.86 | 17.77 |
| Bachelors and above | 16.67 | 15.12 | 16.2 |
| <i>Percentage of respondents who have</i> | | | |
| Ration card holder (%) | 99.01 | 97.67 | 98.61 |
| Aadhar card holder (%) | 97.77 | 99.42 | 98.26 |
| Bank account (%) | 98.51 | 99.42 | 98.78 |
| <i>Primary occupation of respondents (%)</i> | | | |
| Agriculture & allied activities | 97.02 | 95.35 | 96.52 |
| Wage labor | 0.5 | 1.16 | 0.69 |
| Trade and business (trader, shopkeeper, tailor, blacksmith, carpenter, etc.) | 0.5 | 1.16 | 0.7 |
| Professional (doctor, engineer, lawyer, teacher, etc.) | 1.99 | 1.74 | 1.91 |
| Govt. employee/semi govt./political office bearer | 0 | 0.58 | 0.17 |

Table 8: Land use pattern of the sample households

| Respondent Type | Total agriculture area (in acres) | | Total irrigated area (in acres) | | Irrigation intensity (%) |
|-------------------------|-----------------------------------|-------|---------------------------------|-------|--------------------------|
| | Mean | SD | Mean | SD | |
| Promoted FPO | 6.10 | 6.92 | 3.69 | 3.60 | 60 |
| Organically evolved FPO | 10.60 | 20.41 | 7.62 | 14.63 | 72 |
| Total FPO | 7.74 | 13.65 | 5.24 | 9.50 | 68 |
| Non FPO | 6.92 | 8.53 | 4.46 | 6.12 | 64 |

| Respondent Type | Total agriculture area (in acres) | | Area under FPO activity (in acres) | | FPO share of total agriculture area (%) |
|-------------------------|-----------------------------------|-------|------------------------------------|------|---|
| | Mean | SD | Mean | SD | |
| Promoted FPO | 6.10 | 6.92 | 2.76 | 3.05 | 45 |
| Organically evolved FPO | 10.60 | 20.41 | 3.54 | 6.97 | 33 |
| Total FPO | 7.74 | 13.65 | 3.04 | 4.86 | 39 |

| Respondent Type | Total irrigated area (in acres) | | Irrigated area under the FPO (in acres) | | FPO share of total irrigated area (%) |
|-------------------------|---------------------------------|-------|---|------|---------------------------------------|
| | Mean | SD | Mean | SD | |
| Promoted FPO | 3.69 | 3.60 | 1.79 | 2.10 | 49 |
| Organically evolved FPO | 7.62 | 14.63 | 2.90 | 3.54 | 38 |
| Total FPO | 5.24 | 9.50 | 2.20 | 2.77 | 42 |

| Respondent Type | Area under FPO activity (in acres) | | Irrigated area under the FPO (in acres) | | Non-irrigated area under FPO (in acres) Mean (%) |
|-------------------------|------------------------------------|------|---|------|---|
| | Mean | SD | Mean | SD | |
| Promoted FPO | 2.76 | 3.05 | 1.79 | 2.10 | 0.97 (35) |
| Organically evolved FPO | 3.54 | 6.97 | 2.90 | 3.54 | 0.64 (18) |
| Total FPO | 3.04 | 4.86 | 2.20 | 2.77 | 0.84 (28) |

3.3.2 Determinants of FPO membership in Maharashtra

Table 9 presents the networks behind the farmers in Maharashtra in becoming FPO member. Around 60% members report their friend/junior or relative doing better as the primary motivation behind joining the group. They are also influenced by the relatives and family friends (52%) and neighbour/farmers in the village convincing them to become FPO members as the primary reasons for joining the FPO. About, 32% farmers reported that KVK or ATMA officer asked them to form the club/group. Approximately, 30% farmers chose to become FPO member as they were lured by the incentive of government subsidy/scheme.

Table 9: Networks and factors determining membership in FPO

| S.N. | Response | % of farmers |
|------|--|--------------|
| 1 | Your friend/junior or same age relative was group member, and he is doing better | 59.55 |
| 2 | Your Senior relative /family friend was group member | 52.11 |
| 3 | Neighbour/ farmers in my village asked me to be member | 44.91 |
| 4 | KVK or ATMA officer asked us to form the club/group | 32.51 |
| 5 | Seed Vendor/ shop keeper/business related trader | 9.68 |
| 6 | NGO/ SHG/ schoolteacher/ professor asked us to form the club | 9.68 |
| 7 | Membership was needed for government subsidy/scheme | 29.78 |
| 8 | To do something new | 1.24 |

Table 10 lists down the perceived benefits by farmers from being an FPO member. In the survey, 82% members report information about crops, technology, seeds being the primary

benefits for joining the FPO. Around 68% came in for cheaper and timely inputs and 42% for technical knowledge such as knowing when to spray the pesticides. This shows that technology adoption is one of the main drivers in FPOs formation.

Table 10: Perceived benefits as a member of FPO

| S.N | Response | % of farmers |
|-----|---|--------------|
| 1 | Get new information about crops, technology, seeds | 81.64 |
| 2 | Get inputs at cheaper costs and at right time | 67.74 |
| 3 | Don't have to do paperwork, NGO persons or group members do it | 20.6 |
| 4 | Get better prices for my produce, new markets | 28.54 |
| 5 | Know when to spray the pesticides | 41.44 |
| 6 | Have better access to credit, govt schemes | 18.61 |
| 7 | Get good attention from senior farmers, kind of monitoring, supervision | 23.57 |
| 8 | No fear of cheating, late payments | 35.48 |
| 9 | No benefit until now | 4.47 |

In the survey, farmers were asked about the operations that are easier upon being an FPO member (Table 11). A big majority (79%) report that buying inputs such as seeds, pesticides, fertilizers of better quality was easier upon membership. This happened along with the knowledge of applying fertilizer, pesticides and nutrients in exact doses. About 32% saw improvement in post-harvest operations such as grading and storing of produce. Approximately, 34% FPO farmers reported transport to market becoming easier subsequent to FPO membership.

Table 11: Operations that became easier after becoming FPO member

| S.N. | Response | % of farmers |
|------|---|--------------|
| 1 | Buying seeds, pesticides, fertilizers of better quality | 78.66 |
| 2 | Applying fertilizers, nutrients in exact doses | 68.73 |
| 3 | Pesticides and insecticides sprays | 61.79 |
| 4 | Harvesting | 41.19 |
| 5 | Post-harvest operations such as grading, storing | 32.01 |
| 6 | Transport to Market | 34.24 |
| 7 | Don't know | 2.98 |

Table 12 presents results of probit regression for determinants of membership in an FPO in Maharashtra. The higher the number of years in farming, the lower the likelihood of him becoming member of farmer producer organisation. Farmers using mobile phones for accessing

agriculture information are more likely of being an FPO member. If a farmer was associated with a cooperative/farmer club in the past he is more likely to become members of FPO. If the land holding of small landholder increases, he is less likely to become an FPO member. Importantly, farmers who get information about new technologies from friends/ relatives or fellow villager/neighbour is more likely of being an FPO member. Also, if farmer has access to private sources for information of new technology, he is more likely to become FPO member.

Table 12: Determinants of FPO membership in Maharashtra: Marginal effects of probit regression

| Variables | FPO member (1=yes, 0=otherwise) |
|---|---------------------------------|
| | Marginal effects (dy/dx) |
| <i>Social group (base: SC/ST)</i> | |
| OBC | 0.038 |
| | -0.09 |
| General | -0.01 |
| | -0.091 |
| <i>Education (base: no school)</i> | |
| Secondary | -0.056 |
| | -0.07 |
| Higher Secondary | -0.126 |
| | -0.111 |
| Graduate | -0.155 |
| | -0.104 |
| Professional | -0.076 |
| | -0.135 |
| Farming primary occupation (1=yes; 0=otherwise) | 0.154 |
| | -0.12 |
| Monthly food expenditure (log) (Rs) | 0.013 |
| | -0.043 |
| No. of years in farming (log) | -0.093** |
| | -0.041 |
| Household size (log) | -0.042 |
| | -0.059 |
| Using mobile for agriculture information (1=yes; 0=otherwise) | 0.129*** |
| | -0.047 |
| Ration card holder (1=yes; 0=otherwise) | 0.281 |
| | -0.192 |
| Total area (acre) | 0.002 |

| | |
|---|------------|
| | -0.002 |
| Have taken loans in the last 3 years (1=yes; 0=otherwise) | 0.036 |
| | -0.044 |
| Member of cooperative before joining FPO | 0.293*** |
| | -0.042 |
| <i>Land Holding (base: marginal)</i> | |
| Small | -0.124** |
| | -0.062 |
| Medium | -0.108 |
| | -0.078 |
| Large | -0.199 |
| | -0.122 |
| <i>Sources of information about new technologies</i> | |
| Friends/relatives | 0.168*** |
| | -0.043 |
| Fellow villagers/neighbours | 0.246*** |
| | -0.044 |
| Demo plots/ Exposure visits | 0.019 |
| | -0.071 |
| Private sources | 0.138*** |
| | -0.044 |
| Government sources | 0.078 |
| | -0.053 |
| Mass Media | 0.062 |
| | -0.055 |
| Fixed Effects | Yes |
| Log pseudolikelihood | -273.09221 |
| Pseudo R ² | 0.207 |
| Correctly classified | 78.37 |
| # of observations | 564 |
| Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1 | |

3.3.3 Technologies adopted by FPO farmers

When asked about new technologies farmers adopted after joining FPO, they seem to be getting attracted by a package of practices rather than pursuing any singular approach. The study finds that adoption of new technologies forms the primary motivation for joining an FPO. The protocols rationalize several cumbersome operations and leads to operational efficiency in the conduct of farm business. Approximately, 84% organically evolved FPO (hereafter OFPO) members report primarily adopting new crop management techniques compared to 79% for

promoted FPO (hereafter PFPO) (Table 13). The OFPO members are simultaneously opting for new water management techniques (62%), improved pesticide and insecticide (54%), improved post-harvest techniques (30%) while PFPO farmers lagged in adopting these technologies at 37%, 43% and 21% respectively. About 5% of OFPO members report shift towards high value agriculture like polyhouse and shadenet. The shift is mostly towards techniques which hold potential for higher value addition and sustainability in farm business. The attractiveness of new crop management protocols, post-harvest techniques with their associated effects on operational efficiencies and hence production volumes and net returns are the primary drivers bringing farmers together to form FPOs.

Table 13: Technologies adopted after joining FPO (% respondents)

| S. N . | Response | Promoted FPO (N=256) | Organically evolved FPO (N=147) | Total FPO (N=403) |
|--------|---|----------------------|---------------------------------|-------------------|
| 1 | Crop Management | 79 | 84 | 81 |
| 2 | Water management - shifted to drip irrigation, adopted fertigation | 37 | 62 | 46 |
| 3 | Pest management - IPM | 15 | 27 | 20 |
| 4 | Improved application of pesticide and insecticide | 43 | 54 | 47 |
| 5 | Improved post-harvest techniques - sorting, packing, grading, storage | 21 | 30 | 25 |
| 6 | Adopting polyhouse, shadenet | 0 | 5 | 2 |

When we enquire about what technologies the farmers plan to adopt in next three years, the responses are varied among the PFPO and OFPO members. About 68 per cent of the PFPO farmers seem to be particularly focused on water management technologies while OFPO at 50 per cent having already adopted the new crop management practices want to focus more on advanced water management technologies like drip irrigation and fertigation. Since the sample farmers also represent water deficient areas, they have a strong inclination towards securing sustainable solutions to the water scarcity issues. Also, 35 per cent of PFPO members want to adopt improved application of pesticide and insecticide as compared to 20 per cent for OFPO members. With 30 per cent OFPO members have a higher preference for post-harvest techniques compared to 21 per cent for PFPO members. Adopting polyhouse and shadenet is also a major priority for OFPO members at 28 per cent compared to 14 per cent PFPO members.

Table 14: Technologies plan to adopt in next three years (% respondents)

| S. N. | Response | Promoted FPO (N=256) | Organically evolved FPO (N=147) | Total FPO (N=403) |
|-------|---|----------------------|---------------------------------|-------------------|
| 1 | Crop Management | 68 | 50 | 61 |
| 2 | Water management - shifted to drip irrigation, adopted fertigation | 66 | 75 | 69 |
| 3 | Pest management - IPM | 16 | 19 | 17 |
| 4 | Improved application of pesticide and insecticide | 35 | 20 | 30 |
| 5 | Improved post-harvest techniques - sorting, packing, grading, storage | 21 | 30 | 25 |
| 6 | Adopting polyhouse, shadenet | 14 | 28 | 19 |

When asked what constrains adoption of new technology, 86 per cent FPO members report high cost being the major reason followed by uncertainty due to adverse weather situation. Higher costs inhibit the farmers' ability to buy agricultural inputs and equipment for undertaking the crop with better crop management practices. Affordable agriculture technology is the need of hour for the Indian farmers. The farmers are in dire need of technological know-how suitable for their operational holdings and local conditions. Since, 86 per cent farmers in India are small and marginal land holders, their capacity to raise capital is very limited. The lack of access to credit is another major constraint in adopting new technology in agriculture. The FPO members also report adverse weather conditions like late monsoon, untimely rain being the major reasons preventing them from adopting new technology. Further the adoption of technology comes with its own risks. If unproven technology is adopted and there are negative consequences, it can hamper the production of the farmers. So, waiting for the results of the technology by early adopters also becomes an important reason for keeping him away from new technology.

Table 15: Constraints inhibiting technology adoption (% respondents)

| S. N. | Response | Promoted FPO (N=256) | Organically evolved FPO (N=147) | Total FPO (N=403) |
|-------|--|----------------------|---------------------------------|-------------------|
| 1 | High Cost | 89 | 82 | 86 |
| 2 | Lack of Credit | 52 | 50 | 52 |
| 3 | Waiting to see the results of adoption by others | 29 | 32 | 30 |
| 4 | Adverse weather conditions - late monsoon, untimely rain | 67 | 68 | 67 |
| 5 | Other | 0 | 1 | 0 |

When asked about the source of information about various new technologies, 68 per cent farmers report the fellow villager or neighbour farmers as the primary sources. The farmer network effect is strong with friend and relatives (50%), demonstration plots or exposure visits (39%), and fellow farmer from other village (31%) being the prominent sources of information related to agricultural technology. The government sources such as agriculture officer, KVK, Agriculture University being reported at dismal 10% by the FPO members. This corroborates with the findings of Agricultural Households Situation Assessment Survey (2003 and 2013) showing the relative decline of agriculture extension mechanism in India. Private sources such as seed companies and input vendors (27%) also find it difficult to reach the farmers. The modern communication sources such as radio, TV, mobile, newspapers, and social networks also lag in terms of their influence in reaching out with information about new technologies compared to the traditional farmer networks in the village. Hence, a focus on augmenting these networks into producer organizations through which new agricultural technology can be disseminated among the farmers. The role of the demonstration effect is the most prominent here.

Table 16: Sources of information for new technologies (%)

| SN. | Response | Promoted FPO (N=256) | Organically evolved FPO (N=147) | Total FPO (N=403) |
|-----|---|----------------------|---------------------------------|-------------------|
| 1 | Friends/Relatives | 49 | 52 | 50 |
| 2 | Fellow villager/Neighbor | 70 | 63 | 68 |
| 3 | Fellow farmer from other village | 28 | 36 | 31 |
| 4 | Demo plots/ Exposure visits | 39 | 38 | 39 |
| 5 | Government sources such as Agriculture officer, KVK, Agriculture University | 7 | 17 | 10 |
| 6 | Private sources - seed companies, input vendor in village | 19 | 41 | 27 |
| 7 | Informal sources – such as retired persons, professors, etc. | 18 | 18 | 18 |
| 8 | Mass media such as radio, TV, Mobile, Newspapers | 15 | 28 | 20 |
| 9 | Social Networks such as WhatsApp, Facebook, Internet | 4 | 14 | 7 |
| 10 | Others | 0 | 1 | 0 |

When asked about the major risks they have faced while adopting new technologies, approximately, 91 percent FPO farmers from Maharashtra experienced market risk was the greatest risk. Also, around 53 per cent FPO farmers in Maharashtra report weather risk and 43 per cent were faced with temperature risk. While the market risk was experienced by 34 per cent and temperature risk by 23 per cent respectively. Insufficient information and financial resources are a major problem faced by FPO members, but PFPO is of a higher magnitude.

Table 17: Major risks in adopting new technologies (%)

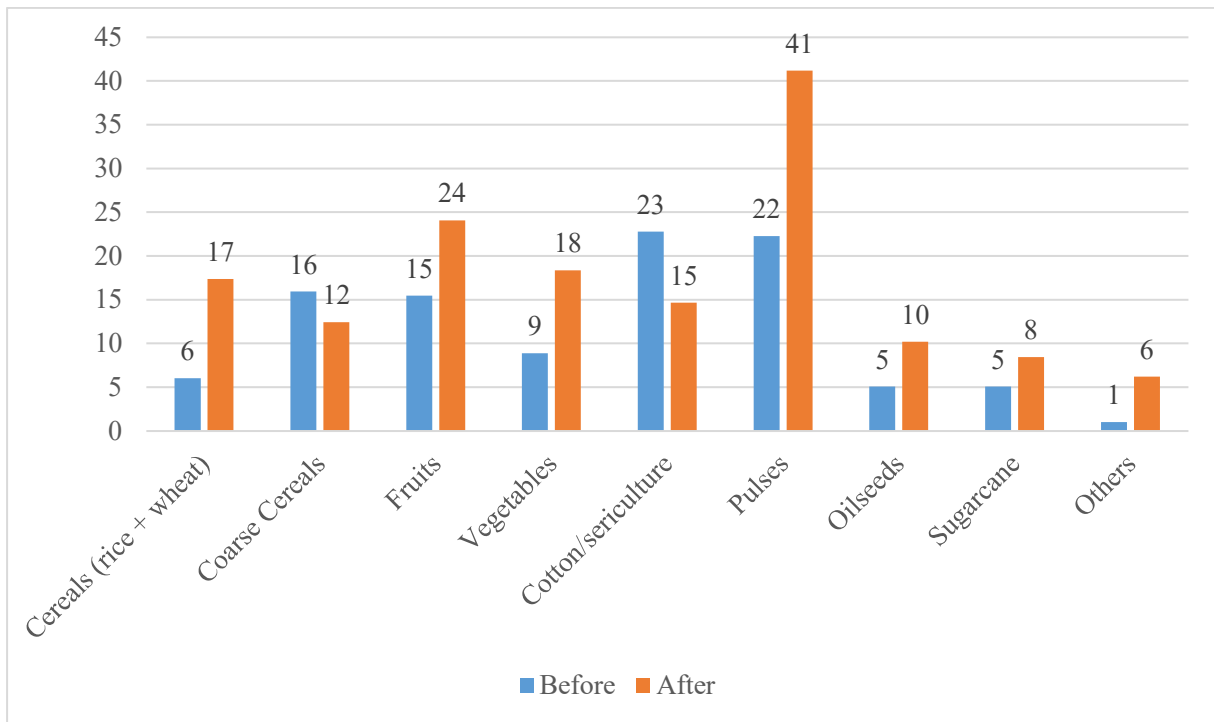
| S. N. | Response | Promoted FPO (N=256) | Organically evolved FPO (N=147) | Total FPO (N=403) |
|-------|------------------------------|----------------------|---------------------------------|-------------------|
| 1 | Market Risk | 91 | 92 | 91 |
| 2 | Weather risk | 50 | 57 | 53 |
| 3 | Temperature | 39 | 50 | 43 |
| 4 | Insufficient information | 43 | 50 | 45 |
| 5 | Insufficient resources/funds | 21 | 30 | 25 |
| 6 | No problems in adoption | 0 | 1 | 0 |

3.3.4 Crop Diversification

When we check whether farmers are shifting towards high value crops, we find that in case of Maharashtra the shift is not only towards fruits and vegetables but also cereals and pulses (Figure 2). At FPO level the strategy is to focus on the commodity predominant in the region and easily accessible to markets. The search for new markets, tapping new markets or creating new markets is present only in isolated cases. The organically evolved FPOs show much dynamism in this case and are attempting to utilise scale effects in marketing of produce to their traditional distant markets. The capacity building in terms of leveraging scale effects by tapping new markets and increasing profitability is an urgent need faced by the FPOs.

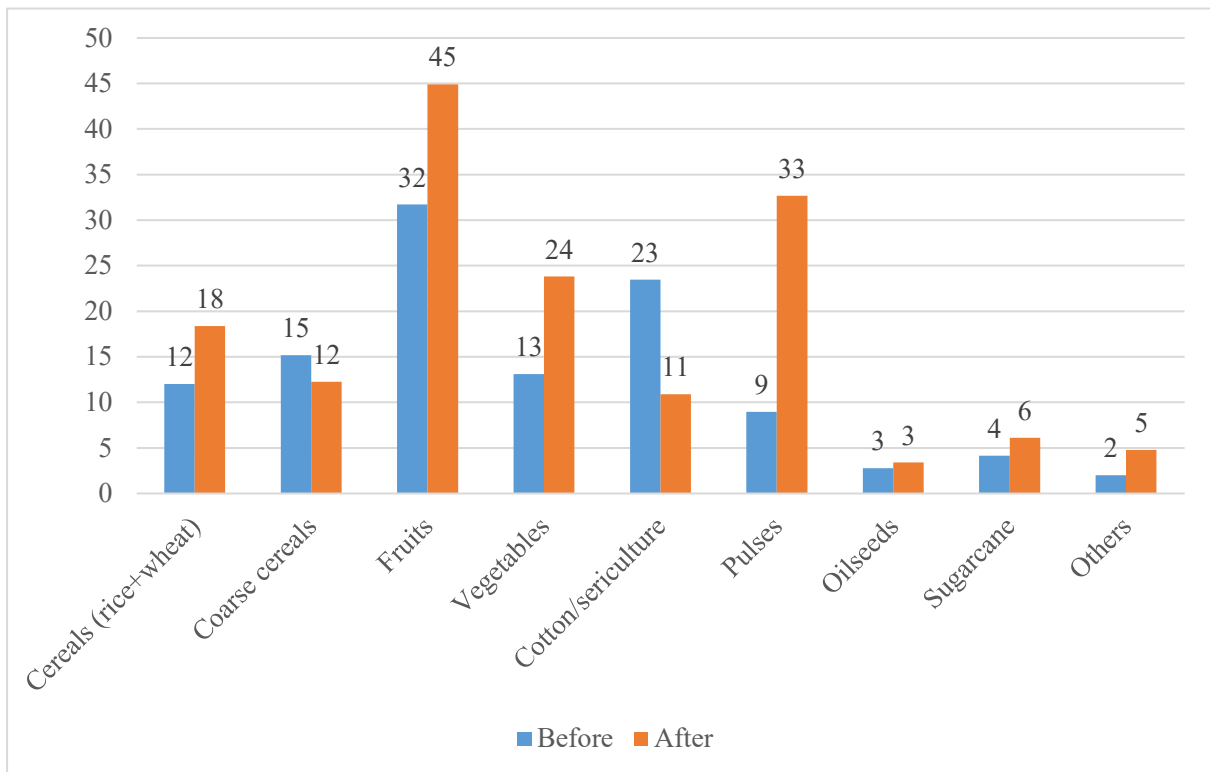
The farmers are predominantly into cereals, pulses and horticulture production before joining FPO. They show a shift towards fruits, vegetables to some extent but we see a major shift to pulses (Figure 2). Farmer's willingness to shift to new crop is usually based on prior experience and future expectations. Therefore, the farmers shifting to high value crops shows willingness to take risks. The OFPO members are more into high value agriculture while PFPO members into pulses prior to joining the group (Figure 3 and Figure 4).

Figure 2: Change in cropping pattern after joining FPO (% respondents)



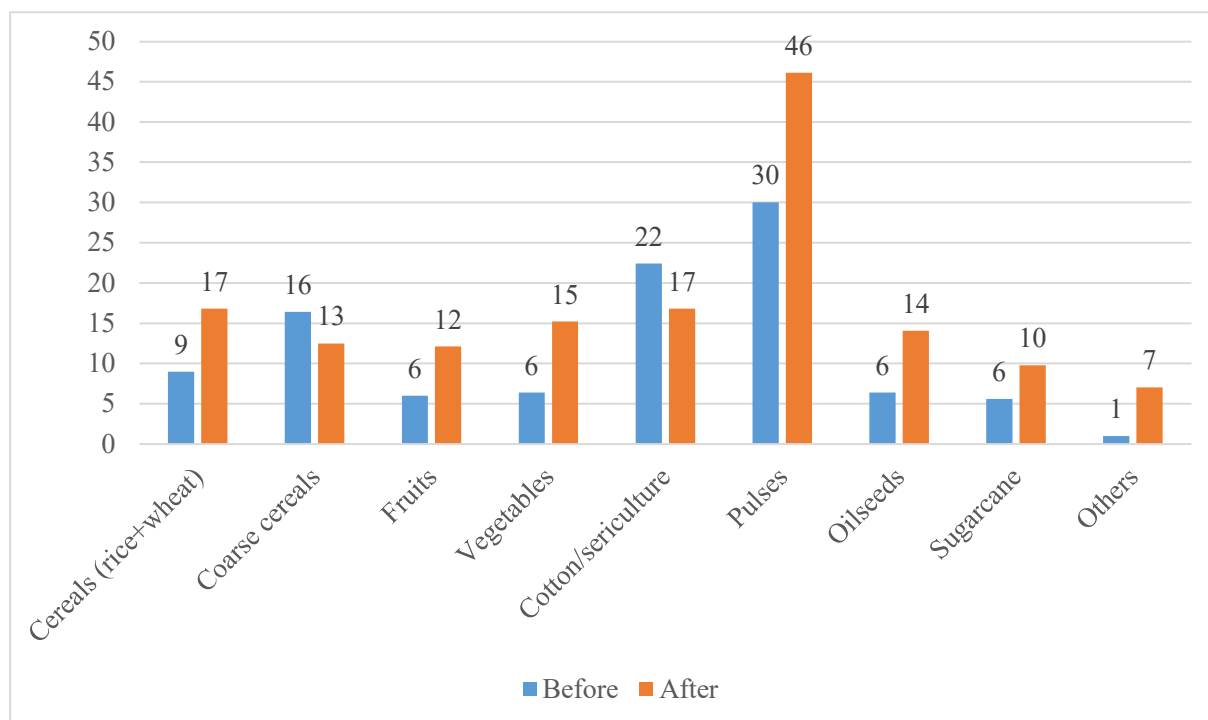
(Fpo N = 403)

Figure 3: Change in cropping pattern for OFPO members (% respondents)



(Organically evolved fpo N = 147)

Figure 4: Change in cropping pattern for PFPO members (% respondents)



(Promoted N_{fpo} = 256)

The OFPO members shift more towards cereals (rice + wheat), fruits, vegetables, and pulses while the coarse cereals and cotton/sericulture see decline. The PFPO members report increase in all types of crops under production. Particularly, for both groups the shift towards pulses being very strong, as the government announce higher minimum support price (MSP) for the 2016-17 season and promised to procure the commodity if farmers shifted to the crop. This led to doubling of production in the state. The government of Maharashtra started a direct channel of procuring through the FPOs, appointing MAHAFFPC, the federation of producer companies at the state level as the nodal agency. The procurement of pigeon pea undertaken by the government in recent years is a major activity of the FPOs in Vidarbha and Marathwada region. The state produces around 30% of the overall production in India.⁶ It is a highly drought resistant crop. With minimal moisture in the soil the seeds can sprout and grow into plant. Even in acute water shortage conditions it can survive the season. If monsoon is good and conditions are right, the potential yield per hectare can be substantially high. As the non-irrigated area is

⁶ The Indian government APY estimate from 2009-10 to 2013-14

high for PFPOs (35%) there is a higher preference for drought resistant crops like pulses and oilseeds (see Figure 4).

Adverse situation affects farmers' crop choice. In recent years, pest attacks like pink bollworm on cotton are on the rise and has destroyed entire crop in the growing areas. This makes farmers risk averse and there is search for a safe and stable yielding crop. The production costs of cotton make them high risk, high returns crop. Even though returns from cotton are higher, we find farmers substituting area under cotton for pulses. We find that since our survey area has primarily (6 FPOs out of 8) belonging to Marathwada and Vidarbha regions, where the pulses are a prominent crop, increasing area under pulses is being brought under the FPO activity. Any crop rapidly spreads if it has certain features, low effort, predictable problem set, low cost, less efforts on field, stable and assured minimum yield, good market demand, and appropriate physical characteristics like size, shape, colour, perishability, transportable.

3.3.5 Product Differentiation

The modern food chains are such that farmers need to plan production schedules based on consumer's demands. This implies production planning catering to needs of front end to optimise at each level of value addition. The demand pattern also has seasonality associated with it and the available information need to show the appropriate time for planting of crops undertaken by the farmers. The farmers find it difficult to cater to real-time change in consumer demand. If there is shortfall in some commodities produced in a producer organization the gap is filled through buying from the APMC markets. This problem can be addressed only when there is clear demand forecasting, and production planning can be initiated in advance. The modern consumers' orders on mobile application for their daily grocery needs, so the farmer needs to consistently achieve higher quality specifications pre-specified in the product information template. To achieve such characteristics farmers, need to undertake tasks according to a production protocol. This approach optimises the crop management and ensures higher returns.

