October 2016

Collective Emancipation of Marginal Farmers

The Case of Krushidhan Producer Company Incubated by Development Support Center in Gujarat

Impact Assessment Study

of **Livelihood Enhancement through Participatory Natural Resource Management (LEPNRM) Programme – Phase II**

Supported by RBS Foundation India

by

Astad Pastakia and Pratul Ahuja

for

Development Support Center, Ahmedabad

Table of Contents

Acknowledgements ii

Executive Summary iii

1 Introduction 1

1.1 Context of Study 1

1.2 Objectives and Methodology 2

2 LEPNRM: Underlying Theory of Change 8

3 DSC's Extension System under LEPNRM-II 18

3.1 Coverage 18

3.2 Main Features of the Extension System 19

3.3 New Technology: Extent of Adoption 22

3.4 Role of Kisan Clubs and Producer Groups 26

4 Impact on Economics of Farming 28

4.1 Profile of Farmers in Sample 28

4.2 Effectiveness of agriculture extension services 31

4.3 Study area level impacts 38

4.4 Project level impact 52

5 Impact on Sustainability of Agriculture 58

5.1 Assessment of Soil Health: Sampling Frame 58

5.2 Findings of Soil Survey 59

5.3 Indicators for Monitoring Soil Health 62

6 Krushidhan Producer Company: Key Accomplishments and Strategic Plans 64

6.1 Overview of Achievements 64

6.2 Governance of Krushidhan 75

6.3 Strategic Planning for Next Phase 87

7 Conclusions and Recommendations 93

Annexure 1: Questionnaire for Sample Survey

Annexure 2: Brainstorming and Assessment of Business Options: Findings from Workshop

Annexure 3: Legal requirements for Production of Bio-pesticides and Bio-fertilizers

Acknowledgements

It has always been a pleasure to take a close look at DSC's work because of a high degree of professionalism that it tries to maintain in all its projects. LEPNRM programme has been no exception.

During the period of the study i.e. from April to September 2016, DSC has undergone a transition in leadership. We are grateful to both Mr. Sachin Oza, the ex-director as well as Mr. Mohan Sharma, the present director for their patronage and valuable feedback during every stage of the study. Such an engagement makes it a learning experience for the external team of consultants as much as it is for the implementation team.

We are thankful to Ms. Dhruvi Shah, Program Director and Mr. Sunil Kumar, Director, RBS Foundation for engaging us for this exercise and for the free hand given in carrying it out to the satisfaction of all stakeholders. The long term committment shown by RBS Foundation to a project like this is often found lacking in most donor agencies who are in a hurry to move on to other areas and target populations. It is a demonstration of the deep appreciation of what it takes to create people's institutions from the base upwards leading ultimately to "value chain development approach" in transforming the lives and livelihoods of marginal farmers in a sustainable manner.

We would like to place on record the untiring efforts of Mr. Jasvant Chauhan, the present CEO of Krushidhan Producer Company who accompanied us during all field visits and responded proactively to all requests for information related to the company. Like wise the entire field staff of DSC was forthcoming in testing all suggestions and ideas and collating the necessary data in a timebound manner. We are also thankful to Mr. Bharat Patel for his extremely valuable inputs during the field surveys and report preparation. Last but not the least, we would like to acknowledge the assistance received in data handling and field surveys from Sandip Varia, Mushtaqali Sheikh, Mahendra Patel, Fulaji Thakor, Vikram Makwana, Tejas Makwana, Ketan Malaviya and Mahesh Parmar.

While the authors have relied heavily on the DSC team for collating the project level data, it takes full responsibiliy for the primary level data collected by it as well as the analysis, conclusions and recommendations presented in the study. We trust that all direct stakeholders of this project will benefit from this exercise. We believe that DSC's experience through this project also has immense value for other NGOs trying to incubate farmer collectives, in terms of what pitfalls to avoid and what strategies to deploy during the start-up phase of promoting an FPO. We look forward to continued engagement with DSC and its various initiatives in the coming years as well.

19 October 2016

Astad Pastakia
Pratul Ahuja

Executive Summary

The Livelihood Enhancement through Participatory Natural Resource Management (LEPNRM) project was initiated by DSC in 2008 with financial assistance from RBS Foundation India. The project adopted a holistic approach towards agriculture development and focused on five aspects namely - productivity enhancement, cost reduction, risk mitigation, value addition and market linkages. In the first phase of the project (2008-2011), the emphasis was on agriculture extension through development of user friendly IEC material, capacity building, development of a cadre of para-workers and formation of SHGs and Farmer Clubs at the village level. The second phase of the project (2012-2016) aimed at promoting a Farmer Producer Organisation (FPO) so that farmers would be better organised to deal with market forces, through backward and forward linkages. The current Impact Assessment Study is focused on Phase II of the LEPNRM project and covers the performance of both the agricultural extension system brought in place by DSC during Phase I as well as the newly formed FPO.

The twin objectives of the study were addressed by having a two member team of consultants. While one looked at the performance of the company, the other focused on the impacts of the extension system as well as the activities of the company on the target population of farmers. In order to assess the impacts on farmers, a field level survey was carried out covering 200 farmers from 145 villages across the 4 districts of Mehsana, Sabarkantha, Aravalli and Ahmedabad in Gujarat. The results of soil samples tested by the Gujarat Agricultural University were taken as the basis for comparison with benchmark data on soil health, in order to analyse the impact on sustainability of farming in the project areas.

To understand the working of the company as well as the internal processes established for smooth functioning, interviews were held with all primary stakeholders and stakeholder groups. The financial statements for the past three years (since the emergence of the new avatar of the company in 2011) were analysed to understand the financial health of the company. An effort was made to estimate the area level impacts on the farming community based on the findings of the field level survey. Using DSC's Theory of Change, the study highlights the importance of a value chain approach for promoting and strengthening farm based livelihoods and provides a conceptual frame to understand the progress made so far. The framework was further used in a workshop mode with DSC staff to carry out a brainstorming exercise and prepare the strategic plan needed for the next phase of the intervention.

Farmer level impacts

Before going to the farmer level impacts it is necessary to explain some of the forces at play which have been affecting both sustainability of farming as well as economic viability of the marginal farmer in the project area.

The average per farmer cultivated land is lowest in Meghraj at 1 Ha and highest in Himmatnagar at 2.3 Ha. About 80 to 100 per cent of this cultivated land across the five project locations is irrigated either through bore-wells or canal network or both.

Over the past 3 years, milch animal population has shown a decline in Visnagar, Himmatnagar and Modasa due to social changes and reduced fodder availability as a result of shift in cropping pattern towards cash crops. A decline in the number of draught animals like bullock, ox etc. has also been witnessed, especially in Visnagar and Himmatnagar where increasing mechanization in agriculture is seen as the primary reason behind this trend.

Increase in menace of wild animals like nilgai and wild pig in agriculture has been reported from across all project locations. Farmers' efforts to deal with this menace by adopting a range of different measures have met with varying levels of success. DSC's extension system has also responded to this challenge recently by introducing solar fencing and group fencing on a trial basis. Other adaptations include changes in cropping pattern towards crops that are not attacked by the ungulates.

The effects of climate change have been felt in the project area during recent years. Some crops like wheat are more sensitive to climate change. Adaptations are being made intuitively by farmers as well as through recommendations from the Agricultural Research Centers located in the area (particularly the Wheat Research Center). Chief among these are the adoption of shorter duration varieties and varieties more suited to higher temperature. Better soil and water management practices are also recommended.

The above changes have resulted in an adjusted cropping pattern which was captured as follows: Cotton and castor are the main Kharif crops in Visnagar, Himmatnagar and Modasa. In Meghraj, cotton and maize - which is grown in place of castor – are the predominant Kharif crops whereas in Vehlal, paddy and vegetables are commonly grown. Wheat dominates Rabi season cultivation across all five project locations while fennel is also grown in Visnagar. In Summer, there is some vegetable cultivation that is carried out in Vehlal; however, farmers in other locations are not able to take any crops due to lack of water.

DSC's extension services have led to a significant reduction in quantity of agriculture inputs like seeds, chemical pesticides, fertilisers, weedicides, irrigation water and labour as well as an improvement in the farmer incomes due to higher crop productivity and better price realisation. The change in agriculture inputs is reflected in the table below:

Percentage change in agriculture inputs after the project

Crop	Seed	Bio-pesticide	Chemical pesticides	Chemical fertilisers	Weedicides	No. of waterings	Labour & Misc.
Cotton	-9	67	3	8	-29	-2	11
Castor	5	0	11	12	-11	1	16
Paddy	-42	Initiated	-11	-18	-58	-9	-9
Maize	-47	Initiated	-49	-11	-21	-20	-9
Vegetables	-23	Initiated	-13	-9	-20	5	-7
Wheat	-10	69	8	0	-11	-5	6
Fennel	12	Not used	-11	13	4	-9	16

The extent of change in crop productivity and price realisation as a result of the project is summarised in the table below. Maize and vegetables have witnessed the highest gains in productivity after the project

while yield of cotton and castor has suffered. Farmers have also realised better prices, especially in the case of wheat, vegetables and fennel by undertaking cleaning and grading.

Change in productivity & price realisation after the project

Crop	% change in productivity	Change in price realisation (Rs./kg)
Cotton	-8	-2
Castor	-4	-9
Paddy	-2	2
Maize	61	4
Wheat	5	6
Vegetables	28	8
Fennel	4	6

The overall impact of DSC's extension services and activities has been extremely positive, not just from an economic but also environmental point of view. The total economic benefit at the project level due to savings in agriculture input expenses and improved income is nearly Rs. 90 crores (refer Table below) which translates to more than Rs. 27,000/- per farmer household. Similarly, the increasing substitution of chemical inputs with bio-inputs and adoption of water-efficient practices and technologies by farmers has led to improved soil health and water savings, which have begun to reverse some of the harmful effects of sustained and excessive use of chemicals in agriculture.