When we inquire about what decision have become easier after joining the FPO, the farmers respond that what to produce and in what quantity being the primary improvements in their production activity. Though the primary objective of the producers' organisation is market linkage, it is still work in progress for most of them.

Table 18: Post membership which of the decisions have become easier? (% respondents)

| S.N. | Responses | Promoted FPO | Organically evolved FPO | Total FPO |
|------|----------------------------------|--------------|-------------------------|-----------|
| 1 | What to produce | 78 | 84 | 80 |
| 2 | How much to produce, product mix | 63 | 71 | 66 |
| 3 | How to pack, store | 48 | 59 | 52 |
| 4 | When to take to market | 43 | 47 | 44 |
| 5 | Which market | 30 | 39 | 33 |
| 6 | None | 5 | 0 | 3 |

(Promoted N = 246, organically evolved N = 147, fpo N = 403)

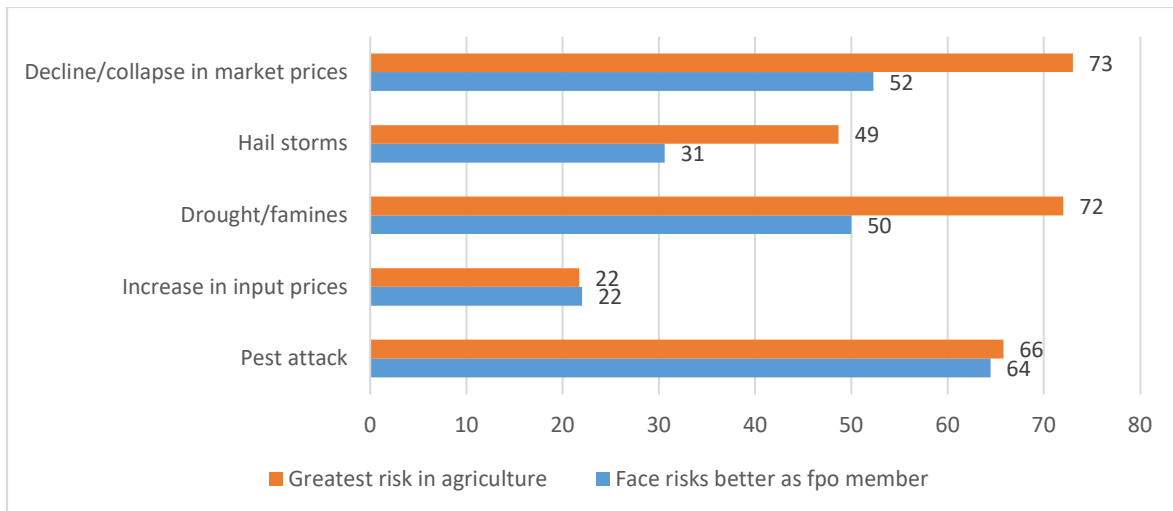
If tomato is sold only as a primary commodity, price premiums cannot be availed of, and fear of price crashes looms large. Instead, a graded, labelled and certified system for tomatoes can mitigate these problems to some extent. Products can be differentiated based on freshness (plucked in the morning on day of sales), organic and some local sourcing identifiers can result in value addition. Such campaigns about food from local areas have been becoming popular in the developed world which can be a precursor for things to come in the developing world. Similar differentiation is plausible if farmers start packaging their products properly, they can command a price premium. Many farmers' organizations are coming up with models of direct supply to urban consumers. The 'dial a bhaji' concept undertaken by the Deccan Valley Farmers producer company from the sample FPOs is a prominent example of such initiative. They deliver the vegetables to doorsteps of consumers within six hours of harvesting them. In doing all this, the FPOs need to get the incentives right. Better performing farmers in a group need to be rewarded while activities that reduce value addition should face some disincentive.

3.3.6 Risk perception among FPO members

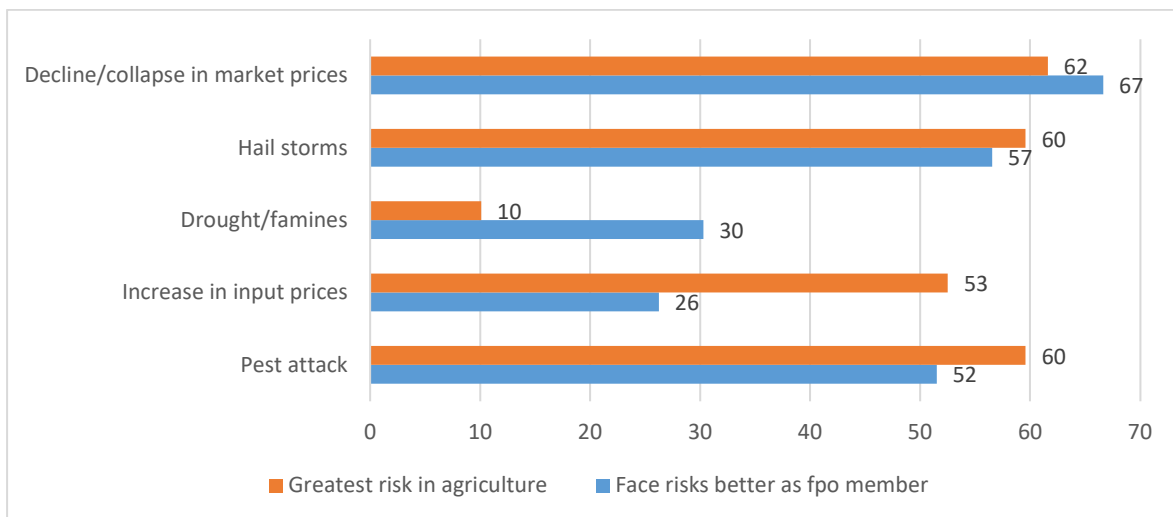
One of the key arguments in the support of formation of FPO is better risk management for its members. To assess the risk coping with FPOs, we asked farmers about the major risks faced and the changes in these risks (subjectively assessed) upon membership of FPO. For FPOs in general including the promoted ones, the members feel the risks of pest attack and risks due to decline in input prices are mitigated being members of FPO. In terms of output market risks, members in organically evolved FPOs seem more confident in handling the market price fluctuations and had more stable yields.

Figure 5: Risk perceptions among different groups of farmers

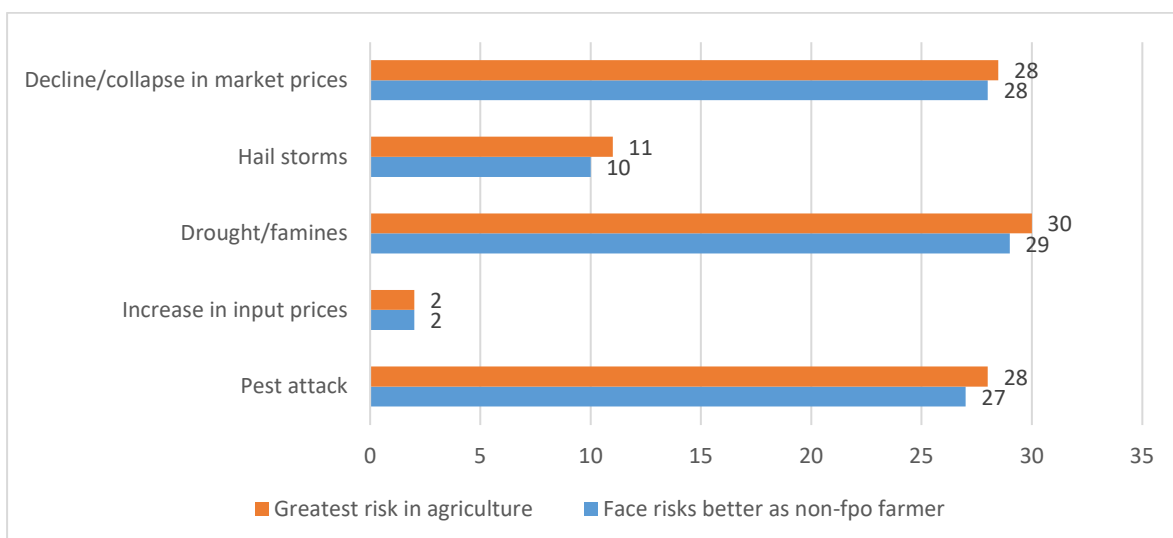
A) Risk perceptions among PFPO members (% respondents) (N=246)



B) Risk perceptions among OFPO members (% respondents) (N=147)



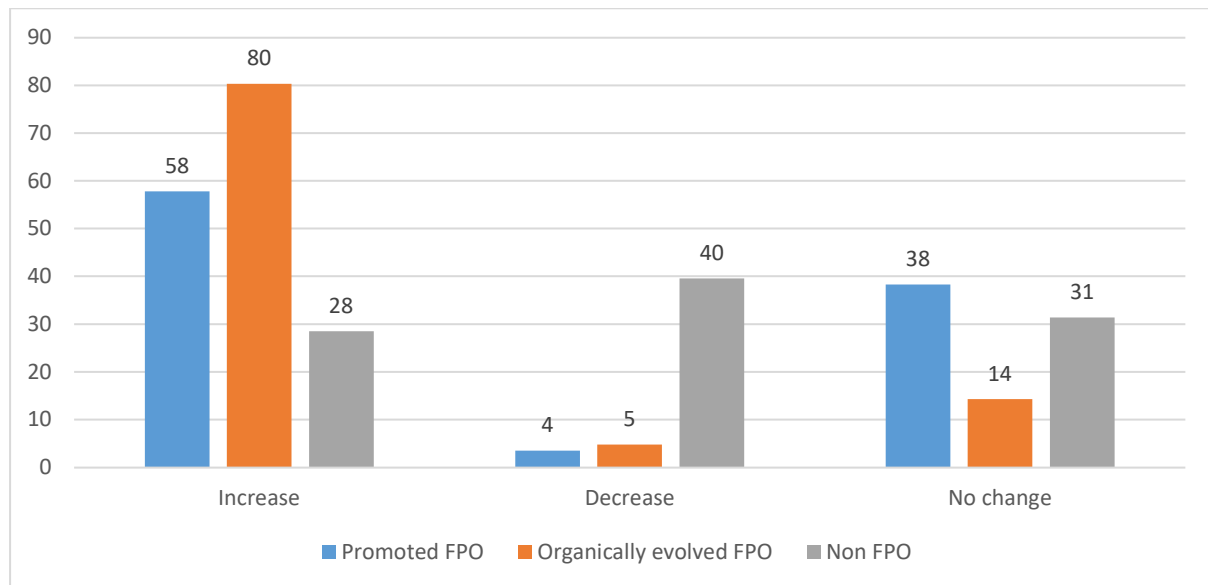
C) Risk perceptions among non-FPO farmers (% respondents) (N=172)



3.3.7 Comparative analysis of promoted versus organically evolved FPOs

Figure 6 shows that majority of FPO members show increase in gross income, but there are significant differences in gross income change between members of organically evolved FPO and promoted FPO. Only 32% non-members report increase in gross income. Also, considerably higher number of non-members (34%) report reduction in their gross income. Changes in incomes can happen due to better output prices, input prices or cost reduction or through increases in productivity.

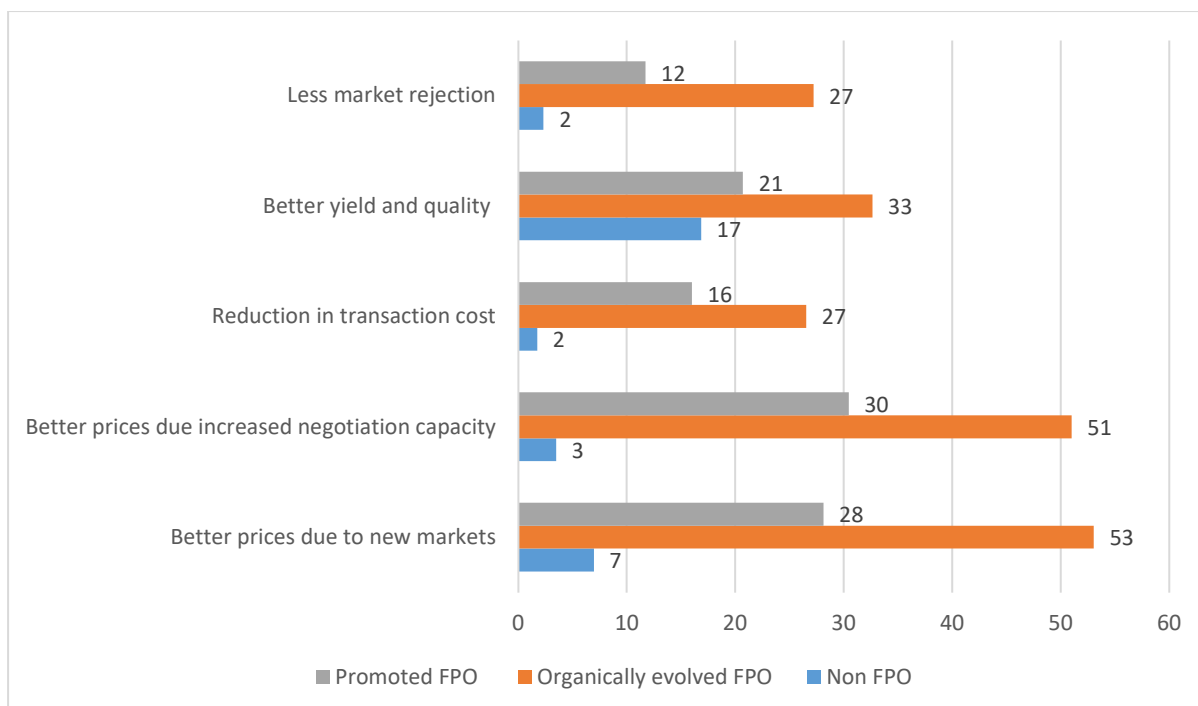
Figure 6: Change in gross income (% respondents)



(Promoted N = 246, organically evolved N = 147, non fpo N = 172)

Most FPO members attribute the change due to better prices received in new markets (Figure 7). This is possibly due to significant improvement in negotiation capacity of the FPO members owing to scale effects. When we further probe about the major reason for change in income, getting better prices owing to fewer rejections driven by better quality emerge as one of the main reasons. The results also show that OFPOs are performing better in strengthening smallholders' position in the value chains. They are facilitating the market-oriented production for the smallholders.

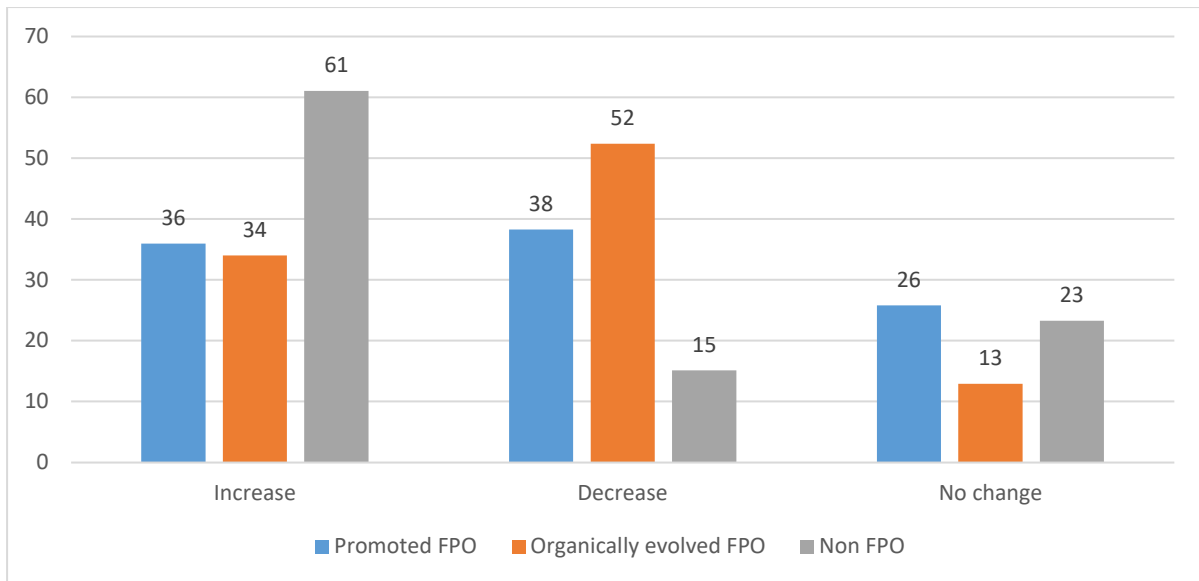
Figure 7: Reasons attributed for changes in gross income (% respondents)



(Promoted N = 246, organically evolved N = 147, non fpo N = 172)

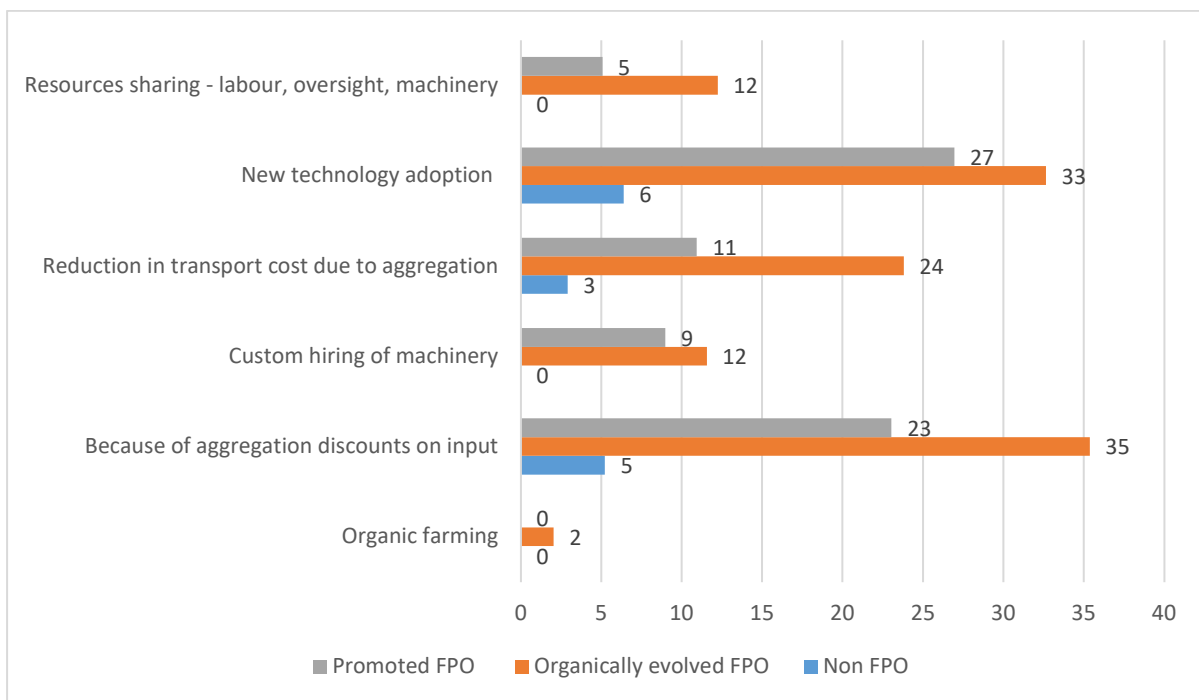
Figure 8 shows that about 52% OFPO members report cost reduction while 38% farmers in PFPOs see reduction in cost. The dynamics of organic formation of FPO plays a pivotal role in this aspect. The role of FPO as an aggregator of inputs at negotiated prices helps reduce production cost significantly. The PFPOs also report spike in their costs (36%) but with simultaneous increase in gross income levels. In case of non-FPO farmers the costs go up while less of them see positive change in gross income. Among FPO members, most farmers attribute technology adoption as the principal reason for cost reduction (see Figure 9).

Figure 8: Post membership changes in costs (% respondents)



(Promoted N = 246, organically evolved N = 147, non fpo N = 172)

Figure 9: Major reasons for change in cost (% respondents)

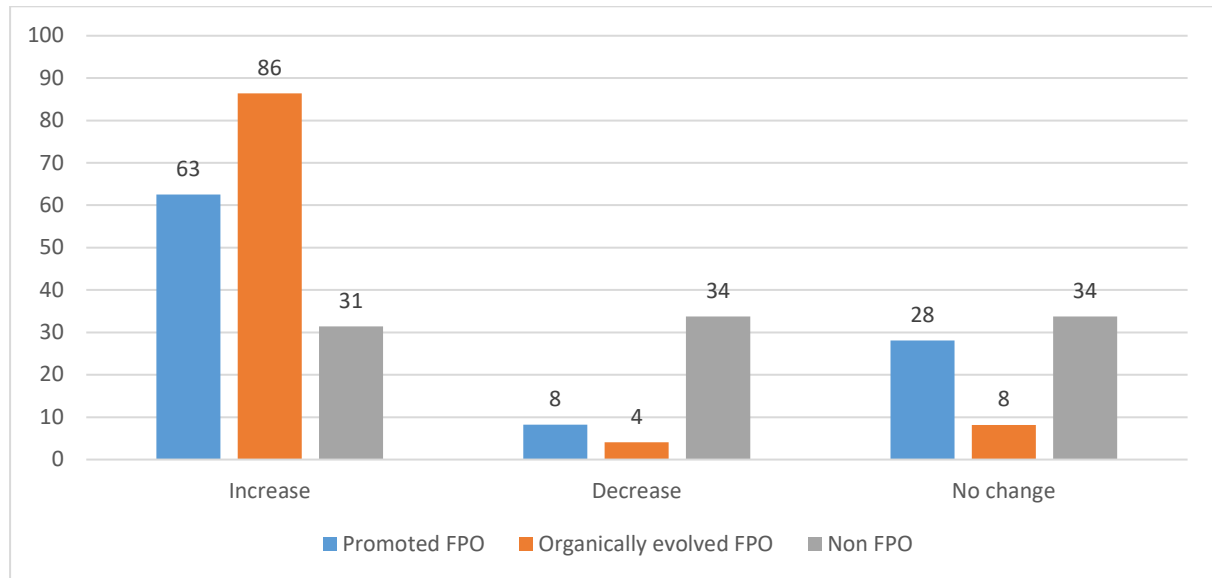


(Promoted N = 246, organically evolved N = 147, non fpo N = 172)

With technology adoption being a prime driver of outcomes, Figure 10 shows significant number of FPO members report increase in productivity of the crops. Only 34% non-FPO farmers report any change in productivity while 34% see a drop in their productivity. Moreover, we find significant reduction in fluctuation in productivity across FPO members thereby mostly

thereby mitigating risks. The increase in productivity among organically evolved FPO members is higher while almost 34% non-FPO farmers report decline in productivity.

Figure 10: Changes in productivity post FPO membership (% respondents)



(Promoted $N = 246$, organically evolved $N = 147$, non fpo $N = 172$)

Table 19 shows results of assessed changes in productivity, cost and income. We estimate the marginal effects from probit regression for the binary outcome variables. After controlling for socio-economic characteristics and location fixed effects, the likelihood of increased income and productivity as subjectively assessed is higher for members of FPOs. The results confirm the summary statistics presented above. In case of organically formed FPO, change in productivity and income is significant. OBC category benefits from being part of FPO with increase in productivity and income, while SCST see improvement in productivity but with increase in cost and no improvement in gross income. In case of non-member farmers, SCST see increase in income but without any change in productivity and reduction in cost. Use of mobile for agriculture information has an influence on productivity along with decrease in cost. In case of FPO farmers a greater number of family members results in increased cost but without any change in productivity and gross income. Higher frequency of group meeting led to improvement in income. FPO members with higher irrigated area show improvement in income with lower cost while for non-farmers there is increase in cost but no increase in productivity or income.

Higher costs for technology inhibit change in productivity for members as well as non-members. Lack of credit constrains adoption of new technology for members while non-

members are more likely to be worse off with negative effect on productivity and income. Friends as a source of information for new technologies reduces overall costs for FPO members. For non-members costs decrease but with simultaneous decrease in productivity and income. This shows high susceptibility to wrong information about new technologies from friends, it is more likely to have adverse effects on the production economics of non-members. The exposure visits arranged by FPO members are more likely to have a positive impact on the income but with no change in productivity or costs. While the non-members see improvement in income and productivity and no change in cost. The government as a source of information for technologies has no effect on either income, productivity or cost for FPO members. The non-members find the information from government sources useful with improvement in productivity and income but with higher costs. Having private sources for information about technologies reduces the income of member farmers with no change in productivity or cost. While private sources affect non-members differentially with improvement in productivity and income, but at higher costs. Access to social networks for information about technology improves income for members but at higher costs. While non-members are more likely to see reduction in productivity and income.

We estimate the model for regression equation:

Gross Income / Cost / Productivity = f [OFPO, Social Group Base General category (SC/ST, OBC), Household size, Experience in agriculture, Using mobile for agriculture related information, FPO membership years, Frequency of group meeting (monthly, Frequency of financial transactions, Irrigated area (acres), Major constraints of technology adoption (High cost, Lack of credit), Sources of information for new technologies (Friends, FPO members, Demo/exposure visits, Government sources, Private sources, Social networks)]

Table 19: Determinants of assessed increases in productivity, decreases in costs and increases in net income: Marginal effects from probit regression

| VARIABLES | FPO Members | | | Non-members | | |
|--|---------------------------------------|-------------------------------|---------------------------------|---------------------------------------|-------------------------------|---------------------------------|
| | Productivity increase (yes=1 no=0) | Cost decrease (yes=1 no=0) | Income increase (yes=1 no=0) | Productivity increase (yes=1 no=0) | Cost decrease (yes=1 no=0) | Income increase (yes=1 no=0) |
| Member Organically evolved FPO | 0.154*** (0.052) | 0.049 (0.060) | 0.116** (0.047) | | | |
| Social Group Base: General Caste SC & ST | 0.136** (0.067) | -0.191*** (0.057) | 0.046 (0.073) | 0.053 (0.156) | -0.164 (0.289) | 0.463** (0.212) |

| | | | | | | |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| OBC | 0.184*** (0.060) | -0.001 (0.061) | 0.107** (0.052) | 0.051 (0.080) | -0.110 (0.127) | 0.111 (0.096) |
| Household members in agriculture | 0.003 (0.014) | -0.029** (0.014) | -0.004 (0.011) | -0.013 (0.021) | 0.057 (0.037) | -0.026 (0.023) |
| Experience in agriculture | 0.002 (0.002) | 0.003 (0.002) | 0.004* (0.002) | -0.004 (0.003) | 0.000 (0.004) | -0.006 (0.004) |
| Using mobile for information | 0.151** (0.063) | 0.149* (0.087) | 0.041 (0.062) | -0.038 (0.070) | -0.046 (0.114) | -0.027 (0.084) |
| Monthly food expenditure (log) (Rs) | 0.006 (0.051) | 0.017 (0.053) | -0.016 (0.051) | 0.043 (0.075) | 0.159 (0.122) | 0.077 (0.080) |
| Years of membership | 0.000 (0.042) | 0.036 (0.044) | -0.023 (0.035) | | | |
| Frequency of meeting | 0.072 (0.058) | -0.011 (0.058) | 0.125** (0.054) | | | |
| Frequency of financial transaction | 0.034 (0.058) | -0.092 (0.058) | -0.080 (0.049) | | | |
| Irrigated area | 0.009 (0.006) | 0.007** (0.003) | 0.012** (0.005) | -0.001 (0.006) | -0.014** (0.006) | 0.008 (0.006) |
| Major constraints inhibiting adoption of technologies | | | | | | |
| High cost | -0.257*** (0.045) | 0.072 (0.077) | -0.059 (0.083) | -0.146* (0.085) | -0.230* (0.120) | 0.033 (0.096) |
| Lack of credit | 0.051 (0.052) | 0.111** (0.054) | -0.006 (0.046) | -0.233*** (0.058) | 0.185* (0.097) | -0.151** (0.071) |
| Sources of Information for technologies | | | | | | |
| Friends | -0.041 (0.053) | 0.182*** (0.055) | -0.006 (0.046) | -0.156** (0.061) | 0.249*** (0.096) | -0.310*** (0.057) |
| Demo exposure visit | 0.101 (0.086) | 0.022 (0.112) | 0.169*** (0.054) | 0.411** (0.191) | -0.014 (0.153) | 0.357** (0.163) |
| Government | -0.107 (0.072) | 0.045 (0.078) | 0.045 (0.059) | 0.419*** (0.135) | -0.224* (0.123) | 0.254* (0.136) |
| Private | -0.106 (0.072) | -0.039 (0.068) | -0.216*** (0.080) | 0.385** (0.184) | -0.421*** (0.152) | 0.520*** (0.173) |
| Social Networks | -0.054 (0.114) | -0.250*** (0.044) | 0.161*** (0.056) | -0.176*** (0.041) | -0.254 (0.217) | -0.202*** (0.040) |
| Observations | 394 | 394 | 394 | 166 | 166 | 166 |
| Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

3.3.8 Performance assessment of FPO

We start with simple index of performance of FPO based on count of changes post joining the FPO. The index is created with two input indicators relating to adoption of technology and risk mitigation of the FPO members.

Index with two INPUT indicators:

We considered the following variables while creating index value for success of FPO.

- 1) Adoption of technology by FPO members
 1. Improved crop management practices
 2. Improved water management
 3. Improved pest management
 4. Improved application of pesticide and insecticide
 5. Improved post-harvest techniques
 6. Adoption of polyhouse, shade net
- 2) Face risks better as FPO members
 1. Decline/collapse in market prices
 2. Hailstorms
 3. Drought/famines
 4. Increase in input prices
 5. Pest attack

Index value is created by using count methodology. These variables are binary in nature. The simple index is the average value of the binary 0 and 1 across all the possible benefits to the farmers subjectively assessed.

Table 20: Index value for subjectively assessed benefits (two INPUT indicators)

| Index Value | Observations | Percentage |
|-------------|--------------|------------|
| 0 | 1 | 0.25 |
| 0.09 | 14 | 3.47 |
| 0.18 | 46 | 11.41 |
| 0.27 | 64 | 15.88 |
| 0.36 | 82 | 20.35 |
| 0.45 | 59 | 14.64 |
| 0.55 | 93 | 23.08 |
| 0.64 | 36 | 8.93 |
| 0.73 | 8 | 1.99 |
| | 403 | 100 |

Table 21 presents the index value of assessed benefits by FPO type. The values are higher for organically evolved FPOs. Promoted FPOs perform well in terms of the number of perceived benefits with a positive response. Across the districts by income (Table 22), the subjectively assessed benefits are greater in number for the high-income districts.

Table 21: FPO wise index value distribution (two INPUT indicators)

| | Observations | Mean | SD |
|-------------------------|--------------|------|------|
| Organically evolved FPO | 147 | 0.43 | 0.16 |
| Promoted FPO | 256 | 0.38 | 0.15 |
| Total FPO | 403 | 0.4 | 0.16 |

Table 22: Income wise index value distribution (two INPUT indicators)

| | Observations | Mean | SD |
|------------------------|--------------|------|------|
| High Income District | 99 | 0.47 | 0.18 |
| Middle Income District | 155 | 0.46 | 0.12 |
| Low Income District | 149 | 0.3 | 0.12 |
| Total FPO | 403 | 0.4 | 0.16 |

Table 23 presents the Poisson regression results for the counts of perceived benefits. After controlling for several covariates including location fixed effects, the count of benefits is higher in case of organically evolved FPOs and as observed in index values above, also higher in case of FPOs in comparatively high-income districts. Lower benefits are observed in case of OBC category farmers. While the farmers with higher monthly expenditure on food experience increase in benefits. High cost inhibits adoption of technologies resulting in reduced benefits to the FPO members. All types of information sources for new technologies - friends/relatives, fellow villager/neighbour, demo plots/ exposure visits, government sources such as agriculture officer, KVK, agriculture university, private sources - seed companies, input vendor in village, informal sources such as retired persons, professors, mass media such as radio, TV, mobile, newspapers, social networks such as WhatsApp, Facebook, internet lead to higher benefits in terms of adopting new technologies which reduce the risks of FPO member farmers. Being clued to activities of FPO by attending monthly group meetings increase benefits for the member farmers.

Table 23: Poisson regression results for count of benefits in the affirmative

| Variables | Count |
|---|----------|
| High Income District (1=Yes, 0=Otherwise) | 0.400*** |

| | |
|---|----------|
| | (0.087) |
| Organically evolved FPO (1=Yes, 0=Otherwise) | 0.080*** |
| | (0.015) |
| Social Group Base: General Caste | |
| SC & ST | -0.095 |
| | (0.066) |
| OBC | -0.100* |
| | (0.058) |
| SEC Code | -0.002 |
| | (0.017) |
| Household Size | 0.003 |
| | (0.005) |
| Average monthly expenditure on food | 0.000** |
| | (0.000) |
| Experience in Farming (Years) | 0.001 |
| | (0.001) |
| Ration Card Holder (1=Yes, 0=otherwise) | 0.076 |
| | (0.199) |
| Aadhar Card Holder (1=Yes, 0=otherwise) | -0.111 |
| | (0.124) |
| Bank Account Holder (1=Yes, 0=otherwise) | -0.032 |
| | (0.211) |
| Total Area (in Acre) | 0.001 |
| | (0.001) |
| Major constraints that inhibit adoption of technologies | |
| High Cost | 0.208*** |
| | (0.070) |
| Lack of Credit | 0.020 |
| | (0.039) |
| Sources of information for new technologies: | |
| Friends/Relatives | 0.099*** |
| | (0.030) |
| Fellow villager/Neighbour | 0.041 |
| | (0.043) |
| Demo plots/ Exposure visits | 0.227*** |
| | (0.054) |
| Government sources such as Agriculture officer, KVK, Agriculture University | 0.060 |
| | (0.056) |
| Private sources - seed companies, input vendor in village | 0.287*** |
| | (0.091) |
| Informal sources – such as retired persons, professors, etc. | 0.152*** |
| | (0.055) |
| Mass media such as radio, TV, Mobile, Newspapers | 0.087 |
| | (0.107) |
| Social Networks such as What's app, Facebook, Internet | 0.068*** |
| | (0.022) |
| Group Meeting (1=Monthly, 0=Otherwise) | 0.232*** |
| | (0.068) |

| | |
|--|---------|
| Block F.E. | Yes |
| Constant | 0.591** |
| | (0.284) |
| Observations | 569 |
| Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 | |

3.4 Summary

The results show that organically evolved FPOs are more successful in terms of adopting new technology and managing their risks better. Also, they are relatively more successful due to vibrant leadership having better market understanding. They seem to overcome the problem of negative selection by selecting members and ensuring homogeneity in commodity under production. This brings a sense of purpose to the farmer enterprise and makes the crop management and marketing objectives to align properly. Also, the reduction in intermediation costs can be effectively done with tangible benefits to the members.

Along with the quality of leadership, commitment of member farmers to the collective cause is an important determinant of its success. Leadership which encourages active member participation in day-to-day activity for handling particular domain builds positive learning curves. Identifying new ways in which organization can work, expand and excel in its activity depends on the quality of leadership. When the constituents have no prior exposure or experience in remaining cohesive as a group for performing business function it becomes incumbent on leadership to identify ways to address the problems.

Our personal interaction revealed that some members are unhappy about company as a format of farmer enterprise. What farmers can achieve in informal group, could be more effective opined these farmers. Being a company means higher compliance costs (fixed costs) that may not be justifiable below a threshold turnover. In Amravati district, one FPO was particularly vibrant and had actively taken over traditional role of traders by selling orange and bananas in distant markets, and with exponential growth over the last 3 years. The role of leadership should be particularly noted here, since the promoter belongs to trader community but having active involvement in agriculture.

Changing cropping pattern is difficult to ask of any farmer. It entails convincing beyond a doubt along with laying of the clear incentives for making the decision. In case of Maharashtra, the farmers are predominantly into cereals, pulses and horticulture production before joining FPO. They show a shift towards vegetables and further towards pulses. The capacity building in

terms of leveraging scale effects by tapping new markets and increasing profitability is an urgent need faced by the FPOs. Farmer's willingness to shift to new crop is usually based on prior experience and future expectations. The crop diversification shows willingness to adopt new production practices.

Lack of awareness about the new technologies, lack of credit markets, and lack of education linked with poor access to adequate information (Gulati et. al., 2007), is usually associated with the use of out-dated harvesting technologies and poor post-harvest infrastructure resulting in low productivity (Desai and Joshi, 2014). To address some of these problems faced by farmers, mainly marginal and small farmers, collective efforts and actions of the farmers is a potential solution. Alongside, the joint effort in coordinating and pooling their access and approach to markets for both inputs as well as outputs can enhance their bargaining power (size effects).

Due to inadequate skills among the farmers, they require professional expertise to build capacity and guide in managing activities. This underscores the importance of better production management techniques to augment the order supply needs. Therefore, optimizing supply chain will be a crucial factor for the success any producer company.

Chapter 4: Technology Adoption and Exports: The Case of Grape FPOs from Maharashtra

4.1 Introduction

Since the 1990s, the grape growing areas of Maharashtra have gone through major structural transformation. This change was primarily induced by the export led growth of the grape sector, and was primarily initiated by the farmers, who were in search of new markets for their produce. Even though some exports happened prior to 1990, the trade was through intermediate traders from Mumbai market and the volume remained very low. In 1989, a venturesome farmer from Nashik district exported grapes to Dubai, UAE and then in 1990 to London, UK and thus started the upswing of transformative change in the grape growing areas. Producing grapes that would comply with the quality specification of the London and Rotterdam traders was challenging and complex. However, through their competent endeavour farmers rapidly adopted modern agricultural technology. The price realization of early export farmers was around Rs.30-40 per Kg⁷, almost 3-4 times the domestic price realization in the traditional Delhi and Kolkata markets. The attractive price led to rapid adoption of export-oriented production practices and induced scientific temperament and attitude of experimentation among the grape farmers. To facilitate these exports, informal farmer networks were turned into producer organizations under the umbrella of Mahagrapes with government incentives for establishing pre-cooling and cold storage value in Maharashtra. A network of producer's organization played a significant role in rise of exports to EU countries.

4.1.1 Area, Production and Yield

We provide a brief overview of the grape production in Maharashtra. The Table 24 and Table 25 provide data on area and production under grapes in major growing states of India. The acreage under grapes has grown more than 9 times from 15,400 hectare in 1987-88 to 140,000 hectare in 2017-18. In early 1990s, the major grape producing states were Maharashtra, Karnataka and Andhra Pradesh. However, the production seems to have only sustained and grown in Maharashtra and Karnataka over the years. The position of Maharashtra in terms of acreage, production, as well as yield has consistently been a dominant one since the 1990s. In 2017-18, the Maharashtra acreage was at 75.9 per cent of the total area under grapes in the country.

⁷ As per APEDA export statistics for year 1990-91.

Table 24: State wise area under grapes in India (in '000 Hectare)

| State | MH | Karnataka | Mizoram | Tamil Nadu | Andhra Pradesh | Punjab | All-India | Share of MH (%) |
|---------|-------|-----------|---------|------------|----------------|--------|-----------|-----------------|
| 1987-88 | 4.5 | 5.7 | - | 1.7 | 1.6 | 1.6 | 15.4 | 29.2 |
| 1991-92 | 17.1 | 6.5 | - | 2.3 | 2.3 | 2.2 | 32.4 | 52.8 |
| 1996-97 | 27.8 | 6.5 | - | 2.2 | 2.1 | 2.5 | 42.9 | 64.8 |
| 1997-98 | 24.7 | 7.6 | - | 2.4 | 1.8 | 2.5 | 40.8 | 60.5 |
| 1998-99 | 27.0 | 7.5 | - | 2.3 | 1.8 | 2.5 | 42.6 | 63.3 |
| 1999-00 | 29.8 | 7.6 | - | 2.4 | 1.6 | 1.3 | 44.3 | 67.2 |
| 2000-01 | 29.8 | 8.2 | - | 2.4 | 1.6 | 1.4 | 45.2 | 65.9 |
| 2001-02 | 32.5 | 10.0 | 0.2 | 2.4 | 1.5 | 1.4 | 47.5 | 68.4 |
| 2002-03 | 35.2 | 9.7 | 0.3 | 2.4 | 1.7 | 1.3 | 52.1 | 67.6 |
| 2003-04 | 41.4 | 9.1 | 0.5 | 2.5 | 1.8 | 1.2 | 57.8 | 71.6 |
| 2004-05 | 43.8 | 10.1 | 0.5 | 2.5 | 1.9 | 1.2 | 60.5 | 72.4 |
| 2005-06 | 45.1 | 10.3 | 1.4 | 2.6 | 2.7 | 1.1 | 66.0 | 68.3 |
| 2006-07 | 45.4 | 12.1 | 0.5 | 2.8 | 2.5 | 1.1 | 65.0 | 69.8 |
| 2007-08 | 45.6 | 14.3 | 1.2 | 2.8 | 2.8 | 1.0 | 68.0 | 67.1 |
| 2008-09 | 55.7 | 14.9 | 1.2 | 3.1 | 3.0 | 0.8 | 80.0 | 69.6 |
| 2009-10 | 82.0 | 17.4 | 1.2 | 2.6 | 1.4 | 0.5 | 106.4 | 77.1 |
| 2010-11 | 86.0 | 18.1 | 1.6 | 2.7 | 1.3 | 0.5 | 111.0 | 77.5 |
| 2011-12 | 92.0 | 16.8 | 1.9 | 2.9 | 1.4 | 0.4 | 116.0 | 79.3 |
| 2012-13 | 90.0 | 19.7 | 2.4 | 2.7 | 1.6 | 0.4 | 117.6 | 76.5 |
| 2013-14 | 90.0 | 20.5 | 2.5 | 2.8 | 1.6 | 0.4 | 118.7 | 75.8 |
| 2014-15 | 93.3 | 21.8 | 2.5 | 2.3 | 1.9 | 0.3 | 123.0 | 75.8 |
| 2015-16 | 90.1 | 23.4 | 2.5 | 2.4 | 1.3 | 0.3 | 122.0 | 73.8 |
| 2016-17 | 104.1 | 24.3 | 2.5 | 2.5 | 1.1 | 0.3 | 136.6 | 76.2 |
| 2017-18 | 105.5 | 26.6 | 2.5 | 2.2 | 1.2 | 0.3 | 139.0 | 75.9 |

Source: Agricultural Statistics at a Glance Reports, Ministry of Agriculture & Farmers' Welfare, Government of India.

The sustained rise in acreage under grapes in Maharashtra has increased with other States. The production grew by almost 10 times in the last three decades from 2.51 lakh MT in 1987-88 to 29.20 lakh MT in 2017-18. Maharashtra alone accounted for 78.3 per cent of the grape production in 2017-18.

Table 25: State wise production of grapes in India (in '000 Metric Tonnes)

| State | MH | Karnataka | Mizoram | Tamil Nadu | Andhra Pradesh | Punjab | All-India | Share of MH (%) |
|---------|-------|-----------|---------|------------|----------------|--------|-----------|-----------------|
| 1987-88 | 49.2 | 114.9 | - | 28 | 40.2 | 17.6 | 251.0 | 19.6 |
| 1991-92 | 341.5 | 141.7 | - | 46.8 | 56.3 | 60.4 | 668.2 | 51.1 |
| 1996-97 | 750.9 | 196 | - | 47.4 | 51.2 | 66.5 | 1134.6 | 66.2 |
| 1997-98 | 568.2 | 226.6 | - | 48.0 | 35.3 | 66.5 | 969.3 | 58.6 |
| 1998-99 | 682.4 | 226.6 | - | 50.1 | 45.0 | 67.1 | 1082.7 | 63.0 |

| | | | | | | | | |
|---------|--------|-------|------|------|------|------|--------|------|
| 1999-00 | 779.0 | 228.2 | - | 51.7 | 32.1 | 34.6 | 1137.8 | 68.5 |
| 2000-01 | 779.2 | 144.1 | - | 54.8 | 31.3 | 37.2 | 1056.9 | 73.7 |
| 2001-02 | 911.6 | 169.7 | 0.6 | 51.7 | 29.4 | 36.7 | 1184.2 | 77.0 |
| 2002-03 | 988.7 | 141.9 | 0.6 | 35.7 | 33.5 | 35.7 | 1247.8 | 79.2 |
| 2003-04 | 1163.1 | 170.9 | 0.6 | 59.9 | 35.0 | 33.7 | 1474.8 | 78.9 |
| 2004-05 | 1233.9 | 185.8 | 0.6 | 69.7 | 37.8 | 32.3 | 1564.7 | 78.9 |
| 2005-06 | 1275.0 | 190.3 | 3.0 | 84.8 | 56.4 | 30.2 | 1649.6 | 77.3 |
| 2006-07 | 1284.2 | 216.6 | 4.2 | 91.6 | 51.8 | 30.7 | 1685.0 | 76.2 |
| 2007-08 | 1290.0 | 258.8 | 10.4 | 83.5 | 58.0 | 26.7 | 1735.0 | 74.4 |
| 2008-09 | 1415.0 | 269.0 | 10.0 | 91.0 | 62.2 | 22.1 | 1878.0 | 75.3 |
| 2009-10 | 440.0 | 317.6 | 18.4 | 44.1 | 29.8 | 15.5 | 880.7 | 50.0 |
| 2010-11 | 774.0 | 330.3 | 20.4 | 53.0 | 27.6 | 12.9 | 1235.0 | 62.7 |
| 2011-12 | 1810.0 | 288.1 | 24.3 | 55.1 | 28.9 | 12.5 | 2220.9 | 81.5 |
| 2012-13 | 2050.0 | 320.9 | 20.8 | 43.4 | 31.5 | 12.5 | 2483.1 | 82.6 |
| 2013-14 | 2160.0 | 302.4 | 23.9 | 47.7 | 34.7 | 12.0 | 2585.3 | 83.5 |
| 2014-15 | 2292.5 | 420.8 | 22.6 | 32.6 | 38.0 | 9.2 | 2822.8 | 81.2 |
| 2015-16 | 2048.1 | 429.8 | 22.6 | 34.1 | 28.2 | 8.5 | 2590.0 | 79.1 |
| 2016-17 | 2378.2 | 450.8 | 18.0 | 29.0 | 18.8 | 8.2 | 2921.7 | 81.4 |
| 2017-18 | 2286.4 | 524.2 | 18.0 | 58.9 | 21.2 | 8.2 | 2920.0 | 78.3 |

Source: Agricultural Statistics at a Glance Reports, Ministry of Agriculture & Farmers' Welfare, Government of India.

Within Maharashtra, grape is majorly grown in districts of Nashik, Sangli, Solapur and Pune. These 4 clusters cover about 90% of the total area. Particularly, the expansion of acreage has been phenomenal in Nashik district, and it is often termed as grape capital of India. The grape farmers in the district have paved the way to high value crop diversification and has influenced replicability in new areas.

Table 26: Acreage of the Major Grape Producing Districts of Maharashtra (in '000 Hectare)

| Year | Nashik | Sangli | Solapur | Pune | Osmanabad | All Maharashtra |
|---------|--------|--------|---------|------|-----------|-----------------|
| 2013-14 | 49.7 | 28.4 | 5.7 | NA | NA | 90.0 |
| 2014-15 | 52.3 | 23.1 | 5.6 | 2.5 | 2.5 | 93.3 |
| 2015-16 | 56.2 | 21.5 | 5.1 | 2.5 | 2.4 | 90.1 |
| 2016-17 | 56.3 | 21.7 | 18.1 | 2.6 | 2.9 | 104.1 |

NA – Not Available

Source: Horticulture Crop Estimates, NHB

Table 27: Production of the Major Grape Producing Districts of Maharashtra (in '000 MT)

| Year | Nashik | Sangli | Solapur | Pune | Osmanabad | All Maharashtra |
|---------|--------|--------|---------|------|-----------|-----------------|
| 2013-14 | 1241.7 | 853.0 | 87.8 | NA | NA | 2160.0 |
| 2014-15 | 1123.4 | 657.5 | 87.2 | 54.4 | 39.0 | 2292.5 |
| 2015-16 | 1237.1 | 611.3 | 61.0 | 56.5 | 38.3 | 2048.1 |
| 2016-17 | 1257.1 | 617.7 | 362.5 | 51.5 | 41.8 | 2378.2 |

NA – Not Available

Source: Horticulture Crop Estimates, NHB

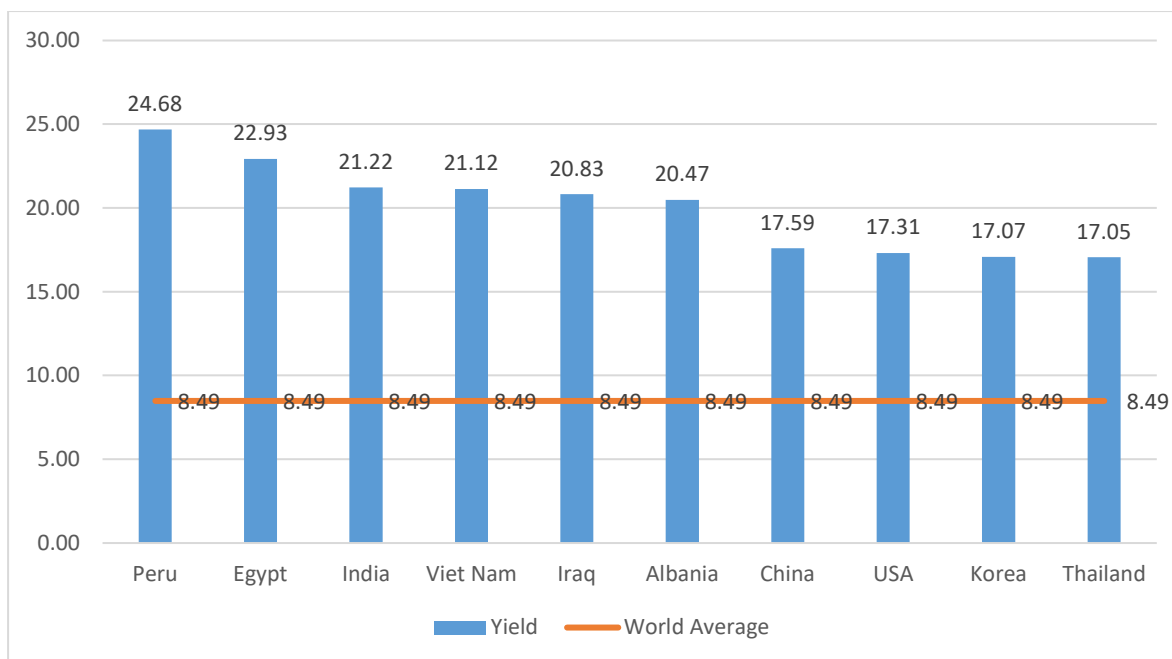
When it comes to productivity (See Table 28), Indian grapes have consistently been one of the highest ranked in the world. The high productivity is due to two factors. The first factor is that grapes normally show high productivity on small and marginal farms. Grapes are almost ‘hand-crafted commodities’ in that they require micro attention to every production operation including pruning, spraying, thinning etc. In India, majority of grape-growers are smallholders and hence the productivity levels are quite high. Except during the crisis years of 2009 and 2010, Indian productivity in grape farming has been one of the best in the world (Figure 11). The second reason is the presence of an institutional framework such as Association of Grape Growers (MRDBS) in Maharashtra, which was instrumental in offering production advisories to the farmers. Grape cultivation is a highly scientific exercise and the presence of such an institution was instrumental in dissemination of production protocols to the small farmers.

Table 28: Productivity of Grapes across major exporting countries

| Year | World | South Africa | Chile | India | Peru | Egypt |
|------|-------|--------------|-------|-------|-------|-------|
| 2001 | 8.47 | 11.89 | 10.69 | 21.20 | 11.01 | 17.30 |
| 2002 | 8.50 | 13.04 | 10.25 | 24.93 | 12.39 | 19.09 |
| 2003 | 8.74 | 15.10 | 11.50 | 23.95 | 13.27 | 20.92 |
| 2004 | 9.48 | 15.79 | 10.83 | 25.52 | 13.61 | 21.91 |
| 2005 | 9.47 | 14.95 | 12.56 | 25.86 | 14.77 | 22.91 |
| 2006 | 9.48 | 15.59 | 12.65 | 24.99 | 16.65 | 23.15 |
| 2007 | 9.54 | 15.76 | 12.87 | 25.93 | 16.11 | 23.67 |
| 2008 | 9.75 | 15.54 | 12.12 | 25.51 | 16.86 | 23.68 |
| 2009 | 10.00 | 15.21 | 13.07 | 23.48 | 18.96 | 21.42 |
| 2010 | 10.02 | 16.65 | 13.33 | 8.28 | 18.70 | 21.24 |
| 2011 | 10.38 | 16.23 | 12.30 | 11.13 | 17.91 | 20.37 |
| 2012 | 10.41 | 14.65 | 12.14 | 19.15 | 18.57 | 20.81 |
| 2013 | 11.30 | 19.27 | 12.11 | 21.04 | 20.14 | 20.79 |
| 2014 | 11.12 | 15.74 | 12.11 | 21.77 | 21.50 | 22.11 |
| 2015 | 11.43 | 16.27 | 12.13 | 21.68 | 22.44 | 22.51 |
| 2016 | 11.62 | 16.67 | 12.18 | 21.23 | 24.69 | 22.93 |

Source: FAOSTAT

Figure 11: Country-wise productivity for select countries for grapes in 2016 (MT/Ha)



Source: FAOSTAT

Although National Horticulture Board (NHB) reports the productivity of grapes to stand at about 23 tonne per hectare in recent times, key informant interviews revealed that the productivity of grapes in Nasik (main grape growing district in Maharashtra) is much higher than India average. Many grape growers from Nasik district have a productivity of about 28 to 30 tonne per hectare. International Organisation of Vine and Wine (OIV) reports also state the productivity of Indian grapes to be 30.1 MT per hectare.

4.2 Evolution of Farmer Networks/Organizations

This case of phenomenal changes and shifts details the evolution of farmer networks and its role in development of the grape sector in Maharashtra. We trace the contribution of various ‘change agents’ by undertaking interviews of key stakeholders. These interactions guide in identifying the pivotal moments and the response of producer’s organisation to challenges in achieving quality production as well as strategic choices under changing market dynamics. The third section portrays the circumstances and triggers leading to introduction of new technology. The fourth section describes the channels of diffusion of new technology and the efficiencies it brought in crop management. It also discusses how adoption of new technology helped in overcoming the SPS compliance issues and its effects on improving share in high value export markets. The final section summarizes the findings and concludes with policy implications.

4.2.1 The Grape Producers' Association and its Network

The *Maharashtra Rajya Draksha Bagayatdar Sangha (MRDBS)* or the Grape Growers' Association of Maharashtra, which was formed in 1960. This producer's organization has played a pivotal role in facilitating transformation in grape farming. The farmer networks it formed played catalytic role in technological change in the farming practices of the grape growers. In the initial years the problems largely revolved around understanding the physiological aspects of the grape plant on which data was scarce. Dr. J. M. Khilari at NRC grapes was instrumental in scientific research as well as translating the available information in English to Marathi writings. These writing were published by the MRDBS to disseminate among the grape grower networks across the Maharashtra state. Arranging seminars and group discussions among the farmers were a year-round activity of MRDBS involving all the stakeholders in the grape sector. This created channels of experimentation and technological dissemination activity among farmers creating shorter and active feedback loops.

MRDBS grew from 60 members covering around 800 acres to 27000 registered members with around 80000 hectares of grapes under cultivation. It is one of the largest farmer producer organizations in India.

In the initial years, the growers association was particularly campaigning a protocol of how to cultivate grapes. With the growing understanding of the biological processes of various stages of growth, there evolved package of practices for handling the grape cultivation by the farmers. These practices factored the local environmental conditions in the growing areas of Maharashtra. This laid the foundation and very sizable number of farmers turned to grapes cultivation. The new entrants to grape farming could typically follow the production protocols with minimal prior understanding of the science behind it. Gradually, with learning by doing and learning from others, the farmer gained experience in handling the necessary practices or interventions to meet the requirements of various stages of plant growth. These production protocols have undergone change from time to time with further insights through experimentation and experience.

4.2.2 The Experiments of Dabholkar 'Prayog Parivar'

When at the height of food crisis in January 1966, Shripad Dabholkar wrote an article for 'Kirkoskar' a popular Marathi magazine, on his experiments in agricultural productivity of various crops, it aroused a lot of interest among the people from Maharashtra. People started

writing letters to him with queries and asking for guidance and by the end of 1966, he had received ten thousand letters. With view of taking guidance from him many people started visiting his place - to see, to learn, to share their knowledge and the results of their experiments.⁸ This massive response made him start the 'Prayog Parivar' or the 'Networking of Self-Experimenting Learners' as he defines it. He introduced the participants having common interests to one another and shared all the communication material he had received from them. This created a feeling of belonging and togetherness in the entire group (Dabholkar, 1998). The process of evolution of such networking resulted in cross fertilization of ideas; and with experiments in cultivation of crops, tangible benefits were observed. Subsequently, the book 'Draksha Sanhita' written by Shripad Dabholkar became an important reference guide for grape farmers.

One such example of network in grapes, 'Vaidnyanic Drakshakula', meaning 'Grape Growers Conclave for Science' was formed by grape farmers at Tasgaon village in Sangli district of Maharashtra (Dabholkar, 1998). It started with just 20 members in 1974, and grew to around 200 farmers by 1982, with 100 from Tasgaon Taluka itself. The groups were essentially a network of learning exchanges for self-experimentation, analysis and technique standardisation, and with core purpose of dissemination of agricultural knowledge. These efforts played a pivotal role in capacity building of farmers and motivated them to undertake high value crops. These attempts at improving production practices of various crops over the years has generated a knowledge base among the farmers of Maharashtra. Among the various crop networks of 'Prayog Parivar', grapes were the most active and dynamic in nature. Their advocacy of scientific experimentation in evolving appropriate production practices played an important role in increasing know-how and spread of crop in new areas of Maharashtra.

In essence, 'Prayog Parivar' was arguing for judicious use of inputs in agriculture. The common theme was summed up as follows: Farmers should calibrate the interventions with appreciation of the plant's growth requirements aimed at higher fruit on the plants. But until the exports of grapes picked up in the early 1990s, there was a lethargy to the process, as it was not an essential requirement which could affect the domestic trade. People knew that seedless grape varieties are available, but it never spread as much among the farmers. There was spurt in innovation among the farmer community when the exports picked up. And 'novel' production practices were adopted to achieve the desired level of qualitative requirements. This

⁸ <http://arunshourie.bharatvani.org/articles/19970705.htm> - article by Arun Shourie

new requirement for knowledge was in sync with the advocacy of 'Prayog Parivar' and many new network groups came up.