Economic impact of project

Expense savings	**Rs.**
Seeds	89,43,491
Chemical pesticide	88,76,135
Bio-pesticide	26,18,050
Chemical fertilisers	86,42,395
Weedicides	1,63,41,103
Irrigation water	1,98,11,424
Labour & misc	75,74,061
Sub-total	**7,28,06,658**
Increased income	
Higher productivity	26,67,70,713
Better price realisation	55,28,57,945
Sub-total	**81,96,28,658**
Grand Total	**89,24,35,316**

KPCL plays a central role in the delivery and effectiveness of DSC's extension efforts, at least in as far as agriculture input supply in concerned. This is corroborated by the fact that a majority of farmers across all project locations claim that input supply has improved after formation of KPCL. The availability of

new variety seeds at fair prices from KPCL outlets has been able to bring down seed failure rates, improve productivity and ensure higher savings for farmers. Sale of genuine chemical pesticides and weedicides from the company retail outlets has helped reduce crop damage due to disease and pest attack. Farmers are now able to buy bio-pesticide, vermi-compost and other bio-inputs such as trichoderma viride, *madhyam* etc. from these outlets, bringing down their dependence on chemical inputs and ensuring better soil and plant health. Also, new agriculture tools and equipment such as *chipiyas*, cutters and spray pumps sold through KPCL outlets not only reduce time and effort, but also the drudgery of labour, helping bring down labour costs.

Suggestions to strengthen DSC's Extension System

Despite the expectation of improved productivity due to adoption of scientific agriculture practices by farmers as part of the project, yields of cotton, castor and paddy have suffered. This is due to a variety of factors including adverse weather conditions, disease, pest attack and the growing menace of wild animals. While little can be done in the case of natural events, dealing with the wild animal menace needs to be accorded top priority. Although DSC has initiated a few pilots in the form of group fencing and solar electric fencing, these options will have to be thoroughly evaluated in terms of their scalability and feasibility in order to come up with an effective long-term solution to this problem.

By and large, the agriculture extension information provided by DSC has been well received, with farmers in each project location deriving varying levels of satisfaction from the different sources of information. Going forward however, it is important to bear in mind that in order to be more effective, a bouquet of different sources of information will have to be offered in each project location, rather than what has been most useful in a particular location. The challenge though is that with very low levels of willingness to pay among farmers, DSC might have to look for other sources of funding to support its agriculture extension information programme.

Some of the key suggestions received from farmers to improve usefulness of the extension services include direct procurement of farmers' produce by KPCL and assistance in grading, packing and marketing of farmers' produce, especially spices and vegetables. Farmers would also like access to the services of an agriculture expert, greater interaction and experience sharing, information on improved seed varieties, latest/low-cost agriculture techniques and available government subsidies and assistance in carrying out animal husbandry scientifically.

DSC needs to remodel its extension system to meet the changing needs of farmers in different project locations. While farmers in newer project locations such as Meghraj and Vehlal want extension activities to continue to focus on agri advisory information dissemination, package of practices and knowledge transfer, those in DSC's traditional project locations such as Visnagar, Himmatnagar and Modasa seek a higher level of engagement. This may include services such as assistance in crop diversification, infrastructure in the form of godowns, cold storage facilities etc., support for marketing of produce and promotion of entrepreneurship among farmers. By offering differentiated levels of extension services to suit different requirements, DSC will be able to retain its appeal and relevance among its farmer members.

In order to maintain and strengthen the network of grassroots-level institutions that form the base of its extension efforts, DSC needs to encourage membership of Kisan Clubs, bio-pesticide and vermi-compost groups. According to the primary survey, one of the main reasons for people not joining these institutions was the absence - and therefore lack of information about activities - of bio-pesticide/vermi groups and Kisan Clubs. Greater efforts therefore need to be made to set up more groups/Clubs and increase visibility of the benefits they offer, so that people are able to see value in becoming a member.

KPCL is currently at a stage of growth where it is well placed to leverage its inherent strengths for expanding its membership base. It enjoys huge appeal not just among its member-shareholders but also non-member farmers who prefer KPCL over other market players, primarily due to the assurance of quality and fair price of agriculture inputs. Considering that a very small proportion of the total project beneficiary farmers are KPCL members, there exists a huge potential for scaling up. To translate this potential into membership, a good starting point will be to consider allowing payment of KPCL membership fee on an installment basis as suggested by some farmers and improve visibility/information about KPCL's activities among non-members to generate their interest in participation.

Impact on sustainability of agriculture

The comparison of soil samples before and after the LEPNRM project on five important chemical parameters of soil health shows that there has been significant improvement. This augers well for the sustainability of agriculture in the region.

i. There has been significant improvement in PH of soils across all regions. In the case of Meghraj it has moved from acidic towards neutral while in all other cases it has moved from alkaline towards neutral condition. This may be considered a significant gain within a short period of 4 years.
ii. EC levels have been maintained at fairly low levels in all project areas. In the case of Visnagar, EC was on the higher side at 1.25 mmhos/cm before the project started as compared to other regions, which has been brought down by 14.4 %.
iii. Both the above changes can be considered positive from the view point of environmental sustainability and can be attributed to conjunctive use of chemical and bio-fertilizers being promoted by DSC. However, isolated cases of high EC persist indicating salinity in soil on account of excessive use of chemicals and/or mismanagement of irrigation water. These farmers must be contacted directly and counselled for better land use and farming practices.
iv. Among the nutrients, organic carbon has shown a marginal increase across project areas. Promotion of greater use of bio-fertilizers, incorporation of crop waste into the soil instead of burning, practice of cover crops and green manuring etc. are some of the time tested methods of increasing organic carbon, which has a direct impact on soil texture, water holding capacity, microbial activity and productivity of soils.
v. In the case of the two macro-nutrients, both P and K have seen significant gains in all regions except Meghraj. In Meghraj, the level of P is almost the same while there has been considerable loss of K. However even after this loss, the soil has a good buffer of 433 kg/ha which is better than some of the

other regions. Depletions of upto 25-50 % of the nutrient buffer can be attributed to the previous crop. Some crops extract more potassium than others.

vi. In contrast to organic carbon, the variation seen in P and K buffers is very high. This again is to be expected because farmers are not in the habit of adjusting dosage based on soil analysis. Some farmers apply higher doses in the hope of getting higher yields, others apply sub-optimal doses. The residual fertilizer contributes to the buffer. Proper management of the nutrient buffer is now consider important for sustainable yields.

Suggestions for better monitoring of soil health

As all studies on soil health indicators have emphasised, soil health is governed by several factors over and above the chemical conditions. Some of these parameters relate to physical conditions of the soil such as porosity, water holding capacity, soil structure, soil depth etc. More importantly, soil being a living eco-system supports a large variety of micro-organisms which interact with the chemical and physical components in the process modifying them. Hence, soil healh indicators should ideally be drawn from all three aspects of soil. Needless to say this makes monitoring soils for their health and sustainabiliy a lot more cumbersome and expensive. However, in order to get a comprehensive idea about soil health status, the authors recommend that during the third phase of LEPNRM, sufficient funds be alloted to monitor soil health on all three categories of soil health indicators. Costs can be minimised by selecting the most important indicators in each category.

Performance of Krushidhan Producer Company

In a recent review paper on performance of FPOs in India, Prof. Tushar Shah identified eight principles adopted by the high growth milk producer companies promoted 3-4 years ago by NDDB. An assessment of Krushidhan FPO shows that it has intuitively followed all these principles in letter and spirit. Krushidhan's financial statements also indicate that over the past three years it has started making modest profits while its growth trajectory has been impressive.

A comparative analysis of business turnover to membership ratio showed that Krushidhan was way below the MPCs. However, it should be noted that there is a qualitative difference between the sales of Krushidhan and MPCs. Most of its sale has been restricted to inputs rather than outputs. When Krushidhan gets into collective marketing of outputs, the turnover is bound to increase significantly as outputs are both bulky and of high value.

This difference has arisen also because Krushidhan works in agriculture with a social mission of making it environmentally sustainable while ensuring the economic viability of the marginal farmer. This mission has guided the portfolio of activities in the first three years where creating backward linkages was considered critical for higher and more sustainable productivity. Also given the diversity of cropping patterns, Krushidhan has to deal with a diverse portfolio of inputs. The company has therefore been more in the service sector rather than commodity business, although it did not charge a penny for its services. The economic benefits derived by farmers due to reduced costs, increased productivity, reduced risk and increased price realisation are estimated to be nearly Rs. 90 crores. When these as well

as the environmental and social gains are factored in, the performance of Krushidhan looks even better than that of MPCs.

Suggestions for strengthening Krushidhan FPO

Krushidhan needs to continue its trajectory of growth using a value chain approach while adhering to the eight principles identified by Dr. Shah. Two factors will enable it to meet its projected targets; a) increasing its share-holder base and thereby available internal funds for doing business while simultaneously increasing member allegiance b) getting into building collective marketing of produce through aggregation, cleaning and grading, storage, market information based selling, value addition and whatever needs to be done to get the farmer a better price for her/his produce. At the same time DSC will need to make its extension services more aligned and synchronised with the activities of the company so that members perceive greater benefits and experience greater loyalty to the company, which is so crucial for collective action.

Some of the issues related to governance and management of the company as well as possible solutions /recommendations are discussed in the report.

1 Introduction

1.1 Context of Study

Development Support Center (DSC) established in 1994 by late Shri Anil Shah is well known for its pioneering work in the field of Participatory Irrigation Management (PIM). More recently it has also established itself as an agency that provides effective solutions for farm and off-farm rural livelihoods through Participatory Natural Resource Management (PNRM). After more than a decade of successful work in the area of PIM and watershed development, in 2008, DSC initiated a project aimed at improving the agriculture based livelihoods of farmers in Gujarat called "Livelihood Enhancement through Participatory Natural Resource Management" (LEPNRM) in Ahmedabad, Mehsana, Sabarkantha, Aravali and Amreli districts of Gujarat with financial assistance of **RBS Foundation India (RBSFI).** About 40,000 rural families in 160 villages were targeted under the project (Figure 1-1). This programme adopted a holistic approach towards agriculture development and focused on five aspects namely - *productivity enhancement, cost reduction, risk mitigation, value addition and market linkages.*

- Project locations

Figure 1-1: Project Areas identified in Map of Gujarat

In the first phase (2008-2011), the emphasis was on agriculture extension through development of user friendly IEC material, capacity building, development of a cadre of para-workers and formation of SHGs and Farmer Clubs at the village level. The project was successful in demonstrating various package-of-practices and technologies that included new varieties of seeds, inter-cropping, soil testing, production and use of vermi-compost and bio-pesticides, drip irrigation etc., with more than 5000 farmers.

The first author had the benefit of conducting the impact assessment study of this phase of LEPNRM. The study showed that the improved practices were shared and adopted by about 15,000 farmers. They benefited by increased crop yield in the range of 20%-70% in various crops such as wheat, castor, mustard, cotton, maize and groundnut. Net income at the farm level was also increased due to better management practices.

Subsequently in October 2011, a second phase of the project was launched by DSC which aimed at promoting a Farmer Producer Organisation (FPO) so that farmers would be better organised to deal with the market forces, through backward and forward linkages. This would result in significant savings in cost of inputs without compromising on the quality and would simultaneously improve the price realised for the produce. The project implemented in 151 villages targeting 32,300 households was completed in March 2016. The districts covered remain the same as in the first phase. It is this project which is the focus of the present impact study.

Some of the important dimensions of Phase II include:

1. Scaling up of better crop management practices, low cost technologies, organic inputs etc. in collaboration with government, cooperatives and private agencies.
2. Capacity building of farmers in collaboration with agriculture universities, crop research stations, private input suppliers, etc.
3. Formation and capacity building of farmers affiliation groups (Kisan Clubs), women enterprise groups, Self Help Groups etc. for participatory learning and collective action.
4. Developing Krushi Dhan Farmers Producer Company (KPCL) into a three-tier, effective service company through hand-holding, capacity building and technical support so that it can benefit small and marginal farmers through cost effective and timely input supply and better price realization on outputs through collective marketing initiatives.

1.2 Objectives and Methodology

Objectives and Expected Outcomes

The set of objectives given to the study team by DSC is reproduced below:

1. To assess the impact of Phase II: Socio–economic and environmental impacts at the household and village levels, benefit-cost ratio of extension services provided by DSC and the business conducted by KPCL.

2. To assess the potential of KPCL through a SWOT analysis of KPCL and maybe that of DSC`s agriculture extension services too.
3. Based on the current and likely scenario of agri-enterprise development and competition from the private sector in the country, to suggest how KPCL could scale-up its operations and make it a financially viable, profit making company – which activities? what scale? which market – local? regional? export?
4. To indicate the likely risks and competitors for each of the suggested activities.
5. To suggest ways and means of mobilising funds for KPCL - accessing credit etc.
6. Since extension and enterprise are closely related, to suggest the role of the support services that need to be provided by DSC to farmers so that they can overcome some of the challenges indicated above.
7. To suggest strategies for making the extension services more demand driven and less dependent on grants.

Apart from providing valuable feedback to various stakeholders of the programme, the study was expected to:

- Suggest a suitable model of agriculture extension services for farmers in 165 villages
- Suggest an appropriate business portfolio and strategies for the KPCL, given its ambition to scale up its turnover and become a profitable venture in the coming five years

Methodology

The methodology included the following:

i) Review of internal reports, project proposal, physical progress reports, case studies etc. and secondary data provided by the project team.

ii) A representative *sample survey* to assess the extent of impact on farm productivity and family income among participating farmers. It was visualised that the sample would include suitable number of respondents from three sections of the farming community which could be seen as three concentric circles of influence:

   - Farmer shareholders of the producer company (innermost circle)
   - Farmers who have accessed services from the company but are not its members (circle just outside of the core)
   - Farmers who are aware of the company and/or DSC by virtue of being located within the project area but have never been directly involved (outermost circle)

iii) The findings would help in developing strategies to broaden the influence of the company and to encourage more farmers to progressively move from outer to inner circles. Details of the sampling frame are given at the end of this section.

iv) A scientific soil survey to assess the improvement in the soil parameters over time. This included testing of organic carbon, PH and nutrient status of soils. Improvement in soil health would serve as an indicator for sustainability of farming practices adopted under LEPNRM. This was carried out with the help/guidance of Gujarat Agricultural University as DSC also has its own facility of mobile van for soil testing.

v) A sample survey among members of the producer company to assess the type and satisfaction of governance was initially visualised. However, we were informed that such a survey had just been completed by DSC with the help of students. It was therefore proposed to utilise the findings of this study as inputs to the larger study of the producer company's performance. In addition, personal interviews with board members and FGDs with active members would be used to understand the governance of the company. The framework provided by Dr. Tushar Shah capturing variables such as member representation, member allegiance, producer centeredness of processes, professional management, checks and balances between the board of governance, professional staff and producer members would be useful for this component of the study.

vi) Individual interviews with professional staff and board members to understand the marketing strategy deployed and the financial status of the company, as well as future plans.

vii) Individual interviews with selected partners of DSC and KPCL who are associated with extension and business activities of the company in Visnagar, Mehsana, Himm\ j]a atanagar and Modasa such as Wheat Research Station, key input suppliers to KPCL etc.

viii) Participatory methods to enable the staff and board of the company to develop the broad contours of long term plan/strategy for the company were visualised. In practice this was achieved through a series of planning workshops facilitated jointly by the consultants and DSC.

Sampling Frame

A sample of 200 farmers was selected for the study. They were selected from within 145 project villages in 5 locations in Gujarat which constitutes the project area. The information on area wise number of farmers and number of villages targeted through project activities is summarised in Table 1-1. A proportionate sample of villages was selected at random as shown in Table 1-2. From each village site, a minimum of 5 farmers including 2 KPCL shareholders, 2 Kisan Club members and 1 control farmer were selected at random from the list of farmers provided by DSC, ensuring representation of marginal, small, medium/large and women farmers.

Table 1-1: Participating villages and farmers in five different clusters of the project area

Name of location	Name of block(s) and district	No of villages	No of farmers registered in the project	No of sample farmers
Dharoi PIM cluster	Visnagar, Unjha, Kheralu, Satlasna, Vadnagar: Mehsana district	60	25,000	90
Guhai PIM cluster	Himmatnagar: Sabarkantha district	30	5500	45
Mazum PIM Cluster	Modasa, Dhansura: Aravalli district	15	3000	25
Meghraj watershed cluster	Meghraj: Aravalli district	20	3500	20
SSNNL Vehlal PIM Cluster	Daskroi: Ahmedabad district	20	1500	20
Total		**145**	**38,500**	**200**

Table 1-2: Sampling frame

Project location	VISNAGAR			HIMMATNAGAR			MODASA		MEGHRAJ			VEHLAL		Total
Clusters	**Dharoi**	**Vadnagar**	**Visnagar**	**Lolasan**	**Ilol**	**Polajpur**	**Mazum**	**Bani**	**Navasamera**	**Navagra**	**Itva**	**Kuha**	**Bhavda**	
No. of villages	6	6	6	3	3	3	2	3	1	2	1	2	2	**40**
No. of samples	30	30	30	15	15	15	10	15	5	10	5	10	10	**200**
Name of villages	Dedasan	Sulipur	Thalota	Lolasan	Dedhrota	Vakhatpura	Kolikhad	Rahiyol	Navasamera	Bhatkota	Itva	Kuha	Bhavda	-
	Fudeda	Kahipur	Pudgam	Dolgarh	Navanagar	Polajpur	Dalilpur	Bhensawada	-	Valuna		Karoli	Dhamatvan	-
	Kot	Malekpur	Denap	Tejpura	Ilol	Navalpur	-	Garudi	-	-	-	-	-	-
	Ransipur	Kesimpa	Kiyadar	-	-	-	-	-	-	-	-	-	-	-
	Javanpura	Navapura	Kansa	-	-	-	-	-	-	-	-	-	-	-
	Khodamali	Sundhiya	Vanagala	-	-	-	-	-	-	-	-	-	-	-
Shareholders	12	12	12	6	6	6	4	6	2	4	2	4	4	**80**
Kisan Club members but NOT shareholders	12	12	12	6	6	6	4	6	2	4	2	4	4	**80**
Ordinary farmers	6	6	6	3	3	3	2	3	1	2	1	2	2	**40**

Key parameters/ indicators

The purpose of the survey is to assess the change (decrease/increase) in productivity of crops, cost structure, price realisation, gross and net incomes etc. This would be assessed through recall data of the performance before and after the intervention and also by comparison between control and sample farmers.

The indicators used to measure the impact at the household level were as follows:

i. Decrease/ increase in per hectare/ per farmer cost of cultivation of 2 major crops in each kharif, rabi and summer.
ii. Change in production related risks of major crops (controllable and natural risks)
iii. Increase/ decrease in per hectare yield
iv. Increase / decrease in price realization
v. Increase / decrease in gross income (per hectare/ per farmer) including labour and transaction costs of 2 major crops in each kharif, rabi and summer.
vi. Increase / decrease in net income (per hectare/ per farmer) including labour and transaction costs
vii. Number of farmers and cultivated area brought under change in crop practices (better management practices adopted from sowing to harvesting and post harvesting processes)
viii. Increased area under efficient irrigation techniques like drip/ sprinkler furrow irrigation etc.
ix. Change in per hectare/ per farmer dose of chemical fertilizers and pesticides
x. Increase/ decrease in production and use of organic inputs (per hectare/ per farmer)
xi. Increase/ decrease in cropped area under seed replacement / seed improvement
xii. Change in mindset of farmers towards adopting sustainable agriculture practices right from pre sowing operations to post harvest processing and marketing i.e. seed selection, balanced use of chemical fertilizers, production and application of pesticides and organic inputs, cleaning, grading etc.
xiii. Level of participation of farmers in farmers organisations and collective actions (Kisan Club, cluster committee, producer enterprise groups and Krushi Dhan Producer Company)
xiv. Change in input supply pattern (accessibility, timeliness, reliability and quality)
xv. Change in the quality and timeliness of information, education and communication services provided to the farmers from the project in comparison of other Departments/ agencies
xvi. Assessment of financial and institutional strength and SWOT analysis of Krushi Dhan Producer Company for its sustainability

2 LEPNRM: Underlying Theory of Change

While LEPNRM-I built the foundation through its extension system to make agriculture sustainable and economically attractive at the same time, LEPNRM-II saw the emergence of Krushidhan FPO as a major force for socio-economic change and empowerment of small and marginal farmers in the project area. Table 2-1 summarises the two phases of the programme in terms of the main focus, reach and impacts.

Table 2-1: Summary of two Phases of LEPNRM

LEPNRM Project	Focus	Reach	Impact
Phase I (2008-2011)	**Agri Extension through Kisan Clubs** to make agriculture viable for marginal farmers and ecologically sustainable and piloting small group enterprise	15,000 farmers out of possible 38,500 300 Kisan Clubs (240 male and 60 female groups) formed in 132 villages	20-70% increase in productivity of crops such as wheat, castor, mustard, cotton, maize and groundnut
Phase II (2012-2016)	Agri extension running parallel to aggregation of farmers under **Krushidhan FPO**	Extension : 32,300 farmers covering 45,500 hectares from 151 villages Market linkages: 6000 farmers Shareholders of FPO: 2035 farmers	Increased use of bio-pesticides and fertilizers; reduced cost on agri-inputs especially seeds; Lower crop loss and higher productivity; Better condition of soil health; higher prices in selected crops like groundnut, pulses, spices; Better economics of seed producers

The underlying theory of change was articulated by DSC at various forums as shown in Figure 2-1. The figure shows how agriculture which was increasingly becoming unviable for the marginal farmer and non-sustainable in the long run due to continuous and indiscriminate use of chemical inputs could be transformed through a series of measures aimed at stabilising cost and production to start with and improving price realisation through collective marketing and value addition at a later stage. The end state would be more sustainable agriculture where farming for marginal farmers would once again become economically viable.