4.2.3 The Mahagrapes Initiative

The members of the producers' association saw exports as an instrument for higher returns. The market window (March-April) for the EU market was very attractive to India but required infrastructure that the grape growers did not have. Producers therefore formed cooperatives to help create the needed improvements. Together with a state government agency called the Maharashtra State Agricultural Marketing Board (MSAMB), the association helped to form cooperatives in the state's major grape-growing regions. Precooling and cold-storage facilities were built for each cooperative at a cost of Rs.52 lakhs; India imported the precooling machines from the United States. The National Cooperative Development Council (NCDC) provided 50 percent of the loan, and state government contributed 45 per cent as share capital; the remaining 5 per cent was borne by members. The National Horticulture Board provided a subsidy of Rs.50 lakhs (Naik, 2005).

With objective of promoting exports under one brand, 'Mahagrapes' a partnership company was formed. In total, 29 cooperatives from the districts of Nashik, Pune, Sangli, Satara and Solapur federated to form 'Mahagrapes' in 1991. The number of member cooperatives came down to 16 in subsequent years. 'Mahagrapes' acted as a platform for providing unique brand identity for the Indian grapes in the EU markets. It was responsible for undertaking the marketing and transaction activity with the EU buyers. By 1990-91 season, the growers' cooperatives began to export their grapes under one brand name, Mahagrapes, to help farmers realize higher and more stable prices. It developed an interesting model, wherein it charged a facilitation fee for the export quality grapes procured from the cooperatives while the rest is passed on to the cooperatives, who then keep a part of the price and pass on the rest to the farmers. The amount each cooperative keeps differs according to their respective business decisions. Mahagrapes as an organisation facilitated availability of information about prices and market requirements for member farmers. And allowed him to learn which varieties received higher prices in export markets (Roy and Thorat, 2007).

Since the marketing arrangement was one of price-sharing, it was also one of risk-sharing and the farmers got good exposure to pricing risk in the export markets. Exposure to the risk also made the farmers open to adopting new technology as they realized that strictly following production protocols would enable them to minimize risk of penetrating the European markets.

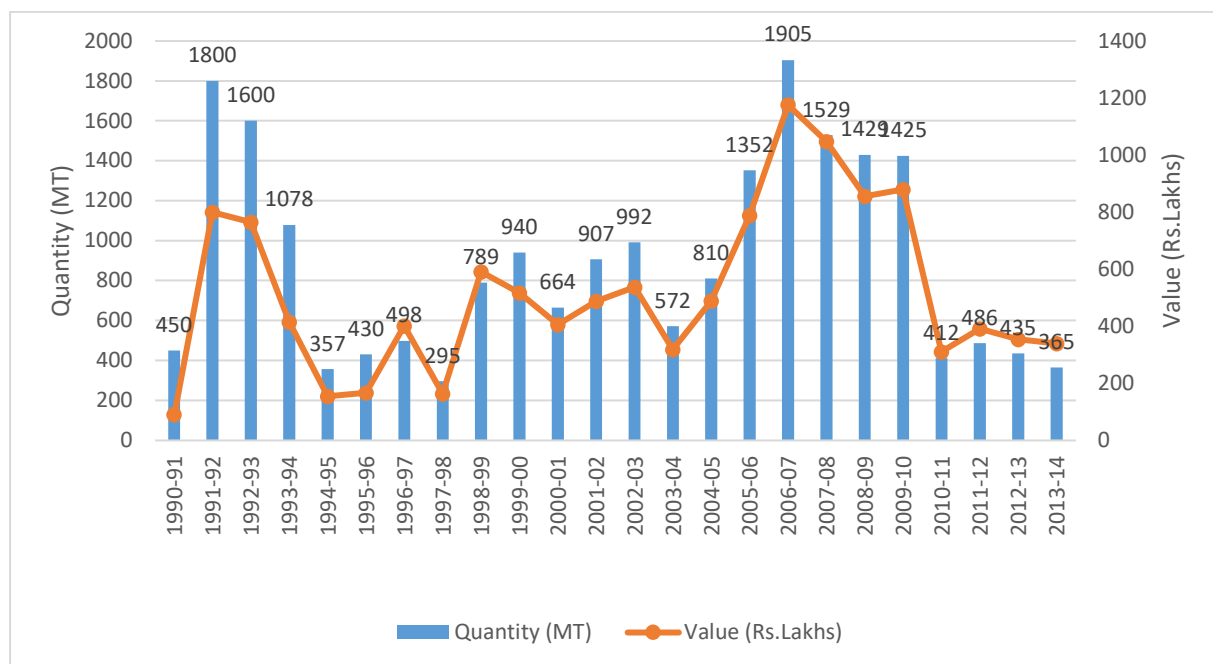
So, the cooperative societies of progressive farmers became the agent of change for diffusion of knowhow about the advanced production practices and export quality specifications and compliance requirements. The member farmers gradually expanded their area under grapes with focus on export markets and adopted an attitude of learning among themselves and with enthusiastic farmers visiting their plots.

The cooperative societies formed under the government policy support, were not mandatorily bound to the Mahagrapes channel of trading with EU markets. They could go on their own and experiment with new approaches to the export markets. Some farmer groups directly traded with the buyers from EU since the early 1990s. With increasing export capacity and rising export demand, the cooperative society's i.e. well-established export families started buying outside the fold of their members. The substantial control over the export channels and social influence gave them advantage in dealing with the smallholder farmers. They offered fixed prices per kg to the smallholder farmers but borne the full risk of realising price in the export markets. As the exports activity required significant stretching of exporter's balance sheets, maintaining high level of working capital during harvesting season became a major priority. So, payment delays of one or two months to farmers became the norm during this period. This business model gave windfall gains to some exporters in the initial years and led to expansion of their capacity. But when the sector got struck with the rejection of export consignments due to MRL compliance issue in 2010, they could not handle the highly leveraged financial positions and succumbed to it. The lack of risk mitigation strategies to handle adverse market scenarios turned out to be fatal to the farmer cooperatives. As a hedging mechanism some exporters started offering base price with a variable component depended on the realised price in the EU markets. Sensing business opportunity the private companies like ITC, Freshrop Fruits, Mahindra Shubhalabh, Deepak Fertilizers, etc. had a breakthrough in rapidly expanding their operation among the farmers. The private company exporters agreed to take the entire risk of marketing the grapes abroad. Thus, once the farmer sold the grapes to the exporter firm, his risk in the process was zero. This coupled with outright payment at the delivery of harvested produce made the new model attractive and led to rapid expansion of the sector.

Since the exporter buys produce as well as risk, markets would evolve in a manner that would price the risk. Technically, in such a situation, the farmer should get a lower price for the produce. However, since the exporter farmers in Maharashtra understood production protocol well, they also realise the fact that it is their adherence to protocol, that minimizes the risk for

the exporter. This approach to risk management further accelerated the switch from the cooperatives type risk sharing model to more of risk bearing model by private companies. Also, the superior qualitative achievements of smallholders started being priced fairly by the private companies. In subsequent years, this approach to exports led to a gradual by definitive shift from sourcing export quality grapes from prominent established exporting families to largely smallholders' segment as well. The risk management in this approach was relatively superior to the earlier practices and it further deepened stakeholder participation and ownership in the value chain. Improved risk management led to better incentive mechanism in terms of reward for good quality achievements. And spurred further competitive behaviour among smallholders for achieving better quality. The smallholder farmers who were already ahead of the curve in terms of qualitative parameters could achieve further higher unit value realisation. This increased Indian overall competitiveness in grapes and resulted in increased market penetration in the EU market.

Figure 12: Mahagrapes exports from India



Since 2014, Mahagrapes has stopped exporting activity due to financial and operational constraints. Over a period, Mahagrapes ceased to be the dominant export channel for small grape farmers (see Annexure 4). In hindsight, it worked as an instrumental organisation which caught steam and became a wider industry. Later declining share and influence of Mahagrapes evidences the success of proverbial market expansive propulsion and wider choices. The proactive role it played created the robust export value chain while adhering to extremely stringent

food safety norms. This development has inspired similar initiatives by APEDA in other high value crops with export market potential.

4.2.4 National Research Centre for Grapes (NRC)

To facilitate scientific research, the National Research Centre for Grapes was established under the Indian Council of Agricultural Research (ICAR) in New Delhi on January 18, 1997, located in Manjri, Pune. The institute has been given the following mandates:

- a) Conducting strategic and applied research to ensure safe grape production and enhance productivity.
- b) Transferring technology and building the capacity of stakeholders to boost sustained grape production.
- c) Serving as the National Referral Laboratory for Food Safety and Pesticide Residue in fruits.

Since its inception, the NRC has provided crucial scientific advice to grape farmers. It has made significant contributions in the fields of plant pathology and disease management. Over the years, the institute's experts have continually reviewed and improved standards. There is an ongoing exchange of information between experts and farmers, promoting the dissemination of scientific knowledge among grape growers.

In response to the rapid alerts against Indian table grapes in Europe in 2003, a pesticide residue monitoring program (RMP) for grapes exported to the European Union was launched in the 2003-04 season. This program aimed to establish full traceability of grapes from farm to consumer levels through a web-based system called 'Grapenet,' with the NRC for Grapes acting as the National Referral Laboratory (NRL). As the number of chemicals listed in the Maximum Residue Limit (MRL) list has grown, the need for scientific advisory to address crop management issues has become crucial. The NRC has actively addressed these problems through seminars, workshops, and farm visits in grape-growing regions.

4.3 Circumstances and Triggers

Grape is a perishable fruit with almost 99 per cent water content and the shelf life is extremely short. The supply in the domestic markets like Delhi and Kolkata faced hurdles since the transportation by trucks used to take 30 plus hours to reach the destination. So, it was a herculean task to deliver the grapes in normal and edible condition to the ultimate consumers. In the late 1980s, the packaging underwent changes from wooden baskets to corrugated boxes.

This took care of the bouncing and rubbing of fruit against each other during transportation and reduced the overall damage levels. It also meant larger quantity could be transported in the same volume with enough safety. Consequently, market demand went up and so did the acreage under the crop in major producing areas. But the expansion of acreage outpaced the demand and since the harvest timings of most farmers coincided or overlapped it created glut in the market. This dampened the prices and reduced the economic feasibility of grape cultivation, it being a capital-intensive crop. Hence, the need for exploring new markets was felt among the grape farmers.

The introduction of post-harvest technology like pre-cooling and cold storage enhanced the shelf life of the grapes. And took away the worries of immediately selling the produce on harvesting. These technologies provided the initial confidence to enter the export markets. When a farmer exported the first consignment on his own to Dubai and London markets it generated huge enthusiasm and boosted the farmers to undertake major risks despite many odds stacked against them.

With climate-controlled containers the produce could reach Rotterdam in 22 days. As the price incentive in export markets was sufficiently high, it took care of substantial costs incurred in export packaging. Some items of packaging were not available in the country at the time. So MRDBS took initiative in bulk buying from foreign vendors and providing it to exporting farmers. The sulphur pads put in each packed box for reducing the perishability rate in transportation and the plastic punnet boxes for grape bunches are a few such products. This protected and preserved the lustre on grapes in in the transportation period.

The palletization of boxes also reduced the space taken in the pre-cooling and cold storage houses. The introduction of plastic crates for post-harvest stages is one important driver of major change in grape sector. It provided safe, protective ease of handling over traditional practices. In recent times the transportation of grapes has majorly shifted to crates as now 'single-usage-crates' made from plastic wastes have significantly reduced the unit prices making it affordable over the corrugated boxes.

Grape is the only fruit where India is on par with highest international productivity levels. This gave a big advantage in terms of focusing just on the quality aspect than increase in per acre tonnage alone. In fact, it made some degree of trade-off between quality and quantity easily affordable to the farmer.

MRDBS farmer network acted like ‘quality-circles’. These helped to be hard focused on meeting the specification of the export markets. It was collective learning through demonstration effect. The government of Maharashtra initiatives since 1990 to arrange farmer’s group visits to Israel and European countries for exposure to advanced agriculture paved and complemented the way forward. The demonstration effect was immense in the early years. The farmers always discussed the new approaches to crop management which they witnessed in their visits. After each visit seminars and workshops used to be arranged for dissemination of know-how and new techniques. The government helped but only as a facilitator. And most importantly it was a time bound help. It withdrew when the push had generated enough momentum.

The attempts by farmer themselves in exporting creating a confidence among the community to take on the challenges. There spurred a competition among farmers as to who produces the best quality grapes and too at scale. Initially, the rejection in a plot used to be as high as 40-50 per cent, but with introduction of new package of practices the exported share per plot went up to 70-80%. These initiatives created a community of innovative and entrepreneurial farmers. Also, the sector as such has shown acumen as well as agility in adopting to overwhelming market situations time and again.

4.4 Spread of Technology

We focus on production technology in terms of products, practices and application of scientific knowledge – inputs like insecticide, pesticide, fertilizers, labour, machinery, tools and implements.

4.4.1 Adoption of new grape varieties

In the 1960s, the introduction of strains of ‘Selection 7’, essentially Thompson seedless variety paved the way for adoption of seedless varieties in the grape growing region. Further, selection and crossbreeding by the farmers and researchers yielded new cultivars popularly known as Sonaka and Tas-A-Ganesh (Apte, 2010). The berries of Sonaka are oblong while of Thompson and Tas-A-Ganesh are round.

Table 29: Varietal characteristics of commercially grown grapes

| Name of the variety | Description | Berry diameter | Region with consumer preference |
|---------------------|--|----------------|---------------------------------|
| Thompson Seedless | Berries are oval to oblong in shape with TSS 18-22 ° Brix, acidity 0.5 to 0.7% | 16 mm to 18 mm | EU, Middle East, Russia, China |

| | | | |
|-----------------|---|----------------|--|
| Sonaka Seedless | Berries are elongated, cylindrical and amber coloured, TSS around 22 ° Brix, acidity 0.4- 0.7% | 16 mm to 19 mm | India, Bangladesh, Nepal, Middle East, ASEAN Countries |
| Sharad Seedless | Berries are oblong to elliptical in shape and bluish black in colour with TSS 18-21 ° Brix and acidity 0.5-0.7% | 18mm to 22 mm | India (domestic market as perishability is high) |
| Tas-e-Ganesh | Berries are roundish shaped and green to amber in colour with TSS 20-22 ° Brix and acidity 0.5- 0.65% | 15 mm to 20mm | EU, Middle East, Russia |

Note: Degrees Brix or °Brix is a measure of the total soluble solids (TSS)

Source: APEDA

The establishment of vineyards on rootstocks started in the late 1990s, with the successful grafting of seedless varieties on dogridge rootstock. NRC played a crucial role in testing and validating the suitability of rootstock for environmental conditions in Maharashtra. Earlier root necrosis was a major problem faced by traditional varieties. The capacity of these plants to have rapid and vigorous growth was limited, as the root uptake of nutrients was insufficient for achieving characteristics needed for commercial production. Rootstocks overcome the adverse effects of salinity and drought and also to modify the scion physiology/ morphology in terms of vigour, fruitfulness, bunches and berry characters, etc. Dogridge rootstock was known for its drought and salt tolerance, so its compatibility with the promising varieties of grapes like Thompson Seedless and its mutants was validated by the NRC scientists. Grafting on rootstock adds one more year until the farmer could see the first production, but the outcome was superior and robust enough to persuade them to make this shift. Having a consistently healthy and productive plantation became a priority in the 1990s onwards as grapes is a capital-intensive crop and risk mitigation strategies become core of production practices.

The introduction of seedless varieties in the domestic market saw a shift in consumer preference. The long varieties received a strong response vis-à-vis the round varieties in the domestic markets.⁹ At large the consumers in South Asia and the Gulf markets prefer long berry varieties, but the EU market preference for round berry varieties. Thompson seedless are preferred table grapes by the EU consumers and a well-established variety in the international trade. So, the area under Thompson seedless grew rapidly as the export demand picked up in the 1990s. The improvement in market access in EU markets significantly impacted the varietal

⁹ <http://apeda.in/agriexchange/Market%20Profile/one/GRAPES.aspx>

composition of the grape growing region, as the traditional seeded varieties like Anab-e-Shahi, Bhokri, Muskat started losing their lustre and are almost non-existent today.

The introduction of seedless varieties implies use of externally induced growth hormones to the grape bunches, to enhance the girth of berries during various growth stages. This necessitated scientific understanding about the growth of the plants by the farmers. Usually, the task of identifying appropriate stages for applying growth hormone solution like Gibberellic Acid (GA) on the grape bunches requires judgemental skill and learning by considering numerous environmental and growth factors at play. Appropriate judgement of the situation has strong correlation with the farmer's craft and knowledge. If the assessment is not up to the mark, as much the farmer tries, he cannot turn around later stages to achieve export quality grapes. At times during these stages the farmer takes help of the progressive farmers, who are well versed in such matters, and respected for their acumen in making agricultural decisions, within the farmer network.

In recent years, the export markets witnessed saturation in demand for Thompson Seedless, the traditional export variety. Based on feedback from high-value markets like the EU, Sahyadri FPO has played a significant role in introducing patented grape varieties to India. It has collaborated with the patent-holding companies from western countries to introduce new varieties such as ARRA 15, ARRA 30, Autumn Royal, Autumn Seedless, Blush Seedless and Sugraone. Since, smallholding being the norm in India, it would be very difficult for the patent holding companies to establish a formal mechanism directly with farmers. Also, the willingness of farmers to pay royalties would be low, since the varieties can be easily passed on to fellow farmers under the Indian law. To overcome these issues, Sahyadri FPO decided to be the sole guarantor for any exports of these varieties from India. Any exports would automatically make Sahyadri FPO liable for these royalties on per Kg basis. As a result, Sahyadri FPO is testing and validating these varieties at FPO member plots. So, these grape varieties are being provided to members for licensed production with buyback guarantees. The ARRA 15 variety offers substantial benefits as it does not require hormone management, thereby reducing labour requirements. This change saves around 10-15% in production costs while achieving higher value in export markets.

To ensure the provision of high-quality mother plants for grafting these varieties, Sahyadri FPO has partnered with the advanced plant nursery Graftech Plants for mass production of saplings. Quality inputs will ensure better plant health and reduce disease incidence, contributing to the

overall success of grape production. The introduction of high-value grape varieties aims to expand market share in EU markets and improve quality in compliance with global standards. This strategic move not only enhances the profitability of grape growers but also aligns with global agricultural practices. This signals a significant diversification towards high value grape varieties in the coming years, making grape farmers ready for the future challenges.

4.4.2 Improvements in crop management

The use of advanced agriculture technology in Indian farms was still in its infancy in the 1980s. The crops were irrigated using flood irrigation, with grapes plantation being no exception. But the introduction of drip and sprinkler irrigation technology by the pioneer company 'Netafim' from Israel in early 1980s introduced change in the landscape of some crops in Indian agriculture. Since grapes are climber plants sudden change in environmental conditions makes it susceptible to excessive shoot growth in short period of time. So, ensuring homogenous plant growth with flood irrigation was a major challenge for the farmers in the 1980s. But with the introduction of drip technology this problem could be overcome. The government of Maharashtra signed a technology transfer programme with Israel in 1990s. And the promotion of drip and sprinkler irrigation among horticulture farmers led to widespread adoption in the 1990s. The use of drip irrigation modulated the volume of water supplied and distributed across the grape plants according to its specific needs during a period. This transformed the grape crop as the method of flood irrigation resulted in excess and uneven distribution of water to the plants. Moreover, this made plants have uneven stages of growth leading to the problem of 'short berries', where grape bunches have uneven berry growth in them, affecting quality and productivity parameters of the crop. With use of drip irrigation, the stages for 'dipping' and 'thinning' of grape now arrive at the same time across the plot. These significant improvements led to uniform quality of fruit bunches at the harvest time. Thereby, instilling confidence in farmers to achieve quality specification required for attempting grape exports.

Among the progressive grape farmers, handling farm labour is one crucial skill for growing export quality grapes, Applying GA growth hormone solution, locally called 'dipping', requires dipping the grape bunches in a container of GA solution manually by the farm labour. When the grape berries grow to a girth of 3-4 mm size, a few days after the flowering stage, the grape bunches are ready for the 'dipping' activity (Table 30). A grape plant on average has 60 bunches after the flowering stage, and a plot of one acre size comprise on average 950 plants. Thus 'dipping' is an arduous task to accomplish for the farmers. It requires delicate skill

on the part of the farm labour, and continuous monitoring by the farmers to ensure each and every bunch is dipped to the fullest. It is natural to miss some bunches and hence monitoring is an important part of this work.

Table 30: Use of plant growth regulators in ‘dipping’ activity for berry growth¹⁰

| For meeting export quality grades | | | |
|-----------------------------------|---------------------------|--------|--|
| 3-4 mm berry size | 30 ppm GA + 2 ppm CPPU | Acidic | Berry elongation and for round berries |
| | Or 1 ppm Homobrassinolide | | |
| | Or 6BA @ 10 ppm** | | |
| 6-7 mm berry size | 40 ppm GA + 1 ppm CPPU | Acidic | Berry elongation |
| | Or 1 ppm Homobrassinolide | | |
| | Or 6BA @ 10 ppm | | |
| For local market | | | |
| 3-4 mm berry size | 40-50 ppm GA + 10 ppm 6BA | Acidic | Berry length |
| 6-7 mm berry size | 40 ppm GA | Acidic | Berry length |

Note: GA, CPPU, Homobrassinolide, 6BA are plant growth regulators

Source: NRC for Grapes

Similarly, ‘thinning’ is an important work task to complete for the grape farmers. When sufficient bunch setting is achieved the dipping activity, and the berries grow to 5-6 mm, the grape bunches are ‘thinned’ by removing the unnecessary berries using scissors. This is to ensure just about required berries for the export quality grapes. This activity helps achieve the required bunch and berry size for the export markets. For example, European markets need a specified type of ‘thinner bunch’ with uniform round-looking berry of 16-17 mm berry-girths with green lustre. The level of sugar is also limited to 15-16 brix. Each bunch typically weighing 450-500 grams is packed in a separate pouch (Apte, 2010). Table 31 provides a detailed list of export requirements over the local market needs.

Simultaneously, the package of practices had to become compliant with the SPS requirements of the buyers and consumers in export markets. This entailed detailed planning, culminating in production schedules and adherence to it on daily basis, and across various stages of the plant growth. This resulted in a shift from reactive approach to pest and disease management to a preventive one. And spurred the use of preventive insecticide and pesticides at regular intervals and at appropriate stages of the plant growth. But these shifts don’t happen on their own. The

¹⁰ These recommendations are based on deliberations of the meeting organized by Maharashtra State Grape Growers’ Association (MRDBS) and NRC for Grapes on 30th April 2010 at NRC Grapes Campus for the management of plant growth without the use of CCC.

progressive farmers had to take lead in guiding and demonstrating the appropriate practices. These had its own trials and tribulations.

Table 31: Horticultural practices to be followed in grape cultivation

| SN | Particulars | Export | Local | Remark |
|----------------|--------------------------------|----------------------------|--|---|
| 1 | Spacing | 10' X 6' | 10' X 6' | Same for both types of grape growing |
| 2 | Area/vine available | 60 sq.ft. | 60 sq.ft | - |
| Back pruning: | | | | |
| 1 | No. of shoots retained/sq. ft. | 0.65 to 0.70 | 1 | Variation in shoots per vine depends on the purpose |
| 2 | No of leaves/shoot (cane) | 16-17 | 16-17 | Required for formation of food material |
| 3 | Leaf area per leaf | 150 to 180 cm ² | 150 to 180 cm ² | Required for photosynthesis |
| 4 | Cane diameter (mm) | 8-10 mm | 8-10 mm | Required to store reserve food |
| 5 | Inter nodal distance (cm) | 5.0 to 5.25 cm | 5.0 to 5.25 cm | This helps in erectness of shoot towards sun that helps in fruitfulness |
| Fruit pruning: | | | | |
| 1 | No of shoots/sq. ft. | 0.75 | 1 | Requires for proper bunch development |
| 2 | No. of bunches/sq. ft. | 40 | 60 | To obtain appropriate bunch weight |
| 3 | No. of bunches per shoot | | | |
| | 1. Shoot (upto 6 mm diameter) | 1 | Based on requirement the number of bunches varies. | The cane diameter can decide how much food material is stored to nourish the developing bunch. |
| | 2. Shoot with 6-8 mm | 1 | | |
| | 3. Shoot with 8-10 mm | 2 | | |
| | 4. Shoot above 10 mm | 3 | | |
| 4 | No of leaves above bunch | 44540 | 44477 | To protect the bunch from sunlight. |
| 5 | Leaf area | 150 – 180 cm ² | 150 – 180 cm ² | For proper photosynthesis of that bunch. |
| 6 | Total leaves/shoot | 16-17 | 16-17 | To supply food material to the shoot. |
| 7 | Shoot thinning stage | At 4-5 leaf | At 4-5 leaf | This avoids loss of reserve food |
| 8 | Bunch thinning stage | At pre-bloom stage | At pre- bloom stage | This helps in fast bunch development |
| 9 | Girdling | 6-8 mm berry size stage | 6-8 mm berry size stage | It increases the berry size by 1 to 1.5 mm |
| 10 | Average Bunch weight (g) | 400 | 300 | Variation in bunch per shoot decides the bunch weight. |
| 11 | Yield/vine (kg) | 16-18 kg | 18 – 20 kg | Exportable quality bunches can be obtained only after retaining appropriate number of bunches per vine. |

| | | | | |
|----|-----------------|----|-------------|--|
| 12 | Yield/acre (MT) | 12 | 14.0 – 15.0 | The yield obtained for local market is higher than the export. |
|----|-----------------|----|-------------|--|

Source: NRC for Grapes

The adoption of advanced technology in reducing the intensive use of chemicals in grape farms has been critical in the transformation. In earlier days, to achieve the required parameters of exports, farmers used to indulge in excessive use of chemicals. Sometimes in the ‘dipping’ activity, excess growth hormone used to be used or at times the solution used to be a complex mixture of 3-4 chemicals to reduce multiple sprays and achieve cost reduction. Excessive or mixing incompatible chemicals often backfire and cause harm to the grape bunches and plants. With gradual diffusion of production protocols these unhealthy practices have subsided amongst the farmers. Similarly, owing to the cases of visible side effects on the plants and improved understanding of plant physiology on the part of the farmers, the use of various growth hormones in single application has reduced considerably. One spillover of these changes is the considerably improved taste of export quality grapes. They are now thought to be suitable for consumption by the domestic consumers. Earlier, the taste of the export quality grapes could become sour due to excessive use of growth hormones and stimulants at the ‘dipping’ stage. Usually, EU consumers prefer just about minimal sugar (15-16 brix) in grapes as it becomes a huge risk if the grapes fall short of the required export quality specifications by the harvest time. As the domestic market consumers prefer sweet grapes i.e. higher brix there would be no demand from the local buyers for the export quality grapes. For the export farmers, if significant portion of grapes got rejected during sorting and selection process, they had no way to dispose of the produce. These grapes could not be converted to raisins either. Further, harvesting low sugar content of grapes meant, the storing quality would go down substantially, as sugar itself acts as preservative and enhances the shelf life of bunches. Since, the export grape bunches are thinner it means lower weight per plot, that too with higher costs incurred for export compliance. These costs were found to be 28% over and above the domestic production costs (More, 2015). The financial loss due these problems have been considerably mitigated due to fine tuning of production protocols according to the needs of the farmers. The continuous improvement in agricultural practices with availability of better information and knowledge of superior practices has been the key driver here.

With the rise of the grape exports, the demand for ‘skilled’ labour increased in the 1990s. The local labour acquired these skills early on and started specialising in such activities by forming

contractual labour groups of 10 to 20 members and demanding higher contractual value for such wage contracts. This was a significant shift in employment with the advent of the export grape varieties and production practices. Earlier the labour wage contracts used to be of three type – daily, monthly, and yearly. The monthly and yearly contracts comprised of kind element in the form of food grains bundled along with wages. All the works were done using these kinds of labours. But the risk premium associated with failure in terms of achieving appropriate handling of ‘dipping’ and ‘thinning’ stages and works gave rise to the specific contractual labour contracts. Hence, the prevalent agricultural practices had to undergo a major shift in terms of its conceptual understanding of growing plants and the labour skills required to achieve the desired effect on the grape plantation.

4.4.3 Mechanisation

The characteristics of available agriculture machinery in India is suited only for the large farmers, as the industry is still to achieve ‘down-sized’ and ‘down-scaled’ version of tractors, tools and implements while keeping in mind the needs of marginal and small landholders. The spraying of pesticide and insecticide with kerosene knapsack pumps was commonplace since it was introduced in the 1960s. In the 1970s, ‘three piston pump’ was introduced for application of pesticides and insecticides. In this setup, the spraying was done using spray guns having nozzles at the front and at the rear and a pipe connecting it with solution tank. With the pumping activity of the three pistons the solution is pushed towards the nozzles with great pressure. This creates a spray of water which was uniformly sprayed over the vegetative parts of the crops. The pump achieves its required rounds per minute (RPM) using power from a kerosene or diesel engine. This setup is to be carried by two labours from place to place and assembled again and again, as the pressure from the pipes drops, if the distance is far away from the pump. In 1980s, electric ‘three piston pumps’ came into picture as the electricity supply expanded in new areas. This substantially improved the coverage of pesticide and insecticide applied and gave an improved instrument for control over pest and fungal disease attacks. This approach to spraying insecticide and pesticide application is still prevalent in most crops. But still the erratic supply of electricity remained a problem in timely application.