The same figure shows how a pyramid structure of people's institutions would prove instrumental in achieving this change. Phase 1 saw the creation of the base of the pyramid which ultimately gave rise to the FPO in Phase II. More than 300 Kisan Clubs/ Producer Groups were formed in 132 villages including 240 male groups and 60 women groups. Six Taluka/ Block level Associations have been formed and these are playing a role of intermediator between Kisan Clubs and the Apex level company. These groups have a total saving of Rs. 40 lakhs and they are linked with KPCL for agricultural input supply and aggregation of outputs for collective marketing.

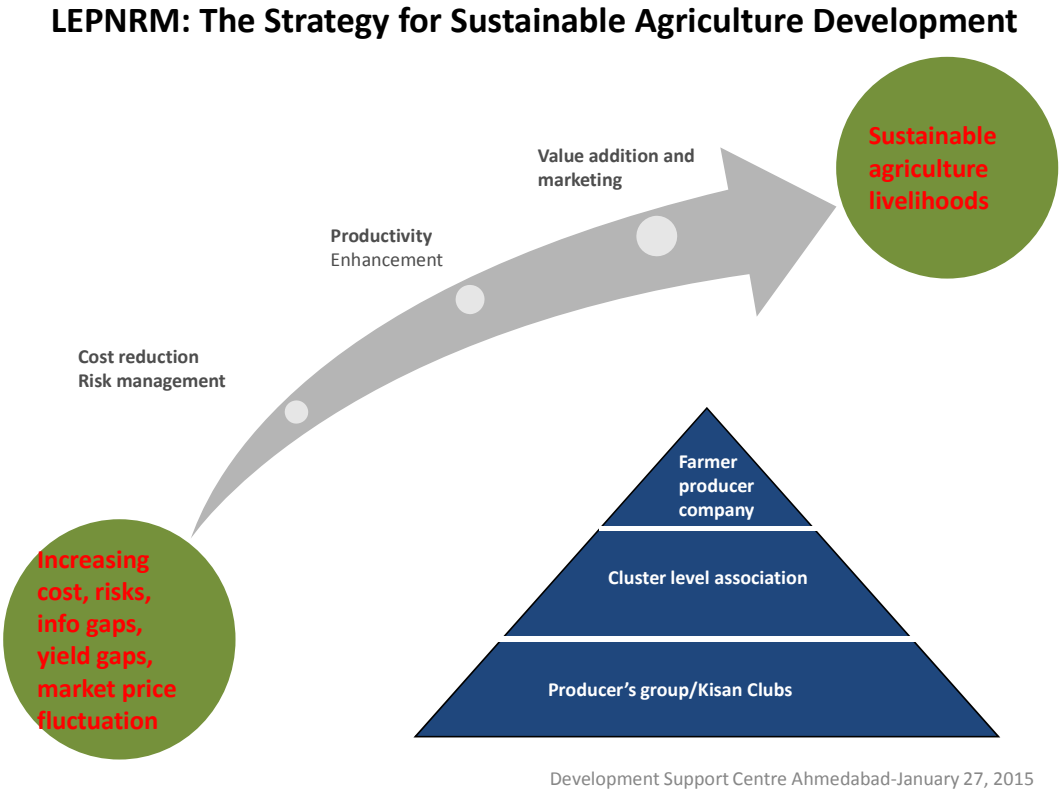


Figure 2-1: Theory of Change articulated by DSC

An attempt has been made in this section to elaborate this theory further and to highlight the fact that it uses a value chain approach for promoting and strengthening farm based livelihoods. This elaborated framework provides a conceptual frame to understand the progress made so far and strategic plans being made for the next phase of interventions.

Conceptual Framework

Based on the understanding of LEPNRM I and II as well as work being carried out by FPOs elsewhere in the country, a simple three-stage conceptual framework can be proposed that underlines a value chain development approach to livelihood promotion (Figure 2-2) viz.:

(1) *Stabilising Cost and Production:* This is the first step which involves dealing with production risks, reducing costs and enhancing productivity through a variety of measures including new technology, building a sustainable asset base, capacity building of farmers and producer groups. It also involves creating market orientation as well as a vision for sustainable agriculture. Much of this was accomplished in LEPNRM I, through DSC's extension work for which the Kisan Clubs became the

nerve centers. This work has been continued and expanded further in the second phase of the programme.

(2) *Understanding and Dealing with Markets:* This involves creating market linkages through a process of aggregation, market intelligence and negotiation in the market place. It can include backward linkages for collective procurement of quality inputs as well as forward linkages for collective marketing of produce. Considerable progress has been made on creating backward linkages during LEPNRM II, while a good beginning has been made in establishing forward linkages. The successful establishment of Krushidhan the FPO has made this possible.

(3) *Moving up the Value Chain:* This is the final stage where farmer's institutions or farmer supported institutions take up backward and forward integration of various steps in the supply chain, enabling them to create and capture value, thereby dramatically improving their share in the terminal price. This is the logical step for moving beyond backward and forward linkages. Already in the seed sector and in supply of organic inputs, the first step of backward integration has taken place. In LEPNRM III or beyond, Krushidhan would aspire to move into this stage.

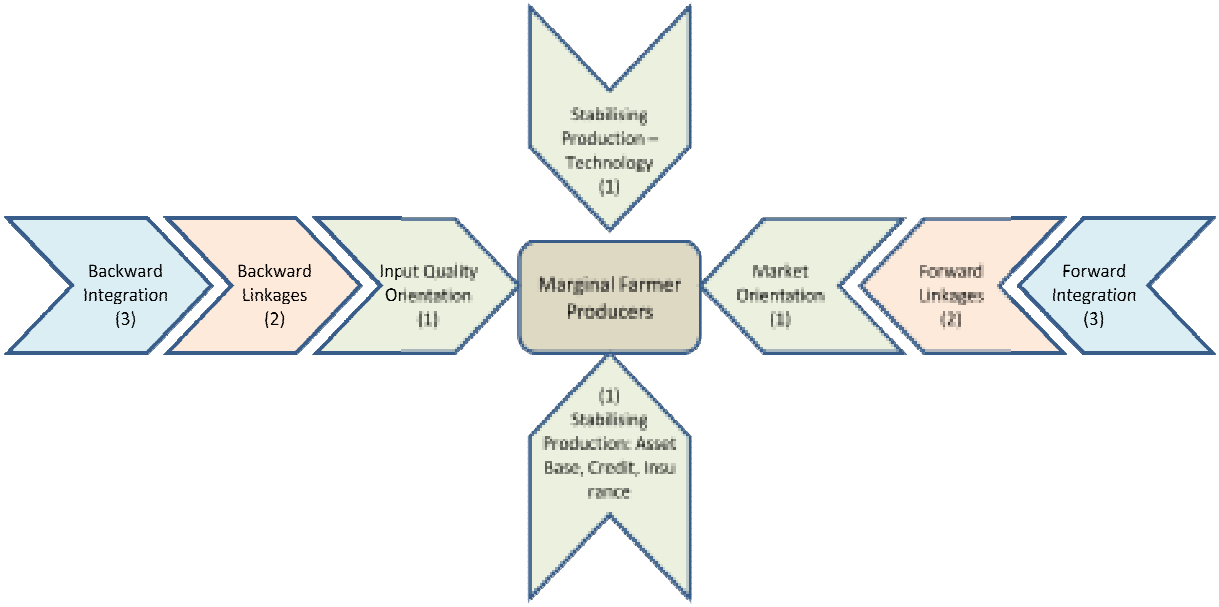


Figure 2-2: Conceptual Framework with VCD Approach

The framework suggests a logical sequence of steps through which VCD can take place. Depending on the particular situation in a sub-sector, some steps may be omitted or by-passed. For example in the tasar silk value chain promoted by PRADAN and CSB, CSB was the only supplier of seed material, hence to scale up, backward integration became essential. Invention of reeling machines made it possible to forward integrate in ways that poor producers could benefit.

In some sub-sectors it may not be possible to progress beyond a particular point on account of various reasons such as:

- Severe entry barriers
- Severe competition including indulgence of malpractices by competitors
- Absence of suitable technology
- Consumer preferences – e.g. in poultry broiler market, consumers in many parts of India have a strong preference for fresh rather than processed/cold storage birds

Sometimes depending on available opportunities backward linkages may happen before forward linkages and vice-versa.

Criticality of People's Institutions

To make a VCD intervention succeed, a development agency must invest heavily in the facilitation of appropriate people's institutions and governance structures at different stages of aggregation. Typically the need for institutions is felt as the intervention moves from primary production stage to marketing and value addition stage. Hence marginal farmers need to come together in the *spirit of collaboration to meet common goals* of dealing with the markets and building capacities to absorb new technology and develop new organizational skills. Producer groups then need to collaborate at a cluster level, which in turn collaborate to create an area level organization that would be large enough to make a dent in the local markets. At an even higher level of aggregation, FPOs could collaborate to form an apex state level company to deal with market opportunities in a pro-active manner.

People's institutions play an important function of governance and maintaining cohesion within the members for collaborative action. Table 2-2 provides an illustrative list of PIs for different levels of aggregation and at different stages in VCD.

Table 2-2: Illustrative List of PIs for Value Chain Development

Stage	Village Level	Cluster Level	Area Level
Stabilising Production	SHGs for credit; Producer Groups for technology absorption	Cluster level Organisation (CLO) for technology absorption (if needed)	Federation of SHGs to mobilize credit from banks (if available)
Market Linkages and collective marketing /procurement	SHGs; Producer groups	CLO for demand aggregation and collective supply of inputs; for collective marketing initiatives	Farmer Producer's Organisation (FPO) with membership of PGs and /or SHGs; employing professionals for marketing; to establish backward and forward linkages
Backward and Forward Integration	SHGs; Producer groups - some of which may specialise in quality inputs like seed material, organic inputs etc.	CLO for absorption of new technology, creating new linkages, continued collective procurement and marketing	FPO with reliable market linkages; employing professionals for marketing and processing technology; Strategic tie-up with a social entrepreneur or creation of special marketing organisation with stakes of FPO in it

Many agencies that are target driven often fail to invest sufficiently in building these institutions. To compound matters there is a dearth of professionals willing to work for farmer's institutions. Neglecting investment in the chain of people's institutions so necessary for VCD, often leads to failure. Fortunately DSC being a pioneer in the field of participatory natural resource management is fully aware of this pitfall and has paid adequate attention to building suitable farmer's institutions.