To overcome these problems there was a need for small tractors which could traverse the width between two rows of grape plants. Only the newly launched Mitsubishi tractors in late 1980s could traverse through the grape rows and had enough power to generate enough RPM, when the rear shaft was connected to the tractor mounted ‘three piston pump’. With this objective a

group of grape farmers got in touch with ASPEE¹¹, a reputed spraying implements company with objective to build a tractor mounted setup for foliar application of insecticide and pesticide. ASPEE rose to the occasion and came up with a tractor mounted 200 litre plastic drums-based setup on the tractors. They undertook extensive trials in the Nashik region at the grape plots of these farmers. The setup had multiple spray nozzles attached in the rear of the tractor with controls knobs to adjust height, direction and volume of the spray.

Subsequently, with learnings from this experiment, a dragged carriage using a tank of 400 litres on two wheels was built by the farmers along with local machine tools experts. These efforts also helped in standardizing the application of 400 litres per acre spraying volume, as recommended by horticulture scientists. This helped in achieving maximum canopy coverage to overcome pests and fungal diseases. The activity could be initiated at short notice and with just one labour, the tractor driver working for 1-2 hours per acre instead of an entire day. The use of small tractors for spraying marked a shift to mechanized farming operations with significant improvement in operational efficiency due to uniform distribution of applied insecticide and pesticide. The costs of the tractor and the spraying unit were initially quite high but has relatively declined with scale in manufacturing owing to widespread adoption of the technology. Presently since they are widely owned by even small and marginal landholders and have become standard crop protection instrument in the grape growing areas. This shift in production technology revolutionised the grape farming operations and led to massive expansion of acreage under grapes in Maharashtra from the 1990s onwards.

4.4.4 Labour

With the expansion in area under grapes in the region, the need for labour exploded from 1990 onwards. With incentives of higher wages, there was an influx of labour from the tribal belt of Nashik district to the grape growing areas. The employment potential of grapes is almost 10 times that of food grain crops like wheat, soybean, and maize. An acre of grapes generates 365 to 400 person days per acre per year compared to 25-30 for wheat, soybean or maize crops. Most of the grape growers being smallholders, it is nearly impossible to have coordination in spacing the pruning timings. The ideal pruning window in October is also limited. If one goes for September pruning, then it becomes high risk bet with challenges in ensuring crop due to adverse weather conditions. If unknowingly too many farmers prune the grape vines on

¹¹ <https://www.aspee.com/about/milestones>

identical days or within a short window of days, the later growth stages of these plots arrive together. However, similar stages of growth for many farmers means the work demand for labour peaks around the same time. This causes acute shortage of skilled contractual labour and there is phenomenal shoot up in wages. A delay of works even by a day or two severely affects quality parameters of export farmers. The situation around 2010 became so dire that the terms of trade for farmers diminished substantially. Some prominent farmers shifted focus to domestic markets in 2011 and 2012 seasons owing to the addition of labour crisis. Targeting higher productivity with relatively lower production costs meant net returns improved, along with lowering of exports associated risks faced in 2010 exports season. But the overall sector was at breakpoint as the viability of grapes as a high value crop diminished.

To overcome this problem, some enterprising farmers and entrepreneurs started exploring various options available to them. How developed countries manage to undertake grape crops with low availability of labour was always a much-discussed issue among these farmers. During their study tours to South Africa, Chile and Italy, they had come across low volume sprayers using electrostatic technology. These countries sprayed growth hormones using these sprayers for effective management of growth stages of grapes. But there was no supplier of these machines in India. And the imports of this machinery for agriculture use was not allowed under the Indian laws. Electrostatic technology is primarily used in paint shops of car manufacturers and imports meant attracting customs duty at rates applied to the auto industry. This dual use technology aspect was difficult to explain to the government officials. Agreeing to the industrial import duty rates meant the cost would go up prohibitively. So, the progressive grape farmers and the MRDBS gave representations on the same to the concerned government departments and its imports were allowed for agricultural purposes along with waiver in import duty. The sprayers are mostly imported from Italy, USA, etc. Since 2014 onwards, the use of electrostatic technology has brought significant improvements in grape farming. These sprayers have removed the requirement of manually dipping bunches in the one litre container of growth hormones solution. In electrostatic spraying, the water droplets can achieve sizes of even 40 microns. It acts like a mist or fog that envelopes and since it's a charged particle it covers the surface area of the entire grape plant, thereby reaching all parts of the grape berries in equal proportion. This production technology removed errors of the manual works done over the years. Earlier the norm was having three 'dipping' and two 'thinning' activities, but now multiple sprays of growth hormone can be taken, almost mimicking the natural hormone

process in seeded grape varieties. And the work of an acre is done in just one hour instead of 2 days for 10 labours. Simultaneously, the requirement for manual thinning of grape bunches has diminished, as the nuanced timing of growth hormone spraying can ensure sufficient natural thinning of grape bunches. So many farmers now have only one manual ‘thinning’ for giving appropriate shape to the grape bunches. Earlier the ‘dipping’ acted like a booster shot for achieving growth in the grape bunches and the intermittent application of light doses was done through normal sprayers used for pesticide and insecticide. But this was a haphazard approach and did not complement the natural requirements of grape bunches. The flowering stage is the most crucial and delicate stage for any fruit crop. And being a seedless grape the natural dose of growth hormone was needed around this stage. But given the large size and uneven distribution of water droplet across the surface area of the grape bunches and canopy, it remained a pipedream to achieve precision in this work. Also, if excess water droplets touched the grape bunch from just one side, then only those berries used to grow faster. The preparation of solution for the new electrostatic spraying requires the mix to be in exact proportions and no undue addition of growth stimulants, pesticide or insecticide can be practised. This approach of substitution of costly labour with electrostatic sprayers has paid dividends for the grape sector as a whole and the exports from Maharashtra have more than doubled since its introduction. Overall, the experience with this new technology has had a positive impact on the overall grape sector.

Achieving ideal formulation for the dipping solution was a difficult proposition for any farmers. And as many farmers, so many types of unique mixtures used to happen. But since the cost of the electrostatic sprayers is high, around 6-16 lakhs, only big farmers have bought it. Even for large farmers the cost is prohibitive, as its usage happens only for a few days in a year, so to overcome this problem they have entered custom hiring business by providing electrostatic spraying services to other farmers. The charges in 2020-21 were around Rs.2000 per acre compared to the Rs.5000 - 6000 per acre for ‘dipping’ and Rs.8000 – 10000 per acre for ‘thinning’ respectively. The adoption of electrostatic technology has brought cost and operational efficiency in achieving export quality grapes, making the grape farmers internationally competitive while simultaneously ensuring high degree of SPS compliance for exports. The leading importer of electrostatic machines from Italy - Shripad Agro Sales Pvt Ltd alone sold over 1000 units by October 2018, that too within 6 years of launching it. The price of machine varies from 5-7 lakhs per unit depending upon its storage capacity. Currently,

all the major grape growing districts have shifted to the use of such machines available through custom hiring operations run by progressive farmers.

The supply of local labour i.e. from the same or adjoin villages was not enough as the requirement went up in peak periods. To overcome this problem labour migration from tribal belt of Nashik district increased. There was gradual diffusion of skills among the tribal labour as training them was an uphill task in initial years. With time they came on par with local work force and the wage differential reduced. This also had spill over in terms of improvements in their farming practices in tribal belt and some diversification from paddy towards new crops like strawberry, tomato, etc.

The role of women in technology absorption and adoption has been critical in transformation of grape region. As grapes is an extremely perishable fruit, the handling of grapes bunches requires skilled labour. To overcome this farmer consciously make choice of employing women due to their inherent superior ability to handle delicate things.

4.4.5 Export Performance

The table grapes are mainly used for fresh consumption in domestic market and very little (about 2%) for export market mainly for Europe, Middle East, Southeast Asia and Bangladesh. A big chunk of table grapes (>30%) are also used for making raisins.¹² As around 90% of the grape production happens in Maharashtra, Karnataka and Andhra Pradesh, the harvesting season peaks in February and March.

Figure 13: Harvesting season of crop across various states in India¹³

| States | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Maharashtra | | | | | | | | | | | | |
| Karnataka | | | | | | | | | | | | |
| Andhra Pradesh | | | | | | | | | | | | |
| Tamil Nadu | | | | | | | | | | | | |
| Punjab | | | | | | | | | | | | |
| Haryana | | | | | | | | | | | | |

Source: NABARD Report on Grape Production in India

EU has a window from January to April when the EU countries are in their lean period. To make grapes available throughout the year to the consumers from EU, the traders fulfil the

¹² <https://nrcgrapes.icar.gov.in/zipfiles/GAPTableGrapes18Feb2013.pdf>

¹³ <http://apeda.in/agriexchange/Market%20Profile/one/GRAPES.aspx>

requirements during this period from far flung production areas. In the early 1990s, established exporters like Chile and South Africa couldn't exports during March and April is what gave the opportunity for the Indian farmers. But now these countries have expanded their harvesting season and new countries like Peru and Egypt have gained significant market share. The comparative advantage of India lies in it being a counter seasonal supplier to Europe. The grape supply situation in 2020 was as below.

Figure 14: Indicative supply calendar of table grapes to Europe

| Countries | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Egypt | | | | | ■ | ■ | ■ | | | | | |
| Spain | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Italy | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| Brazil | | | | | | | | | ■ | ■ | ■ | ■ |
| Peru | ■ | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ |
| South Africa | ■ | ■ | ■ | ■ | | | | | | | ■ | ■ |
| Chile | ■ | ■ | ■ | ■ | ■ | | | | | | | |
| India | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |

Source: <https://www.cbi.eu/market-information/fresh-fruit-vegetables/table-grapes/market-entry>

Indian growers can switch between exporting when it is more opportunistic and falling back on the internal demand due to large domestic demand. This is a huge advantage that South Africa, Chile and Peru do not enjoy, as their production is more than their domestic demand. Moreover, India competes quite well with low per unit prices. European buyers mainly source white seedless grapes from India and often turn to India when Chile and South Africa do not meet the required volumes or price-quality combination.

Figure 15: Change in market share in world exports (in percentage)

| Year | Exporters | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|------|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| 2009 | Chile | 37 | 55 | 59 | 60 | 32 | 5 | 1 | 0 | 0 | 0 | 0 | 15 | 27 |
| | Peru | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 10 | 2 |
| | South Africa | 22 | 17 | 11 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 22 | 8 |
| | India | 4 | 6 | 8 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| | Total share of above 4 countries | 69 | 78 | 78 | 73 | 35 | 8 | 2 | 0 | 0 | 1 | 8 | 48 | 39 |
| | Chile | 12 | 26 | 40 | 53 | 41 | 8 | 1 | 0 | 0 | 0 | 1 | 18 | |

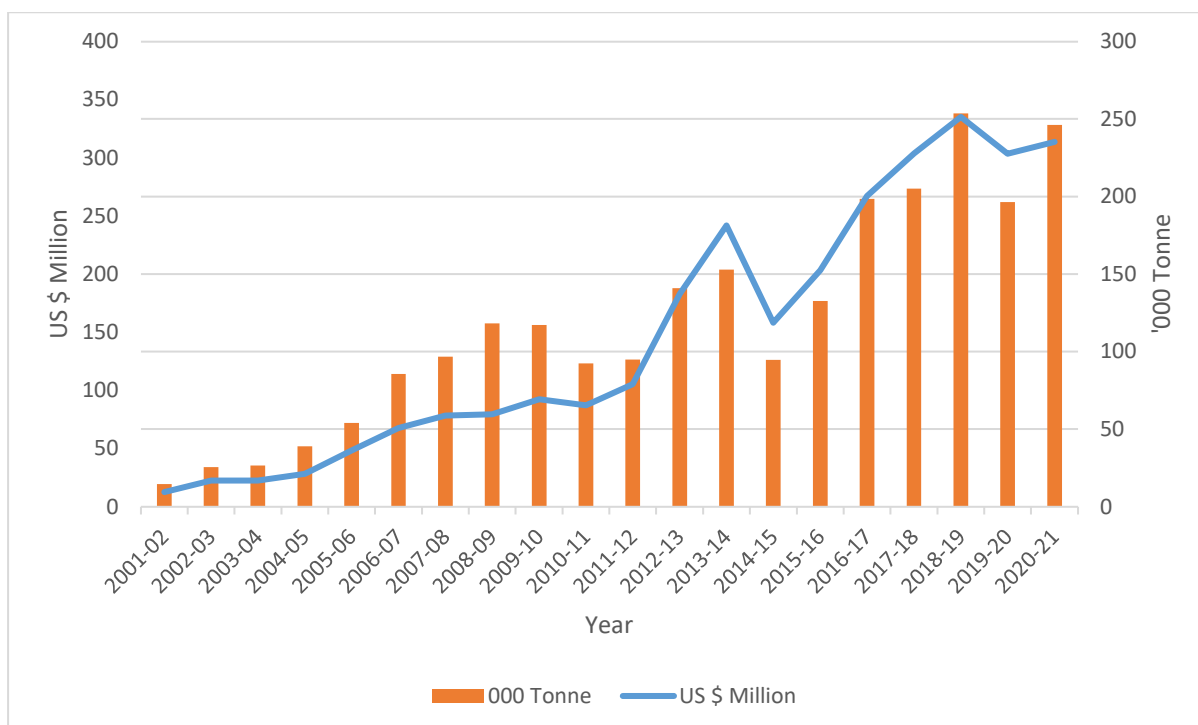
| | | | | | | | | | | | | | | |
|------|----------------------------------|----|----|----|----|----|---|---|---|---|---|----|----|----|
| 2019 | Peru | 24 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 16 | 30 | 8 |
| | South Africa | 25 | 20 | 11 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 18 | 8 |
| | India | 7 | 15 | 15 | 7 | 2 | 1 | 0 | 8 | 0 | 0 | 0 | 1 | 6 |
| | Total share of above 4 countries | 68 | 71 | 67 | 63 | 44 | 9 | 2 | 9 | 1 | 7 | 19 | 50 | 39 |

Source: Trademap

The total market share between these countries remains the same at 39 per cent in 2009 as well as 2019. There is perfect substitution among these countries as there is no other major supplier country during these months. India has gained by doubling its market share during the last decade. The 88 thousand tonnes of grapes from India imported into Europe in 2018 can easily increase if Indian growers can maintain the quality of their seedless grapes and diversify into high value varieties in demand.¹⁴

In 2001-02, India exported 14,571MT of grapes, whereas in 2020-21, Indian exports of grapes had risen nearly 17 times and stood at 2,46,107 MT. In the same time frame, the value of exports of table grapes from India has risen 4 times from 73 million USD to 302 million USD.

Figure 16: Exports of Grapes ('000 MT) from India from 2001-02 to 2020-21



¹⁴ <https://www.cbi.eu/market-information/fresh-fruit-vegetables/table-grapes/market-entry>

Source: Ministry of Commerce - <https://tradestat.commerce.gov.in/eidb/ecomq.asp>

In 2010-11, the supermarket chains in EU found residue of chlormequat chloride (brand name - Lihocin) in some consignments and therefore refused to take the delivery of the produce. The farmers had to sell this in the local markets at 1/3rd price incurring huge losses. These losses were primarily incurred by the grape growers who were first generation exporter families. Since the export activity happens with borrowed money and at leveraged costs this revenue shocks permanently affected financial health of farmer exporters. Thereby, turning them risk averse to exports in subsequent years. Also, loss of trust ensued as small farmers from who they had bought quality grapes for further exports had to bear significant shock from this event. In the subsequent year 2011-12, the exports were subdued before rising in 2012-13 when corporate investments happened and significantly increased market share of grape exports. This event was largely perceived to be a failure of Government information machinery and in fact served as a trigger for aggressive usage of “Grapenet” by APEDA.

Value of Indian exports has increased more than 44 times since 1996-97. The value of Indian grape export was at Rs.52 crores in 1996-97, and in 2020-21 had grown to Rs.2298 crores.

Table 32: Per unit value realisation in the exports markets

| Year | Rs. Crore | Tonne | Rs./Kg | USD/Kg | Average dollar rupee exchange rate across the calendar year |
|---------|-----------|----------|--------|--------|---|
| 1996-97 | 52 | 20,958 | 25 | 0.71 | 36.36 |
| 1997-98 | 65 | 23,680 | 27 | 0.73 | 41.36 |
| 1998-99 | 37 | 11,382 | 33 | 0.77 | 43.05 |
| 1999-00 | 55 | 14,006 | 39 | 0.91 | 44.94 |
| 2000-01 | 83 | 20,646 | 40 | 0.88 | 47.16 |
| 2001-02 | 60 | 14,571 | 41 | 0.86 | 48.61 |
| 2002-03 | 109 | 25,568 | 43 | 0.88 | 46.57 |
| 2003-04 | 104 | 26,470 | 39 | 0.85 | 45.13 |
| 2004-05 | 126 | 38,898 | 33 | 0.72 | 43.93 |
| 2005-06 | 214 | 53,908 | 40 | 0.90 | 45.24 |
| 2006-07 | 301 | 85,563 | 35 | 0.79 | 41.49 |
| 2007-08 | 317 | 96,723 | 33 | 0.81 | 43.78 |
| 2008-09 | 367 | 1,18,133 | 31 | 0.67 | 48.37 |
| 2009-10 | 431 | 1,17,247 | 37 | 0.79 | 45.66 |
| 2010-11 | 391 | 92,437 | 42 | 0.94 | 46.46 |
| 2011-12 | 517 | 94,860 | 54 | 1.11 | 53.42 |
| 2012-13 | 982 | 1,40,967 | 70 | 1.30 | 58.51 |
| 2013-14 | 1439 | 1,52,897 | 94 | 1.58 | 61.01 |

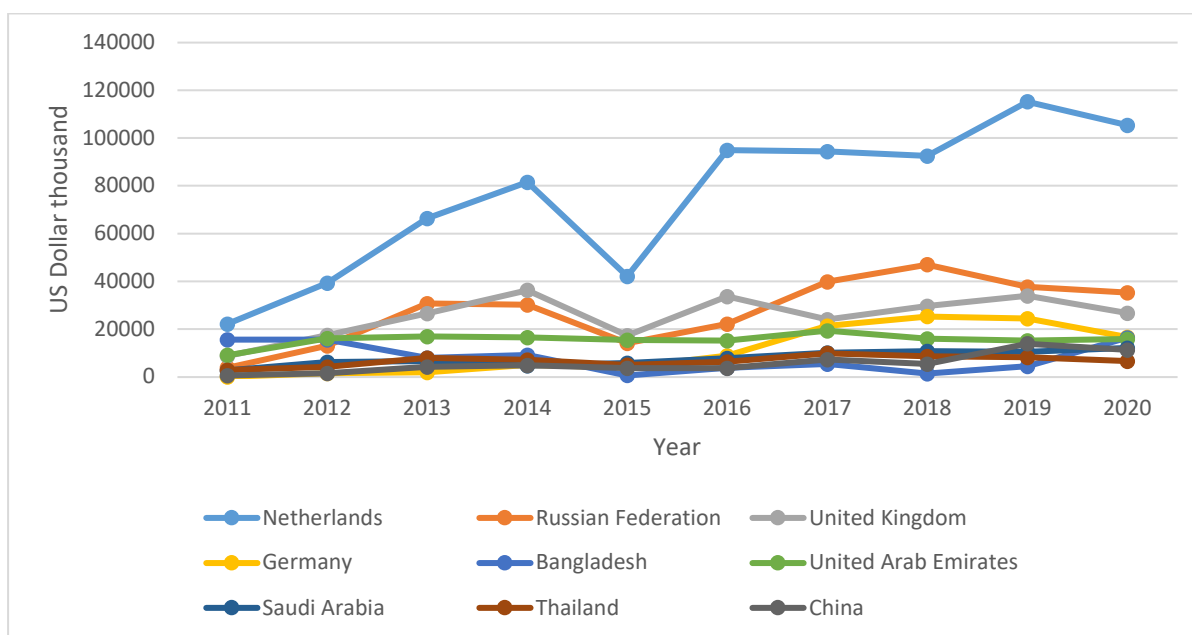
| | | | | | |
|---------|------|----------|-----|------|-------|
| 2014-15 | 974 | 94,570 | 103 | 1.67 | 64.12 |
| 2015-16 | 1362 | 1,32,648 | 103 | 1.53 | 67.18 |
| 2016-17 | 1782 | 1,98,471 | 90 | 1.35 | 65.11 |
| 2017-18 | 1959 | 2,05,039 | 96 | 1.48 | 67.84 |
| 2018-19 | 2338 | 253619 | 92 | 1.32 | 70.41 |
| 2019-20 | 2186 | 196377 | 111 | 1.55 | 74.13 |
| 2020-21 | 2298 | 246107 | 93 | 1.27 | 73.55 |

Source: Ministry of Commerce - <https://tradestat.commerce.gov.in/eidb/ecomq.asp>

Though the USD/Kg price realisation has doubled in the last two decades, the cost of production has increases at a much higher rate. Since, the post-harvest losses have reduced, and the homogeneity in the quality parameters achieved due to strictly adhered production protocols, the per acre MT of grapes accepted for exports has also gone up. This has compensated the increase in cost of compliance to some extent. But since the MRL list has expanded exponentially, the farmer’s capacity to fully comply with the list has reduced significantly. As there is trade-off between the crop for domestic markets at lower cost of production, some farmers opt out of the export production practices midway, if they realise that export risks outweigh the overall production feasibility.

As shown below the major importers of grapes from India in 2020 were Netherlands, Russian Federation, UK, Germany, Bangladesh, UAE, Saudi Arabia, Thailand, and China, necessarily in that order. In 2020, 52 per cent of the export value came from EU countries.

Figure 17: Value of grape exports (‘000 USD) to major destinations

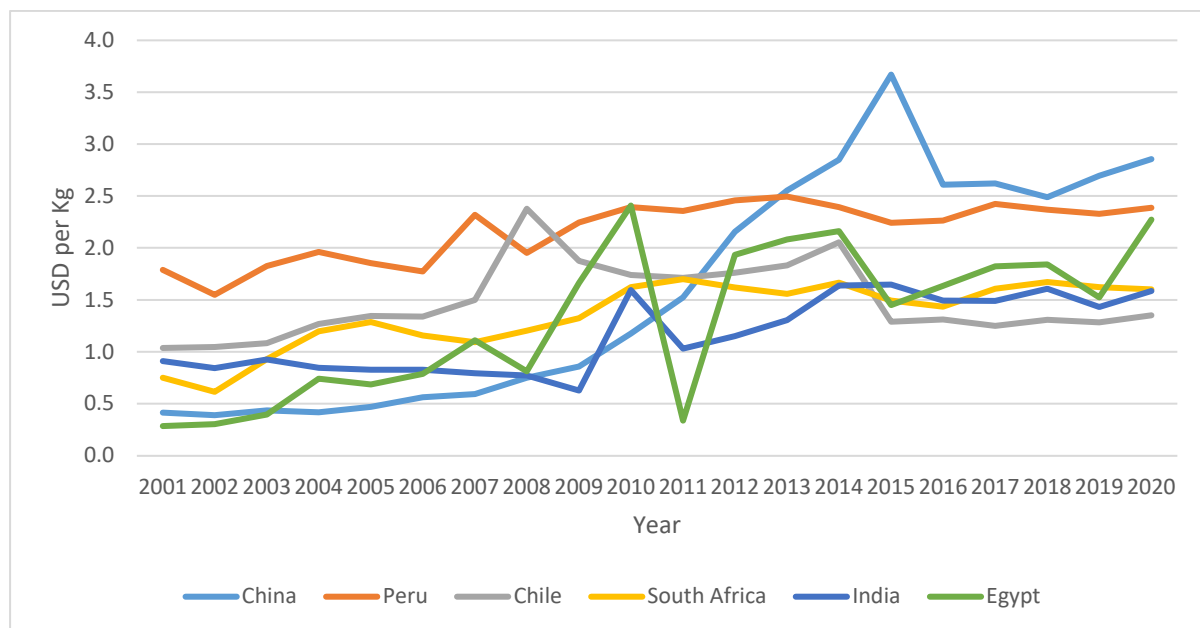


Source: <https://www.trademap.org/>

37 per cent of the Indian grapes' exports are to Netherlands, from where those are re-exported into Europe. UK is a distant second, with 9 per cent of grape value being exported to UK. Grape exports to Russia, UAE and Germany stand at 12 per cent, 6 per cent and 6 per cent respectively. Thus, Indian grape exports primarily move towards three main regions, namely, Europe, Middle East and Russia.

A major observation is that crop management by a farmer with up to 4 acres under grape production is operationally efficient and can achieve almost 90-95 percent of export produce. However, if the acreage under grapes goes on increasing, the farmer's ability to conform to quality and SPS compliance decreases. It is generally observed that a farmer holding 40 acres, usually exports only 50% of his produce. While a farmer with 10 acres under grapes is more efficient than a farmer holding 40 acres and can achieve almost 80 percent export of his produce. The 10-acre farmer has higher operational efficiencies than the 2-acre farmer as cost efficiency kicks in due to scale effects. And the problem of labour shortage is solved by him, with increasingly substituting labour with machinery (More, 2014).

Figure 18: Per unit price realisation in export markets for selected countries (USD per Kg)



Source: Trademap

4.4.6 Market Access and SPS Compliance

As the grape export from India increased, so did the Non-Tariff Barrier (NTB) imposed by the EU buyers. The traceability and hygiene requirement were prominent since the early export

years. For exports to EU markets, three documents related to quality of goods are required - GLOBALGAP Certification, Phytosanitary Certificate, and Health Certificate.

In grape export the most prevalent standard is GlobalGAP certification. Almost all the markets in EU ask for GlobalGAP certification as a precondition for exports. The certification consists of various types of compliance criteria which increase the cost for the farmer. The GlobalGAP Fruit & Vegetables Standard covers all stages of production, from pre-harvest activities such as soil management and plant protection, product application to post-harvest produce handling, packing and storing.

The GlobalGAP Fruit & Vegetables Standard covers:¹⁵

- Soil Management
- Substrates
- Pre-Harvest Controls for Plant Protection Product Application
- Organic Fertilizer Application
- Pre-Harvest Check
- Harvesting
- Final Produce Packing at Point of Harvest
- Produce Handling Covering Hygiene
- Sanitary Facilities
- Packing and Storage Areas
- Quality Control
- Pest Control
- Post-Harvest Washing
- Post-Harvest Treatment

The standard requires that producers establish a complete control and monitoring system. Products are registered and can be traced back to the specific farm unit where they were grown. There are strict regulations about pesticide storage and pesticide residue limits. In addition, it is important to record and justify how the product was produced, so detailed records must be kept about farm practices. Cost of Compliance in the GlobalGAP standard includes cost towards traceability, record keeping and self-inspection, site management, risk assessment, technical services, laboratory analysis, social and substrate management, fertilizer use, crop

¹⁵ https://www.globalgap.org/uk_en/for-producers/globalg.a.p./integrated-farm-assurance-ifa/crops/FV/

protection, irrigation/fertilization, harvesting, produce handling, waste and pollution management, worker health safety and welfare, environmental issues, certification costs, etc.

To fulfil the Sanitary and Phytosanitary Measures (SPS) requirement of EU pertaining to pesticide residues in exportable grape, the state has taken a lead in formulation of pesticide residue monitoring system in consultation with APEDA, National Research Centre for Grapes and Maharashtra Rajya Draksh Bagayatdar Sangh (MRDBS). To smoothen the process, and make it single window system, the state horticulture department in 2004 launched the 'grapenet' system for the traceability of grapes across the export value chain. This compliance with certificate requirement ensures that only recommended fertilisers, pesticides and growth hormones are used by farmers and that too within the bounds of maximum residue level (MRL) specified by the importing countries.

The traceability system carries out the following tasks.

- Registration of grape farms by state horticulture department
- Residue analysis and Agmark inspection by laboratories
- Consignment creation, online application for issue of CAG & PSC
- Certificate of Agmark Grading (CAG) by regional Agmark office(s)
- Issue of Phytosanitary Certificate by PSC authorities
- Monitoring of residue analysis by National Referral Laboratory (NRL)
- Directory
- Daily MIS report
- Service for subscribing detailed reports on grape shipments

Each Inspection Authority (Agriculture/Horticulture Officer) shall visit the farm/plot(s) at least twice to inspect the farm/plot prior to harvesting of the grapes. The first inspection is carried out at the time of farm/plot new registration and the second inspection should be 20 days prior to sampling. Each Inspection Authority (Agriculture/Horticulture Officer) shall prepare the report as per format of inspection report of grape production farm/plot given in Annexure-4 (A) and Annexure-4 (B) and give a copy to farmer after obtaining his signature on it. A copy of Annexure-4 (B) duly completed and signed by all concerned is given to representative of

the laboratory at the time of sampling. And Export Code No. is allocated by DGFT to the registered exporters.

While traceability refers to the ability of the system to trace back the reason of harmful level of residue in food content to its root cause. Residue is the amount of pesticide detected in grapes through laboratory testing. The lab testing is done before the harvesting of the grapes to know whether the pesticide content in the grapes exceeds the limit above which it is harmful for humans. If it is higher, the grapes are rejected at that stage itself. The pesticides sprayed on the grapes lose its presence due to many biological factors over a period. If the pesticide content is detected in lab testing at the destination market country, then it should be traced back to the spray or activity undertaken by the farmer. For this the farmer must maintain a record of every spray undertaken by him. This record is to be submitted to the phytosanitary issuing authority of the state. It is also audited by the GlobalGAP issuing third party certification agency. This process establishes the system for the authorities to know when, how and why the particular pesticide entered the food chain. That is to trace it back to its source hence the word traceability.