To contextualize the discussion, a three stage diagram is presented that brings out the role of various people's institutions under LEPNRM. These are presented in Figure 2-3 to 2.6.

Stage 1

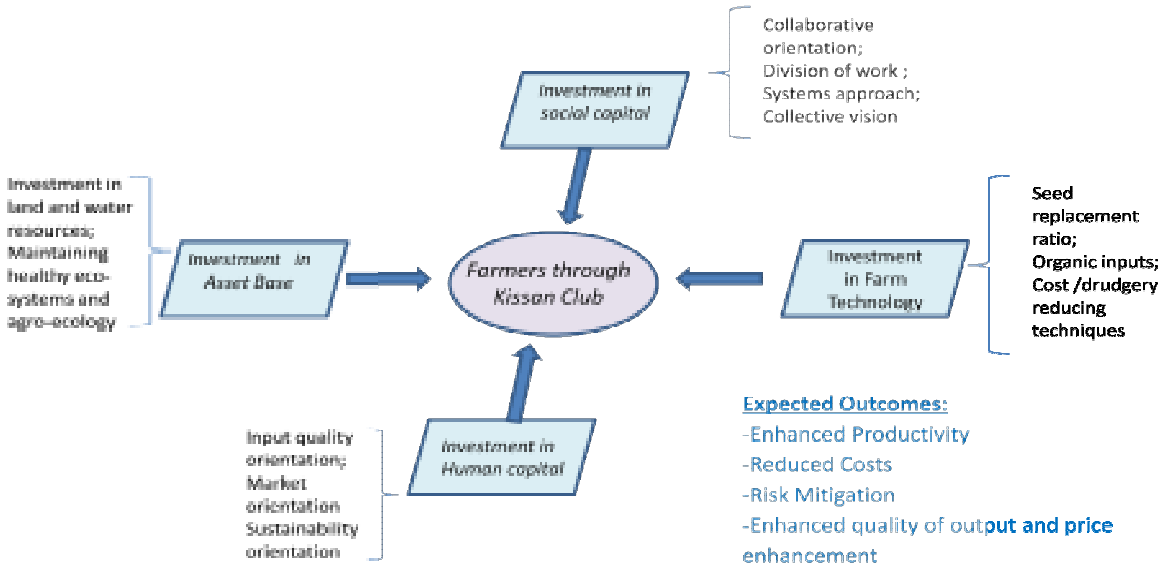


Figure 2-3: Stage 1 – Stabilising Production

As seen in Figure 2-2, Kisan Clubs which are producer groups of 8-12 like-minded and interested farmers became the focal point for introducing change through a range of interventions designed to:

- Enhance productivity of land and water resources
- Reduce cost of production
- Mitigate risks
- Enhance quality of output and resultant price realization

Investments in hardware (land improvement, new seeds, technology, equipment etc.) were suitably balanced with investments in software (capacity building not only to absorb new technology, and work together in the spirit of cooperation but also to develop input quality orientation, market orientation and a vision of sustainable agriculture). This was brought out clearly in the LEPNRM – I review report (2011) as reproduced in Table 2-3 below.

Table 2-3: Framework of assessment used in LEPNRM-I

Sl no.	Activity	Strategy Elements					
		Cost Reduction	Productivity Enhancement	Price Increase	Risk reduction	Social capital	Human capital
1	Participatory extension system (PES)	√	√	√	√	√	√
2	Seed production and supply by farmers	√	√	√	(√)	√	√
3	Input supply by federations (bulk procurement)	√	√	√	(√)	√	√
4	Supply of organic inputs by farmers/ women's SHGs a) Vermi-compost b) bio-pesticide	√	√	√	√	√	√
5	Soil testing	√	√	-	√	√	√
6	Supply of low cost agricultural tools and equipment i.e. drip	√	√	(√)	√	√	(√)
7	Rainfall/ weather insurance	_	_	_	√	√	_
8	Market linkage (cotton)	_	_	√	(√)	√	(√)
9	Contract farming (potato)	_	√	√	√	_	√
10	Local processing and marketing of produce (spices)	_	_	√	√	√	√
11	Credit through women's SHGs	√	(√)	_	_	√	√

(√) – Implies partial impact or impact in some cases

Stage 2

Figure 2-4 shows the emergence of KPCL or Krushidhan FPO as an area level institution to take up the challenge of dealing effectively with markets through establishment of both backward and forward linkages.

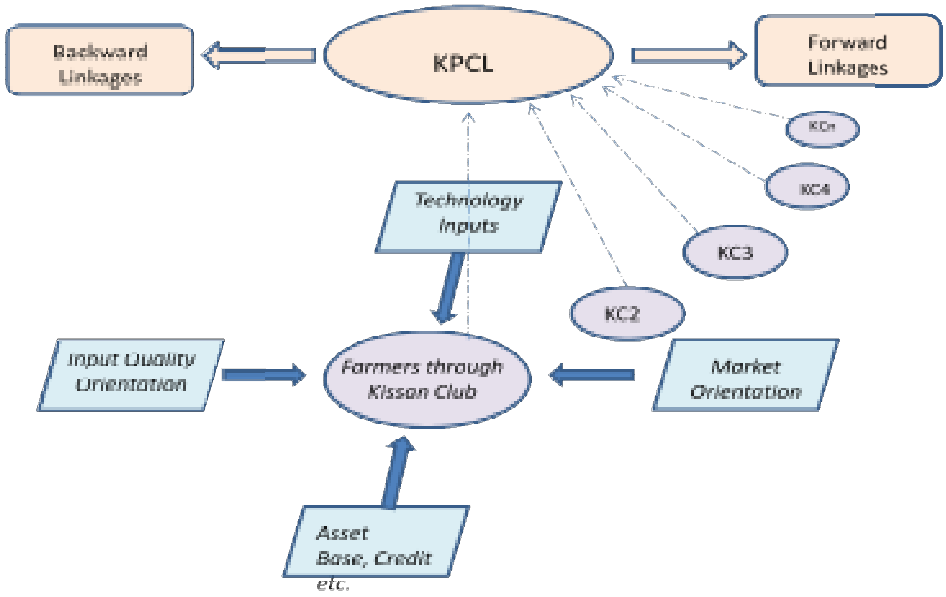


Figure 2-4: Stage 2 – Dealing with Markets

While trying to establish backward and forward linkages, Krushidhan soon realized the importance of having an intermediate body that would link it with the farmers and bring down its operational costs. Hence for a cluster of 8-10 villages a "cluster committee" was formed with representatives of different Kisan Clubs. These committees carry out the function of organizing demand aggregation and physical supply of agri-inputs as per the requirements of the farmers within their cluster. In due course these informal committees are likely to assume greater significance and may become formal entities in their own right. In Figure 2-5, the diagram is suitably modified to include cluster committees as intermediate institutions.

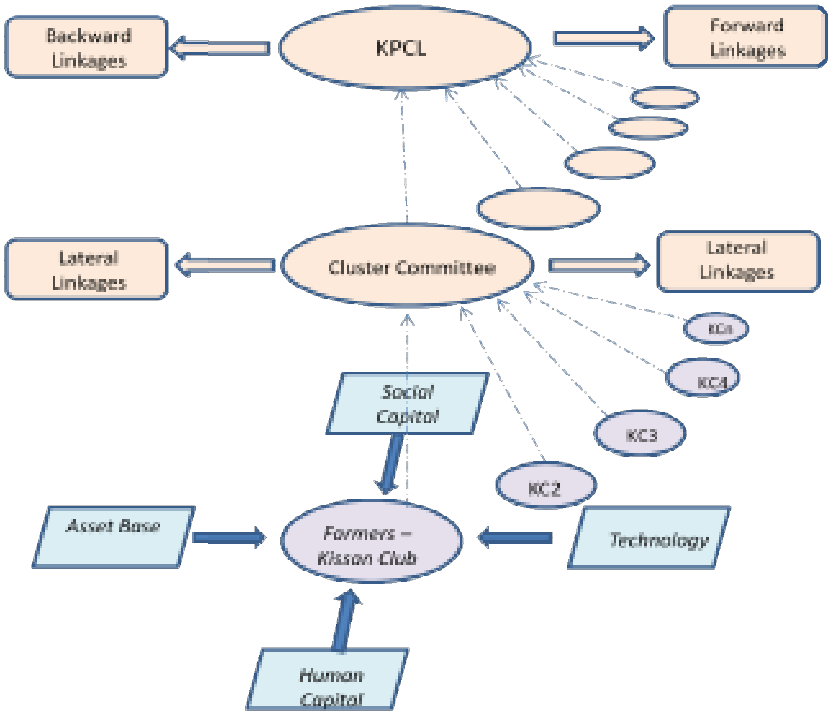


Figure 2-5: Stage 2 - Development of social capital to deal with markets

Figure 2-6 shows the institutional arrangements in Stage 3. In a more advanced stage, the arrangements are modified somewhat with the likelihood of a specialized marketing agency joining the value chain in order to reach distant or niche markets (Figure 2-7).

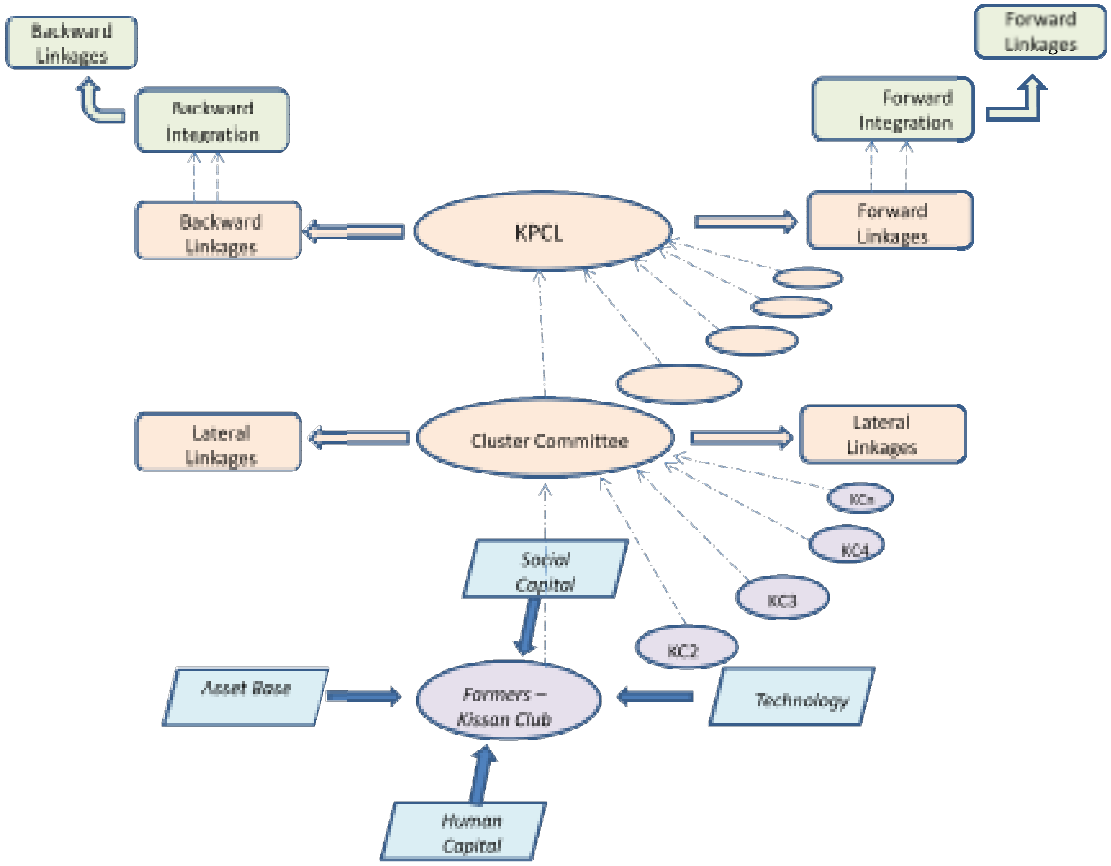


Figure 2-6: Stage 3 - Exploiting Markets

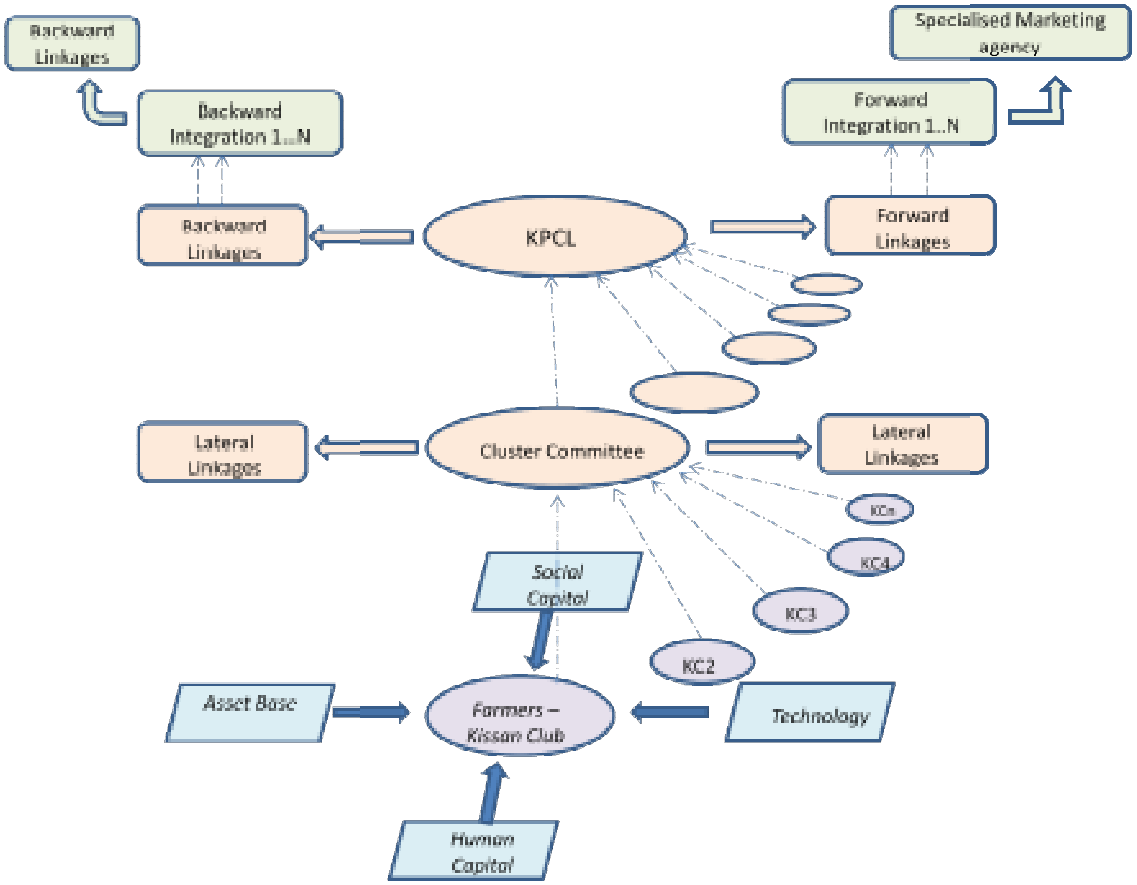


Figure 2-7: Stage 3 (advanced) - Exploiting Markets

3 DSC's Extension System under LEPNRM-II

3.1 Coverage

Although the project area remained the same, during LEPNRM phase II, the extension system was expanded very significantly to cover 32,300 farmers from 151 villages. The total area of farming covered was about 45,500 Ha (Table 3-1). As can be seen from the break-up of coverage across the five project units, Visnagar takes the lion's share with neighbouring Himmatnagar coming a distant second. More significantly, the coverage of Visnagar both in terms of farmers and area covered is greater than all the other four units put together.

Table 3-1: Coverage of Extension in LEPNRM II

Sl. No.	Name of Block	No of Villages	No of farmers	Total area (Ha)
1	Kujad	18	3000	5000
2	Visnagar	69	19500	25000
3	Modasa	18	3000	5000
4	Himmatnagar	28	4500	7000
5	Meghraj	18	2300	3500
	Total	**151**	**32300**	**45500**

The coverage of crops under three different seasons viz. Kharif (monsoon), Rabi (winter) and Zaid (summer) for all five units under the project is summarized in Table 3-2.

It may be noted that wheat, a rabi season crop, occupies the top position with a coverage of 19135 Ha. The project area has an advantage in as much as a Wheat Research and Extension Center of the ICAR is located there. The scientists at the center are extremely responsive and the DSC team at Visnagar has established an excellent rapport with them. In addition, wheat being a thermal sensitive crop has of late been affected by climate change. An increase in about 1 degree C and delay in monsoon are some of the aspects of climate change which are affecting crop productivity. The center has identified new varieties and changes in package of practices that farmers can adopt as an adaptation to climate change. Wheat being a major food grain is also important for the food security of the farming community.

The second position is occupied by fodder in summer season with coverage of 13615 Ha, thus signifying the importance of animal husbandry in the farming systems of the region. Fodder is cultivated in all three seasons but the fodder crops are different in each season. In kharif, crops like jowar are used as green fodder and paddy straw is used as dry fodder; in rabi season, Lucerne (alfalfa) is a popular green fodder which continues till mid-summer as the last harvest is done in March-April. Wheat is commonly used as dry fodder.

During the past two years, the Gujarat Agricultural University has introduced new fodder crops such as *makkhan* grass which the farmers have taken to very enthusiastically. According to the farmers with whom the authors interacted, unlike Lucerne it is not susceptible to insect attack. The leaves are very soft and are much preferred by the animals. The seed costs less than Lucerne seeds. Finally the milk produced has higher fat content by about 1%. A farmer with three animals can get an increased income of Rs 400/day. This bodes well for DSC's thrust to replace chemicals with bio-inputs as a boost in animal husbandry will mean greater availability of organic manure and bio-pesticides.

Table 3-2: Coverage of Crops under Extension for three seasons (Ha)

Crop	Kharif	Rabi	Zaid
Cotton	11390	11390	-
Castor	10390	10390	-
Bajra	2500	-	4000
Maize	1750	-	-
Paddy	3070	-	-
Groundnut	3450	-	1205
Fennel	2500	4100	-
Fodder	4190	5160	13615
Pulses	4335	-	-
Vegetables	1820	1210	1425
Others	315	-	-
Wheat	-	19135	-
Chana	-	805	-
Tobacco	-	3200	-
Potato	-	1000	-
Total	**45465**	**45500**	**20245**

The third and fourth positions are occupied by cotton - a cash crop and castor - an oilseed crop. Both cotton and castor are grown in kharif season but last till the end of winter. Both are cultivated as cash crops. Cotton has been the highest consumer of pesticides. During the past decade, the introduction of genetically engineered Bt varieties of cotton had made the crop resistant to attack from bollworms. However, as the prescribed precautions of maintaining a buffer strip all around the crop has not been followed in most places, the crop of late has shown signs of becoming susceptible to pink bollworm. As a result the expenditure on cotton pesticides has increased to some extent.

3.2 Main Features of the Extension System

An agriculture extension system provides both, knowledge inputs as well as material inputs or access to the same. In this case the knowledge inputs are largely provided by a team of trained workers from DSC through their field offices. DSC also tries to link up with research institutions and provide farmers with

exposure not only through demonstration on farmers' fields but also through exposure visits to successful farmers and research stations elsewhere in the state or country. It also organizes training camps for certain themes, skills or technologies with which farmers may not be familiar. Finally it has established an SMS based advisory which provides critical information during the season to farmers on their cell phone.

There is a direct linkage with the work of the extension team and that of Krushidhan Producer Company. The company makes sure that those seeds of varieties prescribed by the extension team are available in its retail outlets. Similarly as per the outbreak of pests and diseases, the suggested agri-inputs are made available in a timely manner and at the lowest possible price. In the case of bio-inputs, the excess production is purchased from producer groups and sold under the banner of the company. The company also sells equipment that can greatly reduce the drudgery of women and other labourers while improving their efficiency and reducing cost of labour. The range of inputs provided by the extension system and their expected impacts on farming is summarized in Table 3-3.