The procedure of MRL communication to the Indian farmers takes place through various channels. There are statutory signals given by the EU countries regarding the MRL levels. According to the WTO norm once the directive is given to the countries exporting to the EU, it is to be followed by a period of 6 months to adjust to the compliance requirements. The compliance changes are enforced thereafter. The government agency APEDA and the state agricultural department play an important role in communicating these changes with the farmers.

If any complaints regarding residue levels are generated at the destination market, the software generates exact reports about the plots from which the consignment was sourced and also the details regarding the inspection, lab reports, packing house and certification backing the consignment. All of this has helped in creating traceability and has helped in product standardization. Since, there is higher traceability, there is higher trust quotient in the consignments from India and that has created higher returns for the small farmers. KIIs with Grapenet authorities and MRDBS reveal that 60% of registered farms on Grapenet are small farms.¹⁶

¹⁶ Grape and Pomegranate Value Chain in Maharashtra, Chapter 5, ICRIER Report, 2021 by Manasi Phadke, Bhushana Karandikar and Ashok Gulati.

The exacting adherence to MRL as required by the buyer's became a major challenge for the grape exporting farmers. Meanwhile, further addition of new chemicals to the MRL list for testing every year became a norm for the EU buyers. Complying with these stringent nontariff barriers is an increasingly critical factor. It raises the production cost along with increase in overall economic risk (Chaturvedi and Nagpal 2003). Earlier, the compliance differed over the EU countries and was harmonised only in the year 2008.

Table 33: No. of Maximum Residue Limit (RML) chemicals monitored for export compliance

| Year | No. of residues monitored | Description |
|---------|---------------------------|--|
| 1998-99 | 16 | Self-monitoring by exporters |
| 1999-00 | 33 | Self-monitoring by exporters |
| 2000-01 | 33 | Self-monitoring through laboratories recognized by 'APEDA' |
| 2001-02 | 52 | Monitoring introduced by 'APEDA' through recognized laboratories; basic document prepared by 'APEDA' |
| 2002-03 | 64 | Monitoring as above. |
| 2003-04 | 80 | New document announced for regulating grape exports |
| 2004-05 | 32 | Modified document for regulating grape exports |
| 2005-06 | 81 | MRL list – Annexure 5 |
| 2006-07 | 90 | Annexure – 11 |
| 2007-08 | 92 | Pesticides Recommended - Annexure 7 |
| 2008-09 | 95 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2009-10 | 98 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2010-11 | 171 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2011-12 | 174 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2012-13 | 177 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2013-14 | 181 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2014-15 | 182 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2015-16 | 186 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2016-17 | 187 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2017-18 | 203 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2018-19 | 208 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2019-20 | 267 | ICAR / NRC grapes MRL list – Annexure 9 |
| 2020-21 | 269 | ICAR / NRC grapes MRL list – Annexure 9 |

Note: Residue Monitoring System for Export of Grapes to EU (Grapenet) was formulated and implemented from 2006-07 onwards.

Source: National Research Centre for Grapes. Website - <https://nrcgrapes.icar.gov.in/>

In 2009-10, major losses were incurred by grape growers of Maharashtra, when their produce was rejected by the EU traders, due to chemical residue of plant growth regulating hormone (Chlormequat Chloride, trade name Lihocin) crossing the required MRL limits. In wake of this the list of recommended chemical was revised from 99 to 171. The expectation was that due to

the losses in 2009-10, there would be drop in number of grape farmers registered for exports. But the opposite happened, the registration of grape farms plots for exports went up from 14704 in 2009-10 to 19245 within a span of three years (see Table 34). Subsequently, it jumped to 17081 farm plots in 2011-12. It has grown to 45583 in 2020-21 season. The reason for this rise in registration is the widespread dissemination of the export oriented production protocols among the young smallholder farmers. The incentive to earn higher prices is evident from the higher number of registrations. The share of Maharashtra in total Grapenet registration in the country is nearly 99%.

Table 34: Total number of registered farms and area for grape exports in Maharashtra

| Year | Total no. of registered grape plots | Registered area (Ha) |
|---------|-------------------------------------|----------------------|
| 2003-04 | 3528 | 2456 |
| 2004-05 | 6589 | 5879 |
| 2005-06 | 19429 | 15796 |
| 2006-07 | 16927 | 11323 |
| 2007-08 | 19357 | 13565 |
| 2008-09 | 19597 | 14587 |
| 2009-10 | 14704 | 10482 |
| 2010-11 | 15757 | 10957 |
| 2011-12 | 19245 | 15346 |
| 2012-13 | 27765 | 22765 |
| 2013-14 | 23000 | NA |
| 2014-15 | 28000 | NA |
| 2015-16 | 29000 | NA |
| 2016-17 | 38044 | NA |
| 2017-18 | 38000 | NA |
| 2018-19 | 43172 | NA |
| 2019-20 | 32592 | NA |
| 2020-21 | 45583 | NA |

Source: APEDA

Table 35 shows distribution of grape registrations across various districts in Maharashtra reveals a significant concentration in specific regions. Nashik overwhelmingly dominates the grape exports, accounting for 88.04% of the registered grape area. This is in stark contrast to the other districts, highlighting Nashik's prominence in grape exports. Sangli contributes 5.66% followed by Pune at 3.15%, indicating moderate involvement in grape exports. These figures demonstrate the highly concentrated nature of grape export registrations in Maharashtra.

Table 35: District wise area under Grapenet registration

| S.N. | District wise area under Grape registration | 2018-19 | 2019-20 | % Share |
|------|---|---------|---------|---------|
| 1 | Nashik | 38459 | 33223 | 88.04 |

| | | | | |
|----|-------------|-------|-------|------|
| 2 | Dhule | 0 | 2 | 0.01 |
| 3 | Ahmednagar | 504 | 297 | 0.79 |
| 4 | Pune | 1508 | 1189 | 3.15 |
| 5 | Satara | 474 | 432 | 1.14 |
| 6 | Sangli | 2215 | 2135 | 5.66 |
| 7 | Solapur | 158 | 86 | 0.23 |
| 8 | Beed | 1 | 1 | 0.00 |
| 9 | Osmanabad | 237 | 250 | 0.66 |
| 10 | Latur | 130 | 120 | 0.32 |
| | Maharashtra | 43686 | 37735 | 100 |

Source: Grapenet

Table 36 shows the area expansion under grape cultivation in various districts of Maharashtra over selected years, highlighting significant growth and regional contributions to the state's grape industry. Nashik stands out as the dominant district, contributing over half of the total grape cultivation area in Maharashtra. This district has consistently led in grape area expansion, reflecting its pivotal role in the state's grape production. Sangli contributes around a fifth of the total grape area. The district has shown substantial growth, particularly in recent years. Solapur also makes a notable contribution, with a significant share of the total grape area. The district's involvement has increased markedly over the years, indicating a growing focus on grape farming. Pune and Osmanabad have smaller but still significant shares in the total grape cultivation area. Pune has experienced moderate growth, while Osmanabad's share has been relatively consistent. Growth in area of other districts has remained limited compared to the leading districts.

Table 36: Area expansion under grapes in Maharashtra for selected years.

| SN | District | 2003-04 | 2005-06 | 2008-09 | 2010-11 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | % Share |
|----|------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1 | Nashik | 24992 | 25743 | 32807 | 38300 | 33839 | 49667 | 52315 | 56230 | 56270 | 54 |
| 2 | Dhule | 52 | 93 | 54 | 4 | 18 | | | | | 0 |
| 3 | Jalgaon | 18 | 18 | 19 | 74 | 14 | | | | | 0 |
| 4 | Ahmednagar | 331 | 442 | 813 | 745 | 1160 | | | | | 0 |
| 5 | Pune | 822 | 906 | 1290 | 6449 | 1033 | | 2480 | 2500 | 2580 | 2 |
| 6 | Solapur | 2508 | 2641 | 1908 | 8082 | 1836 | 5700 | 5626 | 5060 | 18130 | 17 |
| 7 | Satara | 347 | 353 | 400 | 40 | 526 | | | | | 0 |

| | | | | | | | | | | | |
|----|-------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| 8 | Sangli | 5465 | 5875 | 6670 | 19367 | 1024 | 28435 | 23070 | 21450 | 21680 | 21 |
| 9 | Kolhapur | 87 | 102 | 137 | 44 | 211 | | | | | 0 |
| 10 | Jalana | 89 | 118 | 100 | 50 | 304 | | | | | 0 |
| 11 | Beed | 177 | 179 | 39 | 726 | 147 | | | | | 0 |
| 12 | Aurangabad | 37 | 68 | 26 | 16 | 57 | | | | | 0 |
| 13 | Latur | 435 | 310 | 534 | 54 | 704 | | | | | 0 |
| 14 | Osmanabad | 433 | 445 | 1204 | 956 | 2258 | | 2540 | 2400 | 2910 | 3 |
| | Maharashtra | 41400 | 45100 | 55700 | 86000 | 90000 | 90000 | 93300 | 90100 | 104100 | 100 |

4.5 Export Crop Advisory by Fratelli FPO

4.5.1 Introduction

With a view to bring in international best practices in the Indian Agriculture, a group of enterprising farmers visited Israel, Chile and South Africa. Farmers learned that grape farming is specific to context characteristics of the growing region, but the basic physiology of grape plant remains the same across the world. It only requires location specific adjustments in terms of soil types and microclimatic conditions. A visit to Chile by a group of 22 progressive farmers in 2015 was particularly insightful. In one of the farms, a large-scale production of around 5000 acres was undertaken, but with precision farming the homogeneity in the grape plots was visually stunning. The shoot canes on each plant were exactly 20, and any information at even a single plant level was readily available for customised care, due to the digital crop monitoring plans. And Chilean farms achieved all this with serious labour shortage issues in the country, much grave than the Indian situation. The visiting farmers understood the need to follow practices that are proven world over to raise their produce quality vis-a-vis global competitors in major export markets.

The questions like what constrains Indian farmers from achieving technical capability of global standards have always been discussed and debated among the grape growers. The earlier notion that local climate conditions in Maharashtra is unique and therefore, requires only unique local solutions is undergoing change. The production protocols that stabilised over the years are becoming cost prohibitive as the price realization per kilogram in the EU markets has not improved, though the export volume saw significant increase.

In the first abroad visit of 2014, a group of 17 farmers visited South Africa to learn about the grape cultivation methods followed by the export-oriented farmers. There they met Rodrigo Oliva, a grape expert providing technical advisory services to exporting farmers. He was invited to India and shown the cultivation practices followed by the farmers. In a lecture in Nasik, he stated that “Inter-country differences in the climatic conditions need not be reason to keep away from best global good agricultural practices in grape farming. Hence, the guidance from an international expert is relevant and invariant irrespective of the country. The foundational techniques to maintain a healthy plant works anywhere on the planet as the plant physiology remains the same”. Convinced by his inputs, a group of 60 farmers from Nashik district came together in 2015-16 season and hired Rodrigo Oliva, for crop advisory services on soil, water and nutrient management. The farmers paid one lakh rupees each for farm plot of typically 1 to 2 acres for the advisory services. Some farmers, sceptical about certain ideas, left the group in the second season of 2016-17. Constant questioning and healthy scepticism are a rare trait among grape growers of Maharashtra. Despite this, the group expanded rapidly to 120 member farmers in 2016-17, with 30 new additions from Sangli district.

Rodrigo Oliva had few assistants from South Africa stationed in India throughout the year, with planned visits at regular interval to grape plots of the group members. The work usually starts with digging pits for soil structure analysis and customised advisory for each plot. Typically, each plot was to be irrigated at a stretch of 8 to 20 hours and with an interval of 8 to 14 days in between two irrigations. This is to be done based on the outcome of soil analysis, specific schedules were advised to each farmer. Initially, the farmers found the recommendations counter intuitive and aroused much discussion among the farmer community. The common scientific understanding advocated by Indian scientists until the point was of irrigating orchards for 1-2 hours with interval of a day or so. The premise analogy being that plants needs water just like human beings on daily basis to perform their vital biological functions. But these practices did not allow for growing deep roots and constrained them to a shallow root zone markedly around the water zone created by dripper irrigation. This happened due to plant experiencing no need to search for water as it was readily available in immediate vicinity. This inhibited development of healthy and balanced growth as the size of plant reflects the size of root zone under the soil. In some of the investigations, it was found that there existed excessive toxicity due to overuse of fertilisers. This was constraining plant growth, and the farmers were not aware of it. When the recommended procedure for leaching

out the excess toxicity was followed, farmers witnessed stark difference in the plant health in a period of month or two. The plots under these custom advisory services saw improvement in soil aeration and reduction in needs for external plant nutrients.

Fratelli Fruits farmer producer company was formed in 2018 by a progressive grape farmer Ananth More. He assisted Rodrigo Oliva during his interactions with farmers and helped in translation from English to Marathi. In 2-3 years, he became well versed in the teachings and was continuously reached for advice over the phone. So, it was decided to formalise the activity into a producer's organization to manage the operations professionally. The FPO's membership saw rapid growth, increasing from 50 members in 2018-19 to 169 in 2020-21, and then to 550 in 2021-22. By 2022-23, the total membership had reached 800 farmers. Since, the social media outreach is extensive the 'influencer' phenomenon has also played a role in the expansion of Fratelli FPO membership. The FPO charges a fee of Rs.15000 per grape plot per year which is considerably less than other expert advisories and facilitated access to many small and marginal farmers.

During the pandemic Covid, the activities of Rodrigo Oliva as hired consultant visiting farms came to a halt. But he was later involved as Executive Strategic Advisor to the Fratelli FPO and is invited to India regularly for public seminars where around 1-2 thousand farmers are in attendance.

Fratelli provides agronomy services in soil management, water management, nutrient management and crop management. The list of works advised by the Fratelli FPO include -

A) Soil Management -

1. Topographic - Soil profiling, Soil analysis, Ripping, Drainage.
2. Soil amendment - Sulphur, Gypsum, FYM, Acid dosing pump
3. Plot designing - Selection of crop, Spacing, Selection of rootstock, Selection of variety, Structure.
4. Drip design - Selection of laterals, Selection of dripper, Selection of motor pump, Filtration system, Pipeline, Acid dosing, Water analysis.

B) Water Management - Water holding capacity/ Retention, Calculation of water tank, Evapotranspiration, pH, Temperature, Crop growth, Wind speed, Humidity.

C) Nutrient Management - Application of fertilizer to soil through drip irrigation, EC/PH monitoring, Leaf petiole analysis, Study of irrigation intervals, Study of soil analysis, Study of various types of fertilizers, Sequence of applying micro and macro nutrient fertilizers.

D) Crop Management – Weed management, Pest and insect management, Plant disease management, Canopy management, Plant growth regulator, Spraying units.

The FPO has 12 agronomists, who visit every 12th day and recalibrate the advisory to the farmer meanwhile teaching techniques of soil moisture analysis, irrigation management, canopy management, etc. The agronomic advice is customised to specific requirements of grape plots based on scientific probing.

4.5.2 Research design

To understand the activities of the Fratelli FPO, a primary survey of 97 members out of a total of 550 in 2021-22 season was conducted in 25 villages of Nashik and Pune districts. Majority of Fratelli FPO members are concentrated in these two districts. Also, in 2019-20, these two districts covered 91.19% of the export registered plots on Grapenet. The primary survey comprised of a questionnaire instrument for productivity, cost and income data as well as qualitative information about the change in cultivation practices undertaken based on the customised crop advisory services.

4.5.3 Socio-economic profile of FPO members

The study surveyed 97 respondents, with an average age of 35.71 years. Each household had an average size of 7.8 members, with 2.3 members engaged in agricultural activities. The caste composition shows that 68% belong to general category, 4% are OBC, 7% to SC and 1% to ST category. The education levels of the respondents varied with 11% having completed secondary education, 22% had attained higher secondary education, and 34% were graduates. Additionally, 20% of the respondents had professional qualifications, out of which 11% had a degree of B.Sc in Agriculture or Diploma in Agriculture. This shows even farmers with formal education find themselves undertrained and in need of crop advisory services. The respondents had been farming for an average of 13.8 years, managing around 15.8 acres. Of this, 7.2 acres were dedicated to grape cultivation. On average, 1.7 acres were under the advisory services of Fratelli FPO, and they had been receiving this advice for 1.9 years.

Table 37: Socio-economic profile of Fratelli FPO members

| Variables | Mean |
|-----------|------|
|-----------|------|

| | |
|--|-------|
| Sample Size | 97 |
| Age of the respondent | 35.71 |
| HH Size | 7.8 |
| HH members engaged in agriculture activities | 2.3 |
| <i>Percentage of respondent belonging to</i> | |
| General category | 68 |
| Other backward caste | 24 |
| Scheduled caste | 7 |
| Scheduled tribe | 1 |
| <i>Percentage of respondents who</i> | |
| No school | 0 |
| Secondary education | 11 |
| Higher secondary education | 22 |
| Graduation | 34 |
| Professional | 20 |
| B.Sc / Diploma in Agriculture | 11 |
| No. of years in farming | 13.8 |
| Total Area (Acre) | 15.8 |
| Area under grapes (Acre) | 7.2 |
| Area under advice of Fratelli FPO (Acre) | 1.7 |
| No of years advised by Fratelli FPO | 1.9 |

4.5.4 Technologies adopted by FPO farmers

Before joining the FPOs, grape farmers were significantly impacted by consistent productivity and profitability issues. The major issue affecting 46% of farmers was variation in quality of grapes in the form of inconsistencies in the size of grape bunches and berries, as well as color variations, all of which are critical factors in export market acceptance and pricing. Productivity issues, such as reduced fruitfulness, were reported by 28% of farmers.

Table 38: Major issues faced by farmers before joining the FPO (N=97)

| S.N. | Items | Frequency % |
|------|---|-------------|
| 1 | Quality - variation in size of bunches and berries, color, etc. | 46 |
| 2 | Productivity - less fruitfulness, cracking, less yield, etc. | 28 |
| 3 | Water management issues | 27 |
| 4 | Sub-optimal crop health | 26 |
| 5 | Crop failure | 25 |
| 6 | Post-harvest high perishability | 7 |
| 7 | Weather risks | 6 |
| 8 | High costs | 5 |
| 9 | No grape plot before | 5 |

| | | |
|----|---|---|
| 10 | Insufficient sugar level at harvesting time | 4 |
|----|---|---|

This underscores the difficulties in achieving optimal yields, which directly affect the net returns on the capital employed. Water management emerged as a significant concern for 27% of respondents, highlighting the critical need for efficient irrigation practices in grape cultivation. Sub-optimal crop health was another major issue, affecting 26% of the farmers. This encompasses a range of problems including pest infestations, diseases, and nutrient deficiencies that can severely compromise the quality and quantity of the harvest. Crop failure, reported by 25% of farmers, further emphasizes the vulnerability of grape production to various environmental stresses. Post-harvest high perishability was a concern for 7% of the farmers. Weather risks impacted 6% of the respondents in form of unseasonal rains, hailstorms, high humidity, and extreme temperatures. High production costs were reported by 5% of the farmers. This includes the cost of inputs such as fertilizers, pesticides, labor, and technology, which can be prohibitively expensive, especially for small-scale farmers. About 4% of the farmers faced issues with insufficient sugar levels at the time of harvest, this affects the quality, yield and marketability of grapes. Additionally, 5% of the respondents indicated that they had no grape plots before joining the FPO, suggesting a lack of experience grape cultivation. and were therefore willing to follow best practices. Joining FPOs appears to provide farmers with the support and resources needed to address these issues more effectively, potentially leading to improved outcomes in grape cultivation.

Table 39: Major technologies adopted by farmers after joining the FPO (N=97)

| S.N. | Items | Frequency (%) |
|------|--|---------------|
| 1 | Drip design change | 27 |
| 2 | Water management | 19 |
| 3 | Soil health management based on reports | 18 |
| 4 | Crop management | 10 |
| 5 | Less use of plant growth regulators | 9 |
| 6 | Fertigation management | 8 |
| 7 | Improved application of pesticide and insecticide. | 4 |

The adoption of various agricultural technologies by farmers after joining the Fratelli FPO has led to significant improvements in farming practices and overall productivity. The most widely adopted technology is the change in drip design, with 27% of farmers implementing this

practice. The modification in drip design reflects a significant improvement in crop health thereby mitigating major risks in production. Water management techniques have been adopted by 19% of the farmers. Efficient water management reduces water stress on crops, and ensure consistent crop growth, ultimately leading to better yields. Soil health management based on soil health reports has been adopted by 18% of farmers. Regular soil testing and subsequent management based on the reports allowed farmers to maintain optimal soil health conditions, ensuring the availability of necessary nutrients. Crop management practices have been adopted by 10% of farmers. The reduction in the use of plant growth regulators has been observed in 9% of farmers, as advised by the Fratelli agronomists excess usage leads to diminishing benefits with adverse impact on plant health. Fertigation management has been adopted by 8% of farmers. This practice involves the application of fertilizers through drip irrigation for precise nutrient delivery directly to the plant roots. Earlier this application was based on guesswork and soil health analysis was not done regularly. Now, the member farmers conduct soil health analysis 5-6 times per year. The improved application of pesticides and insecticides has been adopted by 4% of farmers. Proper application techniques ensure effective pest control while minimizing the risks of overuse. These improvements lead to better crop management and productivity. The Fratelli FPO's role in providing customised advice and providing necessary demonstrations, training and support has been instrumental in achieving these positive outcomes.

4.5.5 Export Crop Advisory Services

1. Soil Management

Soil analysis determines the water application needs of plants. For soil analysis, the composition of clay, silt and sand is measured to arrive at the water holding capacity of the farm plot. This becomes the guide in irrigation management through the year. Drip design not being accurate leads to deficient or excess irrigation affecting the health of the plant and therefore quality and yield. Whenever the soil moisture reduces below 30-40%, the plot is irrigated to fill the entire water holding capacity of the soil. The next irrigation depends on the reduction of the soil moisture in the soil, whenever it touches 30-40% irrigation is done. So based on the variability of the soil (light, medium, heavy) the irrigation intervals may vary from 4 to 25 days. And the single irrigation application timings may vary from 20 minutes to 22 hours at a stretch depending on water retention capacity of the soil. The drainage of the soil plus the evapotranspiration of the soil are major determinants in this aspect. So primarily,

growth stage (vegetation crop coefficient), water tank (water holding capacity of the plot), and evapotranspiration rate determines the decision-making process of member farmers of Fratelli FPO. In this approach, if water shortage is expected in future, then it needs to be anticipated at least 3-4 irrigations earlier, so that irrigation hours are gradually reduced. A sudden reduction in water application acts like a shock to the roots and the growth of plants is affected. This continuous calibration of plant environment gives higher control over the desired quality and yield.

Soil reaping is deep tilling of the soil to break the soil layers for the root zone. The porousness at depth helps in maximizing root growth area. Most of the grape plots have heavy or calcareous soils increasing the acidity of the soil. Thereby, gypsum, sulphur and acid dosing are advised in the initial days of the membership of the grape farmers. To address ferrichlorosis toxicity problem, acid dosing is done using acidosis pump. Normally, a dose of 1 litre sulphuric acid per acre. This acid dosing decision requires soil and leaf petiole analysis reports and is not based on visual observation alone. Therefore, response to the problems is proportionate to the soil and leaf petiole analysis reports from the testing labs.

For soil testing, random 5-6 digups are done to understand the soil and root structure in the farm plot. About 1-2 kg of soil is collected and mixed to create sample for soil analysis. While for leaf petiole analysis, depending on the growth stage of the plants the petioles amounting to 150 gm in a farm plot of about 1–2-acre size is collected. In each irrigation the water should percolate equally throughout the maximum possible root area. This brings equilibrium in energy exchange. The physiological processes are not at optimum if required water balance is lacking.

Normally, organic soil matter above 0.6-0.7% is considered good. It was observed that excessive use of organic (cow dung) manure every year leads to excess ethylene production in the roots leading to necrosis. This results in berry drop in crucial flowering stage of grape bunch. Excess organic matter leads to higher EC (electric conductivity) of 5-8. The higher EC results in higher deposition of salts and nitrates adversely affecting the plant growth. This evidence led to reduction in application of organic fertilizers thereby reducing cost of fertilisers. Also, the required export quality and yield is being achieved at lower resources use. Hence, nutrient management leading to cost savings for the member farmers. This cost reduction is anywhere between 10% to 30% of overall production costs.

According to the experts at Fratelli FPO, if at 12-13mm size of the grape berries one irrigation is not done properly then it reduces sugar by one brix. And 1 brix less means 1 MT reduction in per acre yield. This inference is based on the acute observation of the Fratelli FPO agronomists.

2. Water Management

Table 40 shows the importance of irrigation and soil management in the successful cultivation of grapes. Proper irrigation ensures that grapevines receive the necessary water to maintain growth, fruit development, and overall plant health. Root and soil management focuses on maintaining healthy root systems and optimizing soil conditions. Earlier the focus was on increasing applications of nutrients and plant growth regulators, therefore Indian grapes were always the lowest value grapes in the EU markets. The average price received in EU markets was always around 4-5 Euro per Kg way below 11-18 received by Chile or South African farmers.

Table 40: The importance of various aspects in cultivation of grapes:

| S.N. | Items | % |
|------|-------------------------------------|----|
| 1 | Irrigation | 40 |
| 2 | Root and Soil Management | 20 |
| 3 | Bunch Thinning | 10 |
| 4 | Weather | 8 |
| 5 | Nutrition | 5 |
| 6 | Crop Load Management | 5 |
| 7 | Canopy Management & Crop Protection | 5 |
| 8 | Plant Growth Regulators | 5 |
| 9 | Pruning | 2 |

Source: D. Lujbetic, 2004

The most important aspect Fratelli FPO had to advice on was design of the drip irrigation system. The grape farmers were the first adopters of drip irrigation in the 1980s in India, without which modern grape production is not possible. The lack of understanding in drip irrigation design was found to be extremely high with 27 percent farmers being advised change in drip design.

The most frequent advice by Fratelli FPO is changing the size of the dripper based on the soil profile and soil analysis report. The dripper sizes vary based on how much litres of water it discharges in an hour. With 4, 8, 12, 16 litres per hour being the normal sizes. If the water holding capacity of soil is high, then lower capacity dripper is preferred as percolation of water

takes time and overflow of pit is avoided. While a highly porous soil structure signifies low water retention, so a dripper of 16 litres is optimum for such soils, as it can absorb higher amounts of water per unit of time. If wrong dripper is used, then however good water management one does, it is unsuitable and leads to excess or deficient irrigation. Also, uniform distribution of water in the grape plot is also important and is the prime cause of quality variation. Correcting these issues led to major improvements in crop health for the Fratelli FPO members. In some cases, complete overhaul is required and hence replacing the whole system was advised. This entails major one-time costs for the farmers, but there is willingness to undertake it based on the experience of other FPO members. It costs around Rs. 1 lakh per acre for drip irrigation system when plantation is done.

3. Nutrient Management

In case of fertiliser application in open fields, the nutrients can evaporate or might not satisfy the needs of roots at the desired location. To overcome this precision fertigation technologies are needed which deliver the required fertiliser in as much amount the plant can absorb in a given period of time. Here, the frequency of application can be calibrated according to the needs of the crops in their various stages of growth. The irrigation intervals can be adjusted to the plant needs. These elements of fertiliser, water, drip irrigation equipment, weather, and time are synchronised using automation software that optimises the response of the farmers.

Fratelli itself tied up with Vanita Agro and provides the soil health, leaf petiole analysis testing services to the member as well as non-members farmers wherever possible across Maharashtra. Vanita Agro has specialised labs providing testing services to the agriculture community. It is also one of the largest manufacturers of chelated micronutrients, water soluble fertilizers, plain micronutrient mixtures, secondary nutrients and plant growth regulators / stimulants.

Table 41 shows the typical record kept by the farmers to monitor the nutrition levels in the plant by conducting leaf petiole analysis. This highlights the need for careful nutrient management, particularly for nitrogen, potassium, sulphur, ferrous, and boron, to ensure optimal crop health during both pruning seasons. Any deviation from the recommended range needs to be brought within the range by various soil amendments or application of water-soluble fertilizers through drip irrigation.