Table 3-3: Summary of extension work and expected impacts

No.	Type of Knowledge input	Conjunctive use of Producer company	Expected Impacts on marginal farmer
1	Demonstration/ Trial on farmers field for: - Package of practices for a given crop or variety - Introduction of new crop or variety - New techniques such as SRI in paddy	Timely supply of seed or planting material Timely supply of all other agri-inputs	Increased productivity; Reduced cost
2	Adjustment in crop variety, date of sowing, method of sowing etc. to deal with climate change	Timely supply of new variety seeds	Risk reduction
3	New measures, techniques or technology to deal with menace of ungulates like wild boar, neelgai etc.	Linkage with suppliers of new technology	Risk reduction
4	Introduction of new tools and equipment to reduce drudgery and cost of labour	Supply of those tools and equipments through company outlets	Cost and drudgery reduction
5	Promoting self reliance in seed supply through backward integration in production of certified and foundation seed	Company procures seed produced and supplies to interested farmers	Better price realisation and better income
6	Substituting chemical inputs with bio-inputs in agriculture to the extent possible	Supply of bio-inputs not available locally; Procurement of surplus production of bio-inputs from producer groups	Improved soil health and productivity; Long term sustainability of agriculture

7	Self-reliance in supply of bio-inputs through producer groups and women's SHGs	Procurement of surplus production of bio-inputs from producer groups	As above; Also alternative livelihood for poor women/ farmers
8	Cleaning and grading of produce before selling with the help of new technology	Supply of new equipment and after sales services	Better price realisation
9	Cottage industry for producer groups to add value to local produce before selling in the market	Branding and marketing through common outlets of the company	Better price realization; Alternative livelihood for the poor
10	Demonstration of drip-irrigation technology and other water conservation techniques	No role at present as DSC facilitates direct linkage of farmers with suppliers	Reduced cost, improved water use efficiency, better productivity, better soil health

Of the categories listed in the table above, the most important are demonstration of new crop technology (1 and 2), self reliance in seed production (5) , substituting chemicals with bio-inputs (6 and 7) and improved water use efficiency (10) as these have been implemented on scale. The rest are mostly on pilot scale or trial basis, but which are promising and should assume larger proportions in the near future. We discuss the extent of adoption and the progress made in some of the more important ones in the following section.

As discussed earlier, DSC uses a combination of methods to reach out to the farmer and build the capacity of the farmer to adopt new technology that not only improves the economics of farming but also makes it ecologically sustainable. The appropriate mix of methods depends on the local culture and preferences of farmers. Table 3-4 shows the full range of methods used and the extent of participation of farmers in these extension/capacity building events. As the table shows, over 73,500 individuals participated in 2891 events during Phase II of the programme. The most important of these from the point of technology extension were demonstrations, exposure visits, farmer workshops and training (1 to 5). The other events (6 to 9) were more to do with capacity building for people's institutions including Kisan clubs at the grassroots level and KPCL as the apex institution.

Table 3-4: Range of extension methods used by DSC

Sl . No.	Type of event	No of events organised	No of Participants
1	Demonstrations/ trials in farmers' fields	1308	10,331
2	Exposure visits for farmers	153	1,955
3	Farmer meetings/ workshops	642	12,303
4	Training	215	3,218
5	Night video shows	262	9,998
6	KPCL awareness campaign	106	32,400
7	Cluster level shareholder sammelan	119	2,104
8	Special sammelan for women shareholders	44	304
9	Inauguration of Kisan Club by NABARD officials	42	1,198
	Total	**2891**	**73,811**

3.3 New Technology: Extent of Adoption

Adoption of New Crop Production Technology

Table 3-5 shows the impact of field demonstrations on farmers based on the adoption rate and area of adoption under different crops. The rate of adoption is calculated as the proportion of farmers adopting the technology in their own fields after getting exposed to it at the field day. The results show that out of more than 15 crops for which demonstrations were carried out, the adoption rate has been more than 40% for all except two. The adoption rate was more than 100 percent for fennel and more than 200 percent for groundnut. This shows that farmers who had visited the demonstration went home and shared the information with others and induced them also to adopt the package of practices demonstrated. It could also mean that some farmers adopted the following year after seeing the performance of first time adopters in their village. This depends on when the demonstration was carried out. Whatever be the case the extension team needs to be congratulated for achieving such high rates of adoption.[1]

[1] It is not known however what criteria were used for determining whether a person has adopted a technology or not. In most POPs there are a few "non-negotiables" which must be implemented for the farmer to be classified as adopter. Very often farmers choose to adopt some and not all of the prescriptions in which situation it would be a case of partial adoption. On the other hand some farmers exposed to the technology may not adopt the same year due to some factors beyond his/her control (e.g. weather not suitable, seeds not available, lack of credit etc.). When these constraints are removed he/she may adopt the technology the following year – which would be a case of delayed/ deferred adoption.

Table 3-5: Extent of adoption resulting from Field Demonstrations

Crop	No. of Demos	No. of field days	No. of participants in field day	No. of farmers adopted POP	% adoption	Area in Ha
Cotton	178	97	2255	1287	57	565
Castor	62	32	680	467	69	225
Wheat	434	72	1633	1066	65	446
Organic wheat	97	45	1287	76	6	47
Maize	19	16	585	453	77	168
Sorghum fodder	15	9	140	58	41	12
Fennel	25	9	181	252	139	60
Groundnut	24	27	471	1080	229	576
Cumin	17	4	96	2	2	0
Chana	63	10	187	123	66	47
Mung	12	5	64	35	55	7
SRI Paddy	38	10	387	186	48	86
Makkhan ghas (new fodder crop)	56	26	734	490	67	35
Madhyam	197	24	556	294	53	280
Other	71	64	1075	498	46	119
Total	**1308**	**450**	**10331**	**6367**		**2674**

The table shows that the extent of adoption has been in 2674 Ha of agricultural land by over 6350 marginal farmers. It is to be expected that there would be a multiplier effect as during subsequent years more farmers would try to emulate the successful first time adopters.

Backward Integration: Seed Production by farmers

The project has seen adoption of seed technology, mainly in wheat crop – first for truthful seed and more recently for certified and even foundation seed. Although the quantum of seed produced is still not very big, farmers have gained sufficient confidence during the past three years to be able to take it up on a bigger scale. This kind of backward integration is very important from the economics point of view as farmers who produce the seed get more remunerative prices. Farmers who buy that seed from the producer company also gain by getting timely supply of certified seed at a reasonable price.

Table 3-6 summarises the experience of becoming self-sufficient in seed supply at least in one crop to begin with. The figures show that while many farmers were involved in production of truthful seed, only a handful have ventured into certified and foundation seed production. This is because the quality standards are more stringent in the latter and therefore the risk of the lot getting rejected is higher. There has been a shift from production to truthful seed to certified seed during the last year. This aspect and the reasons for the same are discussed later in the section on impacts of extension system.

Table 3-6: Adoption of seed production technology in wheat

Type of wheat seed	Production in tonnes	No. of farmers producing seed	Additional income to seed producer (Rs lakhs)	Area to be covered (Ha)	Increase in production of wheat (tonnes)	Additional income to farmers using the seed* (Rs. Lakhs)
Truthful seeds	155.7	151	15.6	1235	1037.7	228
Certified seeds	46.9	11	2.3	372	312.7	63
Foundation seeds	2.8	10	0.43	23	19.0	5
Total	205.4	172	18.33	1630	1369.4	296

*Estimated on the basis of additional yields ranging from 10% to 40% realized by using certified/truthful seed material

Shift from Chemical to Bio-Inputs

Given the steady deterioration of soils in the project region due to continuous and indiscriminate use of chemical fertilizers as well as the harmful impact of pesticides on the local agro-ecology, a need was felt to gradually steer farmers towards rationalization of the use of chemical inputs. Hence soil-testing based prescriptions were made for the appropriate dosage of chemical fertilizers. Conjunctive use of vermi-compost and other bio-fertilizers was promoted. Adoption of bio-pesticides was advocated with chemical pesticides to be used as a measure of last resort. To achieve this, producer groups and women's self help groups were encouraged to produce these inputs at the village level and supply them to farmers locally. In this way the farmers would be assured of getting good quality of inputs without incurring additional cost on transport of the material which is bulky in nature. The efforts made in promoting bio-inputs and the extent of adoption by farmers in the project area is summarized in Table 3-7. The table shows that over 1860 demonstrations led to about 3500 farmers adopting the use of bio-inputs in approximately 3,250 Ha of land.

Table 3-7: Adoption of Biological Inputs for Sustainable Agriculture

Bio-input adoption	No. of demos	Demo area (Bighas)	No of farmers Adopting Bio-inputs	Area of Adoption	
				(Bighas)	(Ha)
Vermi application	984	234	1,968	7,872	1,874
Bio-pesticide application	880	262	1,554	5,828	1,388
Total	1,864	496	3,522	13,699	3,262

Table 3-8 shows how this was produced within the farming community itself, thereby eliminating the need to import these inputs from other regions. The figures suggest that some farmers have imported vermi-compost from neighbouring areas as the estimated area with local production is much less that estimated area of adoption. The reverse is true for bio-pesticide, suggesting that some bio-pesticide produced may have remained unsold or sold to outsiders. It is also possible that the real adoption may

be underestimated by DSC. These discrepancies could also partly be explained by the fact that the rate of application of bio-inputs vary from farmer to farmer quite a bit depending on a number of factors including type of crop, planting density, quality of bio-inputs obtained and cash available with the farmer to procure the input.

Table 3-8: Production of Bio-inputs by Farmers and Producer groups

Bio-input production	No. of producer groups	No. of members	No. of beds	Production	Area covered (Bighas)
Vermi-compost					
Group	19	248	522	745 (tonnes)	1862
Individual	-	157	384	1170 (tonnes)	2926
Total			405	1915 (tonnes)	4788
Bio-pesticide					
Group	45	780	-	31200 (litres)	7800
Individual	2	30	-	17200 (litres)	4550
Total					12350

Adoption of New Tools and Equipment

In addition, 176 *chipiyas*[2] were sold resulting in savings of an estimated 4400 person days of labour, valued at Rs 8.8 lakhs. Also sold through the outlets of the company were 245 cutters and 15 spray pumps.

Adoption of Cleaning and Grading of Produce

This initiative has been taken up on pilot scale but should prove very important in the next phase of LEPNRM when the company moves into aggregation of produce for collective marketing so that farmers may realize a better price for their produce.

Cleaning and grading machines have been procured and given to a few villages so that farmers may get their produce cleaned and graded for a small fee before selling in the market. A beginning was made with wheat where 790 farmers paid to get the services of the machine. Similarly 54 farmers go to Jagudan to get their fennel cleaned and graded. The details and benefits accrued through this initiative are summarized in Table 3-9.

[2] A *chipiya* is a hand tool used to uproot crop stubble without having to bend or apply much force. This greatly reduces the drudgery of labour and even women can use the hand-tool to save the cost of hiring labour.