Table 41: Nutrient profile of grape orchard using leaf petiole analysis

| Nutrient | Unit | Normal Range | After April Pruning | After October Pruning |
|----------|------|--------------|---------------------|-----------------------|
|----------|------|--------------|---------------------|-----------------------|

| | | | Petiole Test 1 | Petiole Test 2 | Petiole Test 3 | Petiole Test 4 | Petiole Test 5 | Petiole Test 6 |
|-----------------------|-----|-----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Nitrate Nitrogen | ppm | 700-1200 | 1152 | 1351 | 1050 | 802 | 918 | 829 |
| Ammonical Nitrogen | ppm | 400-700 | 2622 | 1232 | 1690 | 895 | 464 | 184 |
| Nitrogen | % | 0.91-1.60 | 1.73 | 1.74 | 2.35 | 1.04 | 0.93 | 0.77 |
| Phosphorus | % | 0.2-0.5 | 0.39 | 0.48 | 0.62 | 0.53 | 0.49 | 0.24 |
| Potassium | % | 1.2-2.5 | 2.4 | 3.86 | 5.29 | 3.53 | 3.6 | 1.86 |
| Calcium | % | 1.0-2.5 | 1.04 | 1.28 | 0.71 | 1.02 | 1.13 | 2.04 |
| Magnesium | % | 0.3-0.6 | 0.48 | 0.58 | 0.28 | 0.31 | 0.38 | 0.73 |
| Sulphur | % | 0.21-60 | 0.12 | 0.13 | 0.16 | 0.14 | 0.14 | 0.12 |
| Ferrous | ppm | 80-120 | 35 | 34 | 49 | 73 | 104 | 102 |
| Manganese | ppm | 25-100 | 56 | 99 | 24 | 36 | 89 | 191 |
| Zinc | ppm | 20-50 | 33 | 56 | 131 | 87 | 72 | 54 |
| Copper | ppm | 5.0-15.0 | 9 | 10 | 28 | 12 | 9 | 6 |
| Boron | ppm | 15-30 | 44 | 55 | 44 | 33 | 33 | 30 |
| Molybdenum | ppm | 0.5-1.50 | 2.4 | <0.03 | <0.03 | 0.37 | <0.03 | <0.03 |
| Sodium | % | 0.01-0.25 | 0.1 | 0.16 | 0.08 | 0.15 | 0.26 | 0.58 |
| Chloride | % | 0.01-0.25 | 0.13 | 0.14 | 0.08 | 0.32 | 0.41 | 0.53 |

In many grapes plots the soil analysis revealed toxicity of some nutrient due to excessive usage year on year. Table 41 shows high level of ammonical nitrogen, almost 4 times above the maximum required as soil amendments advice is implemented by the FPO members. This type of nitrogen grows the plant vigorously making the leaves thinner and vulnerable to pest and insect attacks. It also affects the crucial stages of sprouting, flowering and fruit setting. The vegetative growth which could have become some fruit is turned into tendrils due to rapid cellular growth stimulated by ammonical nitrogen. Therefore, it is the primary reason when crop failure happens despite crop being healthy visually. The incidence of ammonical nitrogen being high was found in almost 60-70% plots, so soil amendment by gypsum 150 kg + sulphur 150 kg per acre is the most advised task when farmers join the FPO. If toxicity of some nutrient is too high due to use of certain nutrients in basal dose applied each year, then acid dosing using sulphuric acid is advised.

4. Crop Management

The role of disease management is extremely important in grape cultivation. Some of the diseases if not controlled preventively and can lead to complete loss of crop. The farmers faced particularly high losses during the covid period which was further accentuated with the unseasonal rains in crucial months of 2019-20 and 2020-21. Withering of bunches due to excess

rainfall, excessive berry drops in harvesting stages, downy mildew disease proliferation on plants were some of the causes which led to 30-36% loss of crop during the covid years.

The disease management can either be done by planting disease resistant varieties or by preventive crop production practices. The use of chemicals in fruit bearing stages requires consideration of residues at the harvesting stage. Central Insecticidal Board and Registration of Chemical Committee (CIB&RC) provides advice on, regulates and manages the uses of new products and determines whether the new product launched by a company is true reflection of the claims it makes on its label. The list of chemicals having label claims is published by the NRC grapes and updated from time to time. The CIB&RC label claim list includes chemicals recommended for major disease and pest in grapes, companies and trade name under which these chemicals are produced, groups and nature of chemical, effective dose on formulation basis, maximum residual limits, pre-harvest interval in days and mode of action is given in the details. But this list is compiled based in internet databases and may not be completely accurate. Resistance to disease was found in actual usage of the farmers despite the information provided in the CIB&RC list. These realities keep the grape farmers continuously on its toes. So effective and timely crop management becomes survival issue for the farmers. Hence, FPOs providing accurate crop advisory based on experimentation becomes pertinent for grape farmers.

Achieving homogeneity in the quality of grapes is the most important aspect a farmer focuses on in the crop practices he adopts. Less sprouting, fruit dropping in flowering stage, high disease incidence in fruit setting stage makes plants vulnerable to crop failure. These are some signs of sub-optimal plant health and requires remedies by the farmers. Many a times crop health issues are realized close to the harvesting stage like – inadequate fruit sugar, cracking of fruit before harvesting stage. Sometimes, the quality is homogenous one year and the next high variation across the plot is found. This makes it difficult to narrow down the source of problem as the crop practices are the same. So, the usual pattern of response would be applying higher doses of fertilisers or plant growth stimulants. This panic reactions would increase the cost substantially. Over a period, these costs keep adding up with no appreciation export prices, effectively reducing the net returns of grape farmers.

Excess irrigation in some stages can lead to total crop failure. The sprouting canes and leaves look in excellent health, but no fruiting happens. Canopy management is one crucial aspect which not all farmers understood previously. To target higher yield, the number of canes on a plant were kept high at 40-45 per plant. Now, with advice from Fratelli depending on plant

health they are optimised and in one case, farmers were asked to reduce the canes from 35 to 30. Usually, one bunch of grapes per cane is the norm. It is not that farmers were not aware of these aspects but consistently ensuring healthy plants was challenging. These micro adjustments help when the plants are vulnerable to disease attacks. Dense canopies keep the sunlight from reaching the soil surface having adverse effect on plant health. Sunlight bouncing back from soil keeps the temperature high and reduces moisture under the leaf surface. Any fungal disease usually attacks below the leaves as the cell structure there is particularly vulnerable. Cane tying is highly labour intensive and therefore costly activity, therefore there is some reluctance, but members are gradually being convinced of its benefits.

Farmers report overall decline in application of pesticide and insecticide sprays after joining the FPO. This is primarily, due to crop health and preventive application of plant protection sprays. Earlier, 45-50 sprays per grape plot, now it has come down to 30-35.

4.5.6 Economics of Grape Cultivation

The economic life of orchards in Nashik district is around 15-18 years. Based on magnitude of production following four classifications were made for grape plot.

| Age Group | Production Stage |
|-------------|-----------------------------|
| 1-2 years | Non-bearing stage |
| 3-10 years | Increasing production stage |
| 11-14 years | Constant production stage |
| Above 15 | Declining production stage |

The cost and returns vary from plot to plot depending upon the age of plant. The cost and returns were estimated using various cost types to understand the economics of production.

| | |
|---------|---|
| Cost A1 | Cost of inputs such as manure, fertilizers, insecticides and pesticides, plant growth regulators + value of hired labour + hired machinery charges + value of owned machine labour + depreciation on implements and for buildings + irrigation charges + land revenue and other taxes + interest on working capital + miscellaneous expenses. |
| Cost | Cost A1 + rent paid for leased-in land |
| Cost B | Cost A2 + rental value of owned land and interest on owned fixed capital excluding land. |
| Cost C | Cost B + imputed value of family labour |

The analysis of the cost of cultivation for Fratelli FPO members reveals significant changes in various expenditures after the adoption of improved farming practices. The cost of hired human labour saw a notable reduction of 15%, indicating increased efficiency or reduced reliance on manual labour. Conversely, the expenditure on mechanical power slightly increased by 4%, reflecting a shift towards mechanization which could lead to long-term efficiency gains despite higher initial costs. The most important change is 92% reduction in the cost of manure, as soil carbon already being within optimal range there was no need for the soil amendment. Similarly, the expenditure on fertilizers decreased substantially by 21%, highlighting improved nutrient management practices. The costs associated with insecticides and pesticides significantly decreased by 25%, implying better pest management practices techniques. Also, expenditure on plant growth regulators saw a significant reduction of 32%, indicating more judicious use of these substances. Overall, the total working capital required saw a substantial reduction of 28%. This significant decrease reflects the cumulative effect of reduced costs in several components. This overall reduction in cultivation cost types underscores the effectiveness of the improved farming practices adopted by Fratelli FPO members, leading to more efficient resource use and significant cost savings. These findings highlight the potential for such practices to enhance the economic sustainability of grape cultivation among the FPO members.

Table 42: Cost of Cultivation of Fratelli FPO members

| S.N. | Cost of Cultivation | Value (Rs./Acre) | | % Change |
|------|---|------------------|---------|----------|
| | | Before | After | |
| 1 | Hired Human Labour | 52875 | 44841 | -15 |
| 2 | Mechanical Power | 15837 | 16412 | 4 |
| 3 | Manure | 31050 | 2500 | -92 |
| 4 | Fertilizer | 48125 | 38250 | -21 |
| 5 | Irrigation Charges | 3374 | 3668 | 9 |
| 6 | Insecticides & Pesticides | 53433 | 40218 | -25 |
| 7 | Plant Growth Regulators | 26875 | 18375 | -32 |
| 8 | Incidental Charges | 7360 | 7851 | 7 |
| 9 | Repairs on Farm Implements | 1194 | 1235 | 3 |
| 10 | Working Capital (1 to 9) | 240123 | 173350 | -28 |
| 11 | Interest on Working Capital* | 14407 | 10401 | -28 |
| 12 | Depreciation on Farm Implements & Machinery | 7641 | 8411.01 | 10 |
| 13 | Land Revenue and Other Taxes | 128 | 128 | 0 |
| 14 | Cost A (10 to 13) | 262300 | 192290 | -27 |
| 15 | Rental Value of Land | 66014 | 68196 | 3 |
| 16 | Interest on Fixed Capital | 4278 | 4159 | -3 |

| | | | | |
|----|---------------------|--------|--------|-----|
| 17 | Amortization Cost | 27579 | 24522 | -11 |
| 18 | Cost B (14 to 17) | 360171 | 289167 | -20 |
| 19 | Family Human Labour | 7872 | 7741 | -2 |
| 20 | Cost C (18 to 19) | 368043 | 296908 | -19 |

The cost of cultivation has seen considerable reductions after the interventions. Cost A decreased by 27%, from Rs. 262,300 to Rs. 192,290. Cost B fell by 20%, from Rs. 360,171 to Rs. 289,167, while Cost C dropped by 19%, from Rs. 368,043 to Rs. 296,908. These reductions indicate more efficient resource management and improved agronomic practices post-intervention. Despite the decline in yield, the price per kg of grapes has increased, particularly in the export market. The export price rose by 22%, from Rs. 64.14 to Rs. 77.95, while the local price increased by 6%, from Rs. 29.25 to Rs. 30.94. The price increase, especially in exports happened due to the improvement in cultivation practices. The gross return from grape orchards has seen a slight overall decline. The export gross return decreased marginally by 1%, from Rs. 297,167 to Rs. 295,240. The local gross return fell by 9%, from Rs. 147,564 to Rs. 133,598. Consequently, the total gross return declined by 4%, from Rs. 444,731 to Rs. 428,837. This slight reduction in gross return despite increased prices suggests that reduced yields significantly impacted overall income, but the overall risk reduced substantially, thereby improving the production economics. The net return over Costs A, B, and C has improved considerably, indicating better profitability after the intervention. Net return over Cost A increased by 30%, from Rs. 182,432 to Rs. 236,547. Net return over Cost B rose by 65%, from Rs. 84,561 to Rs. 139,670. Net return over Cost C grew by 72%, from Rs. 76,689 to Rs. 131,929. These increases in net returns highlight the financial benefits of improved cost management and higher prices, outweighing the impact of reduced yields.

Table 43: Cost of Production and Returns of Grape Orchards (Rs./Acre):

| S.N. | Items | Before (2020-21) | After (2021-22) | % Change |
|------|---------------------|---------------------|--------------------|----------|
| 1 | Cost of Cultivation | | | |
| | Cost A | 262300 | 192290 | -27 |
| | B | 360171 | 289167 | -20 |
| | C | 368043 | 296908 | -19 |
| 2 | Yield (MT/Acre) | | | |
| | Export | 11.83 | 9.40 | -21 |
| | Local | 10.86 | 6.29 | -42 |
| | Total | 10.35 | 7.87 | -24 |
| 3 | Price (Rs./Kg) | | | |

| | | | | |
|---|--------------|--------|--------|----|
| | Export | 64.14 | 77.95 | 22 |
| | Local | 29.25 | 30.94 | 6 |
| 4 | Gross Return | | | |
| | Export | 297167 | 295240 | -1 |
| | Local | 147564 | 133598 | -9 |
| | Total | 444731 | 428837 | -4 |
| 5 | Net Return | | | |
| | Over Cost A | 182432 | 236547 | 30 |
| | B | 84561 | 139670 | 65 |
| | C | 76689 | 131929 | 72 |

* The cost for drip design change is fixed cost and not considered here.

4.6 Summary

The propensity of grape farmers to adopt new technology is relatively high. The continuous adherence to export quality requirement and compliance criteria resulted in upskilling and upgrading of grape sector. And the diffusion of new technology instilled a pursuit of scientific knowledge and experimentation among the grape farmers.

The new entrants to grape farming could follow the production protocols with minimal prior understanding of the science behind it. Gradually, with learning by doing and learning from others, the farmer gained experience in handling the requirements of various stages of plant growth. These production protocols have undergone change from time to time with further insights through experimentation and experience. The adoption of production protocols has systemised the crop management in the grape growing areas.

The grape growing areas have gone through a major change in nature and composition of employment. With the use of advanced machinery there has been a strong substitution effect with labour employed. But this displacement made labour available for further specialised activities which were cost prohibitive earlier. This transition has stabilised the export quality deviations to a narrow band. Also, the scale of employment generated per acre by grape crop is almost 10 times the traditional food grain crops. This has made the grape crop mass employer with relatively higher wages in the rural countryside.

The role played by market access to the EU was pivotal in the transformation of the grape farming. The commercialisation induced by the quality requirements spurred ‘specialization’ in the farming practices. The early adopters of technology played a pivotal role in defining the contours for application of new technology with spillovers in the grape growing areas of

Maharashtra. Though, increasingly difficult but the export quality standards and MRL requirements are the prime drivers of technology adoption in grape farmers.

Many a times deficiencies in nutrients are not visible to the naked eye. So regular soil analysis and plant leaf petiole analysis played an important role in export compliant grape produce. The crop advisory by Fratelli FPO agronomists ensured decision making based on scientific reports thereby reducing costs and mitigating risks. Plant health improvement along with homogenous grape quality on the bunch, plant and across the farm plot was achieved by FPO members.

5. Conclusion

FPOs create a level playing field for smallholder farmers to deal with new corporate buyers who cater to growing urban demand. If the producer organisations can undertake and modernize production technology according to the needs of the markets and get in contractual agreements with corporates, it builds symbiotic relationship between them. The inherent risk in production is hedged and the gains can be distributed to the individual farmers. The access to high value markets also enables the transmission of clues for adjusting the production schedule according to the changing patterns of consumer demand.

We find higher costs and lack of credit constrains adoption of new technology for members as well as non-member farmers. This underscores the need for increasing the net income of farmers by market reforms and building value chains where the farmer share in consumer pie is higher. The domestic markets are not very efficient, displaying a substantial price differential between wholesale and retail markets, primarily because of the high margins retained by intermediate buyers and sellers, product perishability, and the distances between wholesale and retail markets. If the FPO can overcome these by challenges it can transform the agriculture.

Friends as a source of information for new technologies reduces overall costs for FPO members. While the exposure visits arranged by FPO are more likely to have a positive impact on the income. The government as a source of information for technologies has no effect on either income, productivity or cost for FPO members. While the non-members find the information from government sources useful with improvement in productivity and income but at higher costs. Access to social networks for information about technology improves income for members but at higher costs. These implies the need of FPO as disseminator of proven technology.

The use of warehousing receipt finance to hedge the market risks needs to be promoted among the FPOs. And to stabilise the variability in income the FPOs need to connect with the futures markets. The use of instruments like options can mitigate the price risk when there is sudden fall below the expected prices. A forward platform, if encouraged can establish a bilateral channel for farmers, FPOs and other market players to directly enter buy-sell contracts at fixed prices at any time, since forwards can be entered under reasonable and bi-laterally agreeable terms. The government needs to address the lack of awareness and train farmers to use futures markets through workshops and training initiatives.

In case of grapes, active farmer networks and supporting institutions like MRDBS, NRC for Grapes have played important role in dissemination of scientific understanding about the cultivation methods. The diffusion of production protocols among the grape farmers has increased the area in Maharashtra. The stabilisation of these protocols is having spill over in other crops as well. Similar, strategies are being undertaken in other horticulture crops like pomegranate, guava, and custard apple for plant health and disease management.

In the exports markets, the EU buyers are increasing the non-tariff barriers in the form of chemicals to be tested for SPS compliance annually. It has now reached almost 269 chemicals, raising the cost of compliance by increasing the risks and crop management requirements. This is unsustainable in the long run and farmers need to diversify to other export markets like China, Australia, Russia and ASEAN countries. In 2021, the Grapenet shifted to a blockchain based system thereby further increasing the trust value in the practices of grape growers. Varietal change suitable for the export market consumer preferences needs to be adopted by the farmer. The expansion of area in Maharashtra needs to be justified by expansion of the demand in destination markets. Otherwise, it is a recipe for glut in the market and fall of prices. Already, the indebtedness is on the rise due to rise in production costs and stagnant prices in domestic markets. Dedicated export crop advisory by Fratelli FPO is unique initiative to address the challenges in technology domain. This approach can work in other crops as the first principles remain the same.

The evidence from Maharashtra shows that forming FPOs can be beneficial to small and marginal farmers in various ways, mainly in adopting market-oriented production technologies and accessing lucrative market opportunities. However, creating ecosystem that facilitates organically evolved farmer organization is called for. The government interventions to promote FPOs have achieved success in small measures. FPOs with evolving nature and continuous adaptation capability show promise for the future.

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Appendix

Annexure 1: Year-wise FPO formation across districts in Maharashtra

| Year | Upto-2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Grand Total |
|------------|-----------|------|------|------|------|------|------|------|-------------|
| Ahmednagar | 2 | | 1 | 4 | 13 | 19 | 17 | 20 | 76 |
| Akola | | 2 | | 1 | 2 | 15 | 1 | 4 | 25 |
| Amravati | 2 | 3 | | | 13 | 19 | 4 | 13 | 54 |
| Aurangabad | 1 | 1 | 5 | 1 | 5 | 20 | 24 | 4 | 61 |
| Beed | | 1 | 1 | 1 | 2 | 25 | 9 | 7 | 46 |
| Bhandara | | | | 1 | 2 | 2 | 12 | 3 | 20 |
| Buldhana | | | | 3 | 3 | 22 | 10 | 4 | 42 |
| Chandrapur | | | | | 2 | | 8 | 5 | 15 |
| Dhule | 1 | 1 | | | 1 | 9 | 11 | 2 | 26 |
| Gadchiroli | | | | | | | 2 | 3 | 5 |
| Gondia | | | | | 1 | 3 | 11 | 4 | 19 |
| Hingoli | | | | | 2 | 14 | 2 | 1 | 19 |
| Jalgaon | 1 | | | 1 | 7 | 12 | 7 | 5 | 33 |
| Jalna | | | | | 8 | 16 | 4 | 6 | 34 |
| Kolhapur | 2 | 1 | 4 | | 3 | 20 | 3 | 7 | 40 |
| Latur | | | 1 | 6 | 7 | 24 | 11 | 8 | 57 |
| Mumbai | 4 | | | 1 | 2 | 3 | 2 | 4 | 16 |
| Nagpur | 1 | | 1 | | 3 | 5 | 18 | 4 | 32 |
| Nanded | | | | 3 | 1 | 12 | 9 | 2 | 27 |
| Nandurbar | | | | | | 5 | 4 | 5 | 14 |
| Nashik | 5 | 2 | | 5 | 11 | 16 | 37 | 13 | 89 |
| Osmanabad | | | 1 | 4 | 6 | 30 | 10 | 9 | 60 |
| Palghar | | | | 1 | | 1 | 3 | | 5 |
| Parbhani | | 1 | | 1 | 3 | 14 | | 1 | 20 |
| Pune | 5 | 1 | 7 | 5 | 15 | 32 | 22 | 18 | 105 |
| Raigad | | | | 1 | | 1 | 6 | 4 | 12 |
| Ratnagiri | 2 | 1 | | | | 2 | 7 | 2 | 14 |
| Sangli | 4 | | 1 | | 2 | 17 | 6 | 1 | 31 |
| Satara | 3 | | 3 | | 3 | 17 | 3 | | 29 |

| | | | | | | | | | |
|-------------|----|----|----|----|-----|-----|-----|-----|------|
| Sindhudurg | | | | | | 2 | 12 | 1 | 15 |
| Solapur | | | 5 | 3 | 2 | 28 | 5 | 3 | 46 |
| Thane | 1 | | | 2 | | 3 | 9 | 6 | 21 |
| Wardha | 1 | 1 | 1 | 1 | 5 | 4 | 15 | 11 | 39 |
| Washim | | | | | 2 | 3 | 13 | 4 | 22 |
| Yavatmal | | 2 | | 8 | 3 | 16 | 3 | 10 | 42 |
| Grand Total | 35 | 17 | 31 | 53 | 129 | 431 | 321 | 192 | 1211 |

Annexure 2: Farmer groups across districts in Maharashtra

| SN. | District | Farmer groups |
|-----|-------------------------------|---------------|
| 1 | Mumbai City + Suburban Mumbai | - |
| 2 | Thane + Palghar | 1347 |
| 3 | Raigad | 1517 |
| 4 | Ratnagiri | 745 |
| 5 | Sindhudurg | 1145 |
| 6 | Nashik | 2060 |
| 7 | Dhule | 229 |
| 8 | Nandurbar | 667 |
| 9 | Jalgaon | 1389 |
| 10 | Ahmednagar | 5869 |
| 11 | Pune | 6966 |
| 12 | Satara | 536 |
| 13 | Sangli | 1232 |
| 14 | Solapur | 3148 |
| 15 | Kolhapur | 2557 |
| 16 | Aurangabad | 2273 |
| 17 | Jalna | 1556 |
| 18 | Parbhani | 1092 |
| 19 | Hingoli | 863 |
| 20 | Beed | 2960 |
| 21 | Nanded | 1690 |
| 22 | Osmanabad | 10747 |
| 23 | Latur | 714 |
| 24 | Buldhana | 2017 |
| 25 | Akola | 1382 |
| 26 | Washim | 873 |
| 27 | Amravati | 2277 |
| 28 | Yavatmal | 640 |
| 29 | Wardha | 1612 |
| 30 | Nagpur | 1843 |
| 31 | Bhandara | 901 |
| 32 | Gondia | 449 |
| 33 | Chandrapur | 100 |

| | | |
|----|-------------|-------|
| 34 | Gadchiroli | 1174 |
| | MAHARASHTRA | 64570 |

Source: ATMA office, Pune

Annexure 3: Exports and import of grapes from India (1961-2019)

| Year | Export Quantity | Export Value | Import Quantity | Import Value |
|------|-----------------|--------------|-----------------|--------------|
| 1961 | 4 | 2 | 4445 | 993 |
| 1962 | 2 | 1 | 391 | 131 |
| 1963 | 4 | 2 | 1274 | 497 |
| 1964 | 7 | 3 | 1877 | 541 |
| 1965 | 35 | 9 | 357 | 105 |
| 1966 | 16 | 4 | 0 | 0 |
| 1967 | 4 | 1 | 17074 | 3421 |
| 1968 | 2 | 1 | 18338 | 3587 |
| 1969 | 1 | 1 | 18283 | 3878 |
| 1970 | 3 | 1 | 17260 | 3530 |
| 1971 | 10 | 5 | 12934 | 3325 |
| 1972 | 1 | 1 | 19321 | 4677 |
| 1973 | 2 | 1 | 9740 | 2941 |
| 1974 | 1 | 2 | 12873 | 4507 |
| 1975 | 2 | 1 | 16619 | 5637 |
| 1976 | 70 | 47 | 9936 | 3708 |
| 1977 | 29 | 18 | 9878 | 3492 |
| 1978 | 132 | 142 | 8756 | 4761 |
| 1979 | 359 | 363 | 7422 | 3680 |
| 1980 | 319 | 258 | 3600 | 1964 |
| 1981 | 573 | 562 | 2 | 1 |
| 1982 | 1526 | 1646 | 658 | 359 |
| 1983 | 1932 | 1510 | 6887 | 3286 |
| 1984 | 1974 | 1311 | 3248 | 1566 |
| 1985 | 3462 | 2501 | 4000 | 1670 |
| 1986 | 2561 | 2003 | 4541 | 1882 |
| 1987 | 3297 | 3126 | 3179 | 1537 |
| 1988 | 4738 | 4419 | 1146 | 499 |
| 1989 | 6933 | 6111 | 29 | 24 |
| 1990 | 5348 | 4786 | 54 | 41 |
| 1991 | 11143 | 7624 | 0 | 0 |
| 1992 | 10770 | 8229 | 0 | 0 |
| 1993 | 15928 | 10848 | 474 | 128 |
| 1994 | 16813 | 12957 | 0 | 0 |
| 1995 | 22151 | 16607 | 29 | 6 |
| 1996 | 20958 | 14695 | 0 | 0 |
| 1997 | 23680 | 17421 | 0 | 0 |
| 1998 | 11382 | 8902 | 0 | 0 |

| | | | | |
|------|--------|--------|------|-------|
| 1999 | 14006 | 12807 | 9 | 15 |
| 2000 | 20646 | 18468 | 32 | 26 |
| 2001 | 14571 | 13351 | 244 | 296 |
| 2002 | 25568 | 22348 | 407 | 356 |
| 2003 | 26470 | 22271 | 497 | 547 |
| 2004 | 35525 | 24026 | 1111 | 1147 |
| 2005 | 53908 | 48502 | 1496 | 1761 |
| 2006 | 85563 | 66369 | 1976 | 2245 |
| 2007 | 96723 | 76826 | 2723 | 4948 |
| 2008 | 118133 | 84901 | 2967 | 6667 |
| 2009 | 117247 | 89101 | 2387 | 5087 |
| 2010 | 129125 | 102465 | 2861 | 6095 |
| 2011 | 75387 | 77834 | 3899 | 8954 |
| 2012 | 114306 | 131315 | 3952 | 9209 |
| 2013 | 148521 | 194374 | 4078 | 9770 |
| 2014 | 136740 | 223731 | 3774 | 9329 |
| 2015 | 75666 | 123197 | 5107 | 12973 |
| 2016 | 147012 | 219476 | 4558 | 10779 |
| 2017 | 185172 | 275887 | 5423 | 10957 |
| 2018 | 171719 | 275082 | 6436 | 11538 |
| 2019 | 215216 | 307972 | 8159 | 13301 |

Source – FAOSTAT

Annexure 4: Mahagrapes Exports from India

| S. N. | Year | Grapes | | Pomogranate | | Total Value |
|-------|---------|---------------|------------------|---------------|------------------|------------------|
| | | Quantity (MT) | Value (Rs.Lakhs) | Quantity (MT) | Value (Rs.Lakhs) | Value (Rs.Lakhs) |
| 1 | 1990-91 | 450 | 90 | 0 | 0 | 90 |
| 2 | 1991-92 | 1800 | 800 | 0 | 0 | 800 |
| 3 | 1992-93 | 1600 | 765 | 0 | 0 | 765 |
| 4 | 1993-94 | 1078 | 415 | 0 | 0 | 415 |
| 5 | 1994-95 | 357 | 154 | 0 | 0 | 154 |
| 6 | 1995-96 | 430 | 166 | 0 | 0 | 166 |
| 7 | 1996-97 | 498 | 401 | 48 | 14 | 415 |
| 8 | 1997-98 | 295 | 163 | 4 | 2 | 165 |
| 9 | 1998-99 | 789 | 591 | 29 | 16 | 607 |
| 10 | 1999-00 | 940 | 517 | 0 | 0 | 517 |
| 11 | 2000-01 | 664 | 406 | 0 | 0 | 406 |
| 12 | 2001-02 | 907 | 488 | 0 | 0 | 488 |
| 13 | 2002-03 | 992 | 537 | 190 | 109 | 645 |
| 14 | 2003-04 | 572 | 318 | 202 | 89 | 407 |
| 15 | 2004-05 | 810 | 488 | 52 | 19 | 507 |
| 16 | 2005-06 | 1352 | 788 | 0 | 0 | 788 |
| 17 | 2006-07 | 1905 | 1176 | 0 | 0 | 1176 |
| 18 | 2007-08 | 1529 | 1047 | 0 | 0 | 1047 |
| 19 | 2008-09 | 1429 | 856 | 0 | 0 | 856 |

| | | | | | | |
|----|---------------|-------|-------|-----|-----|-------|
| 20 | 2009-10 | 1425 | 879 | 0 | 0 | 879 |
| 21 | 2010-11 | 412 | 310 | 0 | 0 | 310 |
| 22 | 2011-12 | 486 | 390 | 0 | 0 | 390 |
| 23 | 2012-13 | 435 | 354 | 0 | 0 | 354 |
| 24 | 2013-14 | 365 | 339 | 0 | 0 | 339 |
| | Total Exports | 21520 | 12439 | 525 | 249 | 12688 |

Annexure 5: Structured Questionnaire for Farmer Producer Organisations

Module A: Basic Profile

Module E: Land - Crop Management - Technology – Credit

A. Land - Crop Management

B. Technology Adoption

C. Credit

Module I: FPO members

Module J: Non-FPO farmers

Module A: Basic Profile

A1. Interviewer Name

A2. Date of Interview:

A6. District

Ans. 17. Beed 18. Amravati 19. Pune

A7. Taluka

| TALN codes | Taluka |
|------------|-----------------|
| 111 | Amaravati |
| 112 | Chandur |
| 113 | Morshi |
| 211 | Chandur Railway |
| 212 | Tiwasa |
| 311 | Anjangaon Surji |
| 411 | Shirur |
| 511 | Ashti |
| 611 | Beed |
| 711 | Junnar |

A8. Village Name

| VILLN codes | Village Names |
|-------------|---------------|
| 11 | Rohankhed |

| | |
|----|--------------------|
| 12 | Savanga |
| 13 | Pusada |
| 14 | Brahmanwada Bhagat |
| 15 | Nandura Lashka |
| 16 | Devara |
| 17 | Morshi |
| 18 | Chandur |
| 21 | Salora Khurd |
| 22 | Wadona |
| 23 | Nimla |
| 24 | Amla Vishveshwar |
| 31 | Karla |
| 32 | Takarkheda |
| 33 | Bhandaraj |
| 34 | Khirla |
| 35 | Nimkhed Bazar |
| 36 | Turkhed |
| 37 | Dhanegaon |
| 38 | Anjangaon Surji |
| 39 | Padanri |
| 41 | Paundul 1 |
| 42 | Paundul 2 |
| 43 | Paundul 3 |
| 44 | Shirapur |
| 51 | Gitewadi |
| 52 | Dhamangaon |
| 53 | Dohithan |
| 61 | Borkhed |
| 62 | Mahajanwadi |
| 63 | Beed |
| 71 | Kalwadi |
| 72 | Otur |
| 81 | Narayangaon |
| 82 | Basti |
| 83 | Kolhe aali |
| 84 | Khamgov |
| 85 | Kusur |
| 86 | Pargaon |
| 87 | Dhamankhel |
| 88 | Neemdari |
| 89 | Bhorwadi |
| 90 | Dumbharwadi |

| | |
|-----|----------------|
| 91 | Sawargaon |
| 92 | Manjarwadi |
| 93 | Pimpri pendhar |
| 94 | Manikdoh |
| 95 | Sakore |
| 96 | Jimdari |
| 97 | Varulvadi |
| 98 | Ambegaon |
| 99 | Kumshet |
| 100 | Dhangerwadi |
| 101 | Pakande |
| 102 | Yedgaon |
| 103 | Dhumralwadi |
| 104 | Ozar |
| 105 | Narayanwadi |
| 106 | Junnar |

FPCN. What is the name of the FPC?

| FPCN codes | FPC Name |
|------------|---|
| 1 | Green Future Producer Company |
| 2 | Baliraja Shetkari Co. Ltd. |
| 3 | Shubhlabh Farmer Producer Co. |
| 4 | Nagad Narayan Farmer's Producer Company |
| 5 | Agro Unnati Farmers Producer Company |
| 6 | Creative Agro Producer Company Ltd. |
| 7 | Deccan Valley Farmers Producer Company |
| 8 | Krushji Jivan Agro |

A9. Name of the respondent

A9Mob. Mobile no.