Table 3-9: Summary of Cleaning and Grading Activity

Produce	No of farmers adopting	Quantity of produce graded (tonnes)	Income (Rs. Lakhs)
Wheat	790	533.10	10.66
Jagudan fennel	54	22.26	2.23

3.4 Role of Kisan Clubs and Producer Groups

During LEPNRM Phase I, DSC focused on building small groups of interested farmers. The groups were called Kisan Clubs where they would meet to discuss issues of common interest in improving their farming and making it economically viable. New ideas were first seeded in these groups. Later these groups became more proactive and started influencing other farmers in the village. The groups also took an active part in distribution of agri-inputs and in organizing aggregation of produce when collective marketing initiatives were taken. Hence these groups at the grassroots level provided the foundation not only for the extension work but also became the foundation of the producer company, which has a pyramid structure with Kisan Clubs at the base, cluster level committees at the cluster level and Krushidhan as the apex level institution with a representative board of directors.

Aligned to this structure were producer groups and women's SHGs who also supported the company and worked with it closely. Table 3-10 provides the break-up of these informal grassroots level institutions that have played a pivotal role in the success of the intervention as well as producer company.

Table 3-10: Grassroots level institutions forming the base of the company

Sl No.	Type of Institution	No. of institutions	No. of members
1	Kisan Clubs (Male)	235	4607
2	Women Kisan Clubs cum SHGs	91	1479
	Total	**326**	**6086**
	Special purpose produce groups		
1	Spice producer groups (women)	19	102
2	Bio-pesticide producer groups (women)	45	780
3	Vermi-compost producer groups (women)	19	248
4	Group fencing farmer groups (men)	2	73

As the table shows producer groups fall into two broad categories a) Kisan clubs of male farmers and b) Women Kisan clubs cum SHGs. The total number of such institutions created till date is about 325 with a membership of over 6000 individuals. Some of these are special purpose producer groups, bio-inputs being the largest among these. Producer-groups for group fencing are the most recent addition. It is a response to the growing menace of ungulates destroying valuable crops. If this solution is found effective the numbers of such groups is likely to grow rapidly in the coming months.

4 Impact on Economics of Farming

This section summarises the findings from the sample survey in four broad sections:

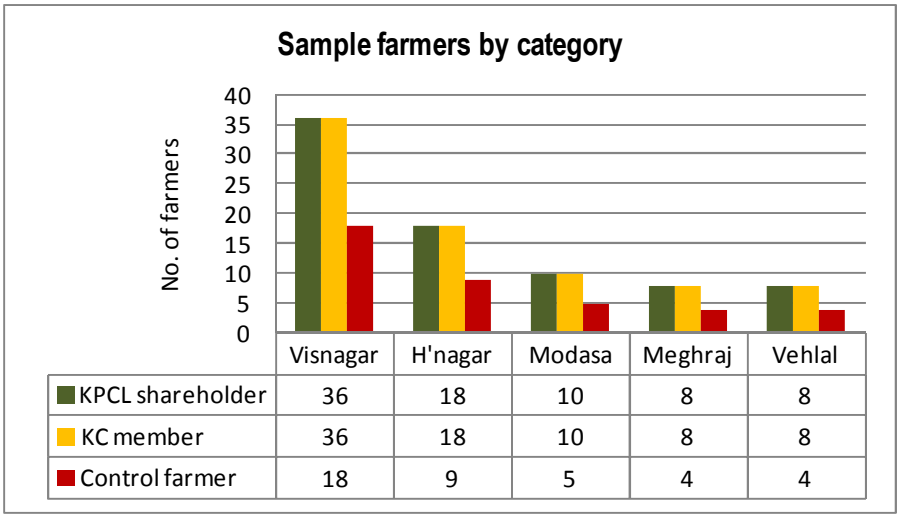
1. Profile of farmers in sample
2. Effectiveness of agriculture extension services
3. Study area-level impacts
4. Project-level impacts

4.1 Profile of Farmers in Sample

Farmer and land details

As indicated in Section 2 above, a primary survey of 200 farmers was conducted as part of the impact assessment study. These farmers consisted of project beneficiary farmers (i.e KPCL shareholders and Kisan Club members) as well as a control group made up of ordinary farmers. The break-up of the total sample by category of farmers is shown in Figure 4-1:

a. KPCL shareholders: 80
b. Kisan Club members: 80
c. Control farmers: 40



	Visnagar	H'nagar	Modasa	Meghraj	Vehlal
KPCL shareholder	36	18	10	8	8
KC member	36	18	10	8	8
Control farmer	18	9	5	4	4

Figure 4-1: Sample farmers by category

Figure 4-2 shows the total land under cultivation in each project location where it can be seen that the average land cultivated per farmer is lowest in Meghraj at 1 Ha and highest in Himmatnagar at 2.3 Ha. Between 80 to 100 per cent of the cultivated land is irrigated, with levels of irrigation ranging from 80%

in Meghraj (rain-fed) to 88% in Himmatnagar, 94% in Modasa, 95% in Visnagar and 100% in Vehlal - the last four locations benefiting from canal irrigation.

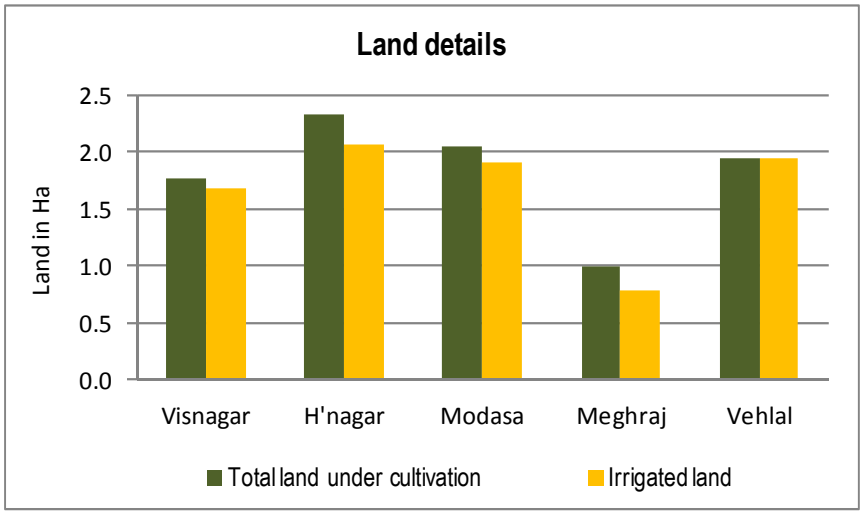


Figure 4-2: Land details

Ownership of milch and draught animals

An analysis of ownership of milch animals before and after the project in Figure 4-3 shows that while the number of milch animals has remained constant in Vehlal and increased by 62% in Meghraj, it has declined by 16% in Visnagar, 8% in Himmatnagar and 4% in Modasa. The number of draught animals has remained constant in Modasa and Meghraj but declined by 29% in Visnagar, 68% in Himmatnagar and 28% in Vehlal as can be seen in Figure 4-4. A number of reasons could be attributed to such a trend.

Milch animals require a lot of tending to, and dispersal and social change among the main farming community of *Patels* (which has traditionally reared milch animals) over the years has meant that this occupation is often looked down upon by younger members of the community who prefer to take up jobs in urban areas instead. Coupled with this, an increasing shift in cropping pattern toward commercial crops like cotton, castor, fennel etc. especially in North Gujarat, has affected fodder availability, in turn impacting ownership of milch animals.

Increasing mechanization in agriculture, especially where farmers have access to canal irrigation and are thus more assured of their crops, along with deficit of labour are seen as the primary reasons for the decline in number of draught animals.

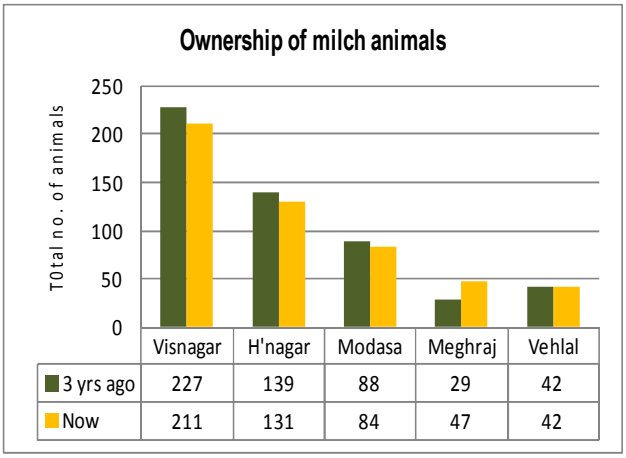


Figure 4-3: Ownership of milch animals

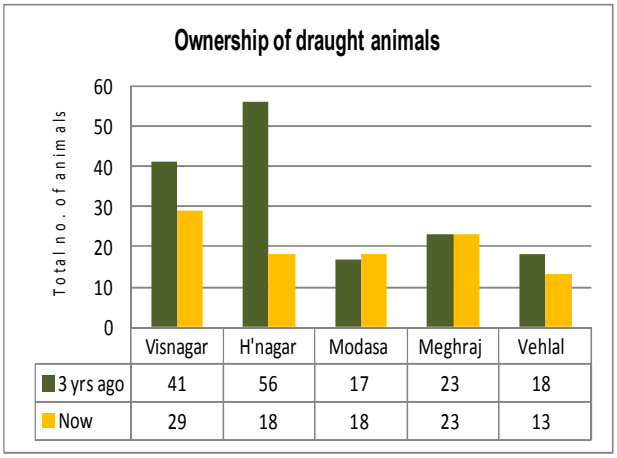


Figure 4-4: Ownership of draught animals

Wild animal menace

Over the past 3 years, increase in menace from wild animals such as nilgai and wild pig and resultant damage to crops has been reported by a majority of farmers – ranging from 94% in Visnagar to 84% in Himmatnagar, 80% in Vehlal, 75% in Modasa and 56% in Meghraj. The survey also discussed the measures farmers had taken to deal with wild animal menace and the effectiveness of the measures adopted.

Table 4-1 shows the level of adoption of the top 3 measures in each project location where the darkest coloured cell represents adoption by the highest proportion of farmers, followed by lighter and lightest coloured cells representing second and third highest proportion of adoption respectively. Two cells having the same shade in a project location mean equal levels of adoption. Table 4-2 indicates the percentage of farmers who found that measure highly or fairly effective. For eg., in the case of Visnagar, while use of poison has been adopted by the highest proportion of farmers, only 88% of the farmers have found this measure to be highly or fairly effective. Taking another example – in Meghraj, while the highest proportion of farmers has registered complaint