A10. Is respondent household head?

Ans. 1. Yes 2. No

A11. If yes, what is the gender of the household head?

Ans. 1. Male 2. Female

A12. If No, what is respondent relationship to head of HH?

| A12 codes | |
|-----------|-------------------|
| 1 | HH head |
| 2 | Spouse of HH head |

| | |
|----|--------------------------------------|
| 3 | Son/daughter of HH head |
| 4 | Parent of the HH head |
| 5 | Brother/Sister of the HH head |
| 6 | Brother/Sister-in-law of the HH head |
| 7 | Grand Parent of the HH head |
| 8 | Aunt/Uncle of the HH head |
| 9 | Nephew/Niece of the HH head |
| 10 | Other Related |
| 11 | Other Non-related |

A13. Religion of the respondent

| | |
|-----------|-----------------|
| A13 codes | |
| 1 | Hindu |
| 2 | Islamic |
| 3 | Christian |
| 4 | Sikh |
| 5 | Buddhist |
| 6 | Others, specify |

A14. Social Group of the respondent

| | |
|-----------|------------------------------------|
| A14 Codes | |
| 1 | Scheduled caste |
| 2 | Scheduled Tribe |
| 3 | Other Backward caste |
| 4 | Other minority (Muslim, Christian) |
| 5 | Open category |
| 6 | Others, specify |

A16. Age of the respondent (complete years)

A17. Education level of the respondent

| | |
|-----------|-----------------------------------|
| A17 Codes | |
| 1 | No school , |
| 2 | Literate, without school |
| 3 | Middle school , upto 4th |
| 4 | upto 8th |
| 5 | upto 10th |
| 5 | Bachelors |
| 6 | Post graduate |
| 7 | Professional (Doc, Engineer, Law) |
| 8 | MBA |
| 9 | Vocational Training |

| | |
|----|--------------|
| 10 | Other [A16o] |
|----|--------------|

A19. Marital status of the respondent

| A19 Codes | |
|-----------|-------------------------|
| 1 | Married |
| 2 | Single |
| 3 | Engaged |
| 4 | Divorced |
| 5 | Separated (w/o divorce) |
| 6 | Widowed |
| 7 | Others, specify |

A20. What is the primary occupation of respondent?

| A20 codes | |
|-----------|--|
| 1 | Agriculture & allied activities |
| 2 | Share cropper/tenant |
| 3 | Wage labor (farm/non-farm) |
| 4 | Primary processing (food processing, small industry, handicrafts, etc.) |
| 5 | Trade and business (trader, shopkeeper, tailor, blacksmith, carpenter, etc.) |
| 6 | Professional (doctor, engineer, lawyer, teacher, etc) |
| 7 | Govt employee/semi govt/political office bearer |

A21. What is the secondary occupation of respondent? A20 codes

A26. What is your average monthly expenditure?

A27. What is your average monthly expenditure on food items in Rupee?

A29. How many people currently live in this household (including you)? And

A29A. How many of them help and are engaged in agri activities

A30. Which of the following assets you have

| A30A Codes | |
|------------|------------------------------------|
| 1 | Electricity Connection |
| 2 | Ceiling Fan |
| 3 | LPG gas |
| 4 | Two wheelers including motor cycle |
| 5 | Color TV |
| 6 | Fridge |
| 7 | Washing Machine |
| 8 | PC /laptop |
| 9 | Car, Jeep, Van |
| 10 | Air Conditioner |

A31 How many years' experience in farming activities?

A331 Do you have a ration card?

A332 If yes, what color?

| A33 codes | |
|-----------|--------|
| 1 | White |
| 2 | Orange |
| 3 | Yellow |

A34 Do you have Aadhar Card?

A35 Do you have Bank account?

A36 Are you a member of any cooperative, club, user association, etc

A38 Do you access to internet on mobile?

| A 38 codes | |
|------------|--------------------------|
| 1 | SMS |
| 2 | What's APP |
| 3 | Internet |
| 4 | Banking, PayTM |
| 5 | Bill payments, recharges |
| 6 | Other |

If yes, which services do you use

| A39 codes | |
|-----------|--------------------------|
| 1 | SMS |
| 2 | What's APP |
| 3 | Internet |
| 4 | Banking, PayTM |
| 5 | Bill payments, recharges |

A39. Do you use it for accessing agriculture related information?

A39A1. If yes, what for do you use it most?

| A39 codes | |
|-----------|--|
| 1 | Prices |
| 2 | Weather advisory |
| 3 | Social networks |
| 4 | New Technology such as crops, machines |
| 5 | Other |

Module E: Land use / Cropping pattern / Production / Technology

E1. Area (acre)

E21. Irrigated area (acre)

E3a. Area under the FPO activity (acre)

E3b. Area under irrigation in the FPO activity? (acre)

E4a1. Which crop/activity are you engaged in as FPO member? (Choose multiple options, if applicable) [for last 3 years]

| E4 codes | |
|----------|---|
| 1 | Cereals (rice + wheat) |
| 2 | Coarse cereals (maize, sorghum, pearl millet, ragi) |
| 3 | Fruits |
| 4 | Vegetables |
| 5 | Cotton/sericulture |
| 6 | Pulses |
| 7 | Oilseeds |
| 8 | Sugarcane |
| 9 | Dairy |
| 10 | Poultry |
| 11 | Roots/tubers |
| 12 | <i>Others</i> |

E4b. What crop activity you had undertaken in the area before joining FPO? E4 codes

E5a. Area under the non FPO activity [for last 3 years] (acre)

E61. Which crop/activity not under FPO? (Choose multiple options, if applicable) [For last 3 years] E4 codes

E81 [If irrigated (check E21)] what is the main source of irrigation? (Multiple choice applicable)

| E8 Codes | |
|----------|-----------|
| 1 | canal |
| 2 | well |
| 3 | farm pond |
| 4 | bore well |
| 5 | lake |

E91. Which of the following crops you are not engaged in, but will like to get into (choose multiple options, if applicable) E4 codes

B. Technology Adoption:

E101-E106. What technologies you have adopted after joining the FPO?

E10
codes

- 1 Crop management - Adopting of new variety, seeds, land preparation, soil management
- 2 Water management - shifted to drip irrigation, adopted fertigation
- 3 Pest management - IPM
- 4 Improved application of pesticide and insecticide
- 5 Improved post-harvest techniques - sorting, packing , grading, storage
- 6 Adopting polyhouse , shade net

E111-E116. What are 3 most important technologies you plan to adopt in next 3 years? (Choose multiple options, if applicable) E10 codes

E121- E124a. What are the major constraints in technology adoption?

E12 codes

- 1 High Costs
- 2 Lack of Credit
- 3 Waiting to see the results of adoption by others
- 4 Adverse weather conditions - late monsoon, untimely rain,
- 5 Face no problems in adoption

E131- E130a. Sources of Information for new technologies

E13
codes

- 1 Friends /Relatives
- 2 Fellow villager/Neighbor
- 3 Fellow farmer from other village
- 4 Member farmers from the company
- 5 Demo plots/ Exposure visits
- 6 Government sources such as Agriculture officer, KVK, Agriculture University
- 7 Private sources - seed companies, input vendor in village
- 8 Informal sources – such as retired persons, professors, etc.
- 9 Mass media such as radio, TV, Mobile, Newspapers
- 10 Social Networks such as WhatsApp, Facebook, Internet
- 11 No source

E141-E44a. Major problems in adopting new technology

E14
codes

- 1 Market risk - was not sure whether the market will accept this variety eg. Cucumber
- 2 Weather risk - For eg. -was not sure whether the new seed of tomato will withstand the high temperature

- | | |
|---|---|
| 3 | Insufficient information - drip system giving uneven water across the field |
| 4 | Insufficient resources/funds |
| 5 | No problems in adoption |

E15a. How frequently seminar/training/agri expo visits organised by your FPO?

| | |
|----------|---|
| I5 codes | |
| 1 | Weekly |
| 2 | Fortnightly |
| 3 | Monthly |
| 4 | Whenever the leader ,KVK, Government officer calls us |
| 5 | One year |
| 6 | Don't know |

E15b. How frequently you attend/participate in it? (yearly)

E15c. Where do you get the information about technology you follow?

C. Credit:

E16. Have any adults in the household taken any loan in the last 3 years?

E181. What was the source of loan?

| | |
|-----------|-----------------------------|
| E18 Codes | |
| 1 | Relative/friend/neighbor |
| 2 | Commercial Bank |
| 3 | Cooperative Bank |
| 4 | Other financial institution |
| 5 | NGO |
| 6 | Employer |
| 7 | Shop / Dealer / Trader |
| 8 | Money-lender |
| 9 | Self-help groups |
| 10 | FPO |
| 11 | others (specify) |

E191. What was the loan mainly used for?

| | |
|-----------|-----------------------------------|
| E19 Codes | |
| 1 | Business enterprise |
| 2 | Agricultural enterprise |
| 3 | To buy agricultural assets |
| 4 | For medical treatment |
| 5 | To meet HH consumption needs |
| 6 | Rent / purchase / improve housing |

| | |
|----|--------------------------------|
| | Educational expenses of HH |
| 7 | members |
| 8 | Wedding |
| 9 | Dowry |
| 10 | Funeral |
| 11 | Purchase Land |
| 12 | To purchase livestock |
| 13 | To lend out at higher interest |
| 14 | To go abroad or to big cities |
| 15 | To repay other loan |
| 16 | Other (specify) |

E201. Amount of loan?

E211. What was the annual interest rate?

E221. What is the outstanding amount of loan?

E23a. Is there any change in credit requirements since you joined FPO?

Ans. 1) increased 2) reduced 3) no change

E23b. by how much?

| | |
|-----------|----------------------|
| E23 codes | |
| 1 | No changes |
| 2 | 5 percent |
| 3 | 10 percent |
| 4 | 15 percent |
| 5 | more than 15 percent |

E24. If being FPO member eases credit constraints in any way?

| | |
|-----------|---|
| E24 codes | |
| 1 | eases working capital requirements |
| 2 | reduces frequent visits to banks reduces frequent visits to informal |
| 3 | sources |
| 4 | does not help in any way |
| 5 | no reduction in constraints |
| 6 | we face no constraints at all |
| 7 | no idea about that |
| 8 | did not take loan |
| 9 | not fpc member |

Module C: FPO member questions

I1. Are you a member of Farmer Producer Organization?

Ans. 1) Yes 2) No

I2. If yes, for how long are you member of this group?

I4. Fees to get membership?

I5. Frequency of group meetings?

| I5 codes | |
|----------|---|
| 1 | Weekly |
| 2 | Fortnightly |
| 3 | Monthly |
| 4 | Whenever the leader ,KVK, Government officer calls us |
| 5 | One year |
| 6 | Don't know |

I6. Frequency of financial transactions with group? (per year)

I71 Why did you choose to become member of FPO?

| I7 codes | |
|----------|---|
| 1 | your friend / junior or same age relative was group member and he is doing better |
| 2 | Your Senior relative /family friend was group member |
| 3 | Neighbor/ farmers in my village asked me to be member |
| 4 | KVK or ATMA officer asked us to form the club/group |
| 5 | Seed Vendor/ shop keeper/business related trader |
| 6 | NGO/ SHG/ school teacher/ professor asked us to form the club |
| 7 | Membership was needed for govt subsidy/scheme |
| 8 | To do something new |

I81 What are the benefits as a member of FPO?

| I8 Codes | |
|----------|---|
| 1 | Get new information about crops, technology, seeds |
| 2 | Get inputs at cheaper costs and at right time |
| 3 | Don't have to do paperwork, NGO persons or group members do it |
| 4 | Get better prices for my produce, new markets |
| 5 | Know when to spray the pesticides |
| 6 | Have better access to credit, govt schemes |
| 7 | Get good attention from senior farmers, kind of monitoring, supervision |
| 8 | No fear of cheating, late payments |
| 9 | No benefit until now |

I91 As a member, what are your responsibilities?

| I9 codes | |
|----------|---------------------------------|
| 1 | Attend and participate meetings |

| | |
|---|--|
| 2 | Responsible for group marketing operations, turnover |
| 3 | Responsible for group finance operations |
| 4 | Responsible for the loan taken by the group |
| 5 | Responsible for Quality Control and production |
| 6 | Do all the work as decided |
| 7 | Don't know |

I10a Have you ever been removed from group?

Ans. 1) Yes 2) No

I10b If Yes, why?

| | |
|-----------|--|
| I10 codes | |
| 1 | not supplying required quality produce |
| 2 | problems adjusting with other members |
| 3 | financial quarrels |
| 4 | other |

I111 What is the greatest risk you face in agriculture?

| | |
|-----------|---|
| I11 codes | |
| 1 | Decline/collapse in market prices |
| 2 | Hail storms |
| 3 | Drought/famines |
| 4 | Increase in input prices |
| 5 | Pest attack |
| 6 | Other - Labor shortage, Could not manage any of these risks |

I121 Which of these risks you can face better as member of the group?

| | |
|-----------|--|
| I15 codes | |
| 1 | Because of aggregation discounts on input |
| 2 | Custom hiring of machinery |
| 3 | Reduction in transport cost due to aggregation |
| 4 | New technology adoption - Eg. less inputs needed because of right usage - pesticides |
| 5 | Resources sharing - labour, oversight, machinery |
| 6 | Organic farming |

I13a Post membership your productivity has changed by

Ans. 1) increased 2) reduced 3) no change

I13b by how much?

E23 codes

- | | |
|---|----------------------|
| 1 | No changes |
| 2 | 5 percent |
| 3 | 10 percent |
| 4 | 15 percent |
| 5 | more than 15 percent |

I14a Post membership your cost has changed by

Ans. 1) increased 2) reduced 3) no change

I14b by how much? E23 codes

I151 [If cost reduced] Major reasons for reduced cost?

I15 codes

- | | |
|---|--|
| 1 | Because of aggregation discounts on input |
| 2 | Custom hiring of machinery |
| 3 | Reduction in transport cost due to aggregation |
| 4 | New technology adoption - Eg. less inputs needed because of right usage - pesticides |
| 5 | Resources sharing - labour, oversight, machinery |
| 6 | Organic farming |

I16a Post membership your gross income has changed by

Ans. 1) increased 2) reduced 3) no change

I16b by how much? E23 codes

I171 [If income increased] Major reasons for increase in gross income?

I17 codes

- | | |
|---|---|
| 1 | Better prices due to new markets |
| 2 | Better prices due to increased negotiation capacity |
| 3 | Reduction in transaction cost |
| 4 | Better yield |
| 5 | Better Quality |
| 6 | Better yield and quality |
| 7 | Less market rejection |
| 8 | Organic farming |

I201 Post membership which of the operations have become easier? Choose multiple options if applicable

I20 codes

- | | |
|---|---|
| 1 | Buying seeds, pesticides, fertilizers of better quality |
| 2 | Applying fertilizers, nutrients in exact doses |
| 3 | Pesticides and insecticides sprays, |

| | |
|---|---|
| 4 | Harvesting |
| 5 | Post-harvest operations such as grading , storing |
| 6 | Transport to Market |
| 7 | Others |

I211 Post membership which of the operations you did first time?

| | |
|-----------|---|
| I21 codes | |
| 1 | Soil testing |
| 2 | Water testing |
| 3 | Used new seed, variety |
| 4 | Visit to research centers, universities |
| 5 | Visit to Markets, post harvest centers |
| 6 | Did nothing |

I221 Post membership which of the decisions have become easier? (1 being the easiest and 5 as less easy)

| | |
|-----------|-----------------------------------|
| I22 codes | |
| 1 | What to produce |
| 2 | How much to produce , product mix |
| 3 | How to pack, store |
| 4 | When to take to market |
| 5 | Which market |
| 6 | None |

I26 Being a group member, has brought changes in economic behaviour?

| | |
|-----------|--|
| I26 codes | |
| 1 | Became more disciplined about agriculture operations |
| 2 | More confident to deal with bank, govt officers, traders |
| 3 | Increase in communication |
| 4 | No change |

I271 Being a group member, has brought changes in social behaviour?

| | |
|-----------|---|
| I27 codes | |
| 1 | University professors, Bank , NGOs show me more respect |
| 2 | Traders, Input vendors show me more respect |
| 3 | Agro officers give more respect |
| 4 | No change |

I28a How many persons from your following networks are group members?

| | |
|---------------|------------|
| I28 codes | village |
| relatives | put number |
| friends | put number |
| neighbours | put number |
| institutional | put number |

I28e From you district other than your village how many people are from your network?

| | |
|---------------|------------|
| I28 codes | village |
| relatives | put number |
| friends | put number |
| neighbours | put number |
| institutional | put number |

I29a Do you know any successful groups?

1) Yes 2) No

I29b Can you name them?

I301 Reasons for their successs?

| | |
|-----------|--|
| I30 codes | |
| 1 | The group members have better access to inputs, technology |
| 2 | They get better prices |
| 3 | They get better yield |
| 4 | They have better access to credit, banks, government schemes |
| 5 | They get better exposure , visits , exhibitions |
| 6 | Other |

I31a Do you know any failed groups?

Ans. 1) Yes 2) No

I31b Can you name them?

I321 Reasons for their failure?

| | |
|-----------|---|
| I32 codes | |
| 1 | No change in income/Reduced income |
| 2 | High costs, working capital requirements |
| 3 | High labour requirement |
| 4 | Difficult to comply with quality requirements |
| 5 | It requires much time, discipline |
| 6 | I did not agree with the working pattern, rules |
| 7 | Only some members dictate the group |

I33 Are you satisfied with the success/operations of FPO?

Ans. 1) Yes 2) No

I33A Please rate on the scale 1 to 5, 1 not at all happy/successful, 5 fully successful

I34 What they would like the change about the FPO?

| I34 codes | |
|-----------|------------------------|
| 1 | number of members |
| 2 | selection mechanism |
| 3 | organization structure |
| 4 | start branding |
| 5 | contract terms |
| 6 | other |

Module D: Non-FPO farmers

J1 Would you like to join the group farming / FPO activity?

| J1 codes | |
|----------|----------------|
| 1 | Yes |
| 2 | No |
| 3 | Not yet |
| 4 | I am Ex member |

J2 If ex member, why did you leave the group?

| J2 codes | |
|----------|---|
| 1 | It was disappointing |
| 2 | It requires much time, discipline |
| 3 | I did not agree with the working pattern, rules |
| 4 | Only some members dictate the group |
| 5 | I can operate better alone |
| 6 | Other |

J3 Would you like to join any other group in future?

Ans. 1) Yes 2) No

J4 If Yes, Why do you want to join the group?

| J4 codes | |
|----------|--|
| 1 | Because of aggregation discounts on input |
| 2 | They get better prices |
| 3 | Their income increases |
| 4 | They get credit easily, govt policy support is readily available |
| 5 | They can visit agri expo |
| 6 | Other |

J5 If No, Why you don't want to join the group?

| J5 codes | |
|----------|---|
| 1 | No change in income/Reduced income |
| 2 | High costs, working capital requirements |
| 3 | High labour requirement |
| 4 | Difficult to comply with quality requirements |
| 5 | It requires much time, discipline |
| 6 | I did not agree with the working pattern, rules |
| 7 | Only some members dictate the group |
| 8 | Other |

J6 If not yet, why you are not joining now?

| J6 codes | |
|----------|--|
| 1 | I am watching results (wait and watch approach) |
| 2 | I am not confident about technology yet |
| 3 | I cannot devote that much time (will not be able to manage new hassles, due to limited family workers,etc) |
| 4 | Not sure if I can comply with quality standards |
| 5 | Not sure if I can manage high capital requirements |
| 6 | Not sure if can manage skilled labour requirements |
| 7 | Other |

J7a How many persons from your following networks you take advice?

| | |
|---------------|------------|
| J7 codes | village |
| relatives | put number |
| friends | put number |
| neighbors | put number |
| institutional | put number |

J7e From your district other than your village people, how many persons guidance you take regarding agriculture matters from below network J7 codes

J21 Frequency of informal meetings?

| J21 codes | |
|-----------|---|
| 1 | Weekly |
| 2 | Fortnightly |
| 3 | Monthly |
| 4 | Whenever the leader ,KVK, Government officer calls us |
| 5 | Others |

J8a Do you know any successful groups?

Ans. 1) Yes 2) No

J8b Can you name them?

J91 Reasons for their success?

| | |
|-----------|--|
| J91 codes | |
| 1 | The group members have better access to inputs, technology |
| 2 | They get better prices |
| 3 | They get better yield |
| 4 | They have better access to credit, banks, government schemes |
| 5 | They get better exposure , visits , exhibitions |
| 6 | Other |

J10a Do you know any failed groups?

Ans. 1) Yes 2) No

J10b Can you name them?

J111 Reasons for their failure?

| | |
|-----------|--|
| J11 codes | |
| 1 | No change in income/Reduced income |
| 2 | High costs, working capital requirements |
| 3 | High labour requirement Difficult to comply with quality requirements |
| 4 | It requires much time, discipline |
| 5 | I did not agree with the working pattern, rules |
| 6 | rules |
| 7 | Only some members dictate the group |

J12 What is the greatest risk you face in agriculture?

| | |
|-----------|-----------------------------------|
| J12 codes | |
| 1 | Decline/collapse in market prices |
| 2 | Hail storms |
| 3 | Drought/famines |
| 4 | Increase in input prices |
| 5 | Pest attack |
| 6 | None |

J131 Which of these risks you can face better if you join the group? J12 codes

J14a In last 3 years, your productivity has changed by

Ans. 1) increased 2) reduced 3) no change

J14b by how much?

| J14 codes | |
|-----------|----------------------|
| 1 | 5 percent |
| 2 | 10 percent |
| 3 | 15 percent |
| 4 | more than 15 percent |

J15a In recent years your cost has changed by

Ans. 1) increased 2) reduced 3) no change

J15b by how much? J14 codes

J16 [If cost reduced] Major reasons for reduced cost?

| J15 codes | |
|-----------|--|
| 1 | Because of aggregation discounts on input |
| 2 | Custom hiring of machinery |
| 3 | Reduction in transport cost due to aggregation |
| 4 | New technology adoption - Eg. less inputs needed because of right usage - pesticides |
| 5 | Resources sharing - labour, oversight, machinery |
| 6 | Other |

J17a Recently your gross income has changed by

Ans. 1) increased 2) reduced 3) no change

J17b by how much? J14 codes

J18 [If income increased] Major reasons for increase in gross income?

| J18 codes | |
|-----------|---|
| 1 | Better prices due to new markets |
| 2 | Better prices due to increased negotiation capacity |
| 3 | Reduction in transaction cost |
| 4 | Better yield |
| 5 | Better Quality |
| 6 | Better yield and quality |
| 7 | Less market rejection |
| 8 | Other |

Annexure 6: Questionnaire for Fratelli FPO Members

Module A: Basic Profile

Module B: Land - Crop Management - Technology – Credit

A. Land - Crop Management

B. Technology Adoption

C. Credit

Module C: FPO members

Module A: Basic Profile

A1. Interviewer Name:

A2. Date of Interview:

A3. District:

A4. Taluka:

A5. Village Name:

A6. Name of the respondent

A7. Mobile no.

A8. Age of the respondent (complete years)

A81 Caste

A9. Education of the respondent

A10. How many people currently live in this household (including you)? And

A11. How many of them help and are engaged in agri activities

A12. How many years' experience in farming activities?

A13. What is your average monthly expenditure?

A14. What is your average monthly expenditure on food items in Rupee?

A15. Annual Income

Module B: Crop Profile

B1. Total Area (acre)

B2 Area under grapes (acre)

B3. Crop profile of the area after joining FPO?

| Year | Area (Acre) | Yield (MT) | | Price (Rs./Kg) | |
|------|-------------|------------|-------|----------------|-------|
| | | Export | Local | Export | Local |
| | | | | | |
| | | | | | |
| | | | | | |

B4. Crop profile of the area before joining FPO?

| Year | Area (Acre) | Yield (MT) | | Price (Rs./Kg) | |
|------|-------------|------------|-------|----------------|-------|
| | | Export | Local | Export | Local |
| | | | | | |

| | | | | | |
|--|--|--|--|--|--|
| | | | | | |
| | | | | | |
| | | | | | |

B5. Frequency of visits by Agronomist?

B6. Frequency of visits by Agronomist head?

B7. No. of soil tests conducted so far.

B8. No. of water tests conducted so far.

B9. No. of leaf petiole tests conducted so far.

(Collect all the soil, water and leaf petiole reports)

B10. What convinced you to join the FPO? (Give reasons)

1. Friends
2. Relatives
3. Social Network/Media
4. Observing benefits in grape plots of FPO members
- 5.....

B11. What issues were faced by you before joining the FPO?

1. Quality
2. Quantity
3. Crop Failure
4. Sub-optimal Crop Health
5. Weather Risks
6. Post-harvest keeping quality of produce
7. Sugar level
8.

B12. What issues were addressed after joining the FPO?

- 1.
- 2.
- 3.

B13. What technologies you have adopted after joining the FPO?

1. Crop management - Adopting land preparation, soil health management based on reports.

2. Water management – drip design change, accurate fertigation based on petiole analysis.
3. Improved application of pesticide and insecticide.
- 4.
- 5.
- 6.

B14. Post membership your productivity has changed by

Ans. 1) increased 2) reduced 3) no change

by how much? ----- (in %)

B15. [If productivity improved] Major reasons for change in productivity?

- 1.
- 2.
- 3.

B16. Post membership your cost has changed by

Ans. 1) increased 2) reduced 3) no change

by how much? ----- (in %)

B17. [If cost reduced] Major reasons for change in cost?

1. Because of optimum utilisation of inputs
2. New technology adoption - Eg. less inputs needed because of right usage – pesticides, insecticides.
3. Balanced nutrition to plants based on soil, water and petiole tests.
- 4.
- 5.

B17A. Change in cost structure

| S.N. | Particulars | After | Before |
|------|-----------------------------|-------|--------|
| 1 | Pesticides and insecticides | | |
| 2 | Fertilisers | | |
| 3 | PGR | | |
| 4 | Labour | | |
| 5 | | | |
| | Total Annual Cost | | |

B17B. Change in no. of works (sprays, cane tying, etc)?

1.

2.

B18. Post membership your gross income has changed by

Ans. 1) increased 2) reduced 3) no change

by how much? ----- (in %) (might be Multiple years)

B19. [If income improved] Major reasons for change in income?

1.

2.

3.

B20. Post membership which of the operations have become easier?

1.

2.

3.

B21. Post membership which of the operations you did first time?

1.

2.

3.

Risk Management

B22. Which are the major risks faced by you in grape farming?

1.

2.

3.

B23. Which of these risks reduced after joining FPO as member?

1.

2.

3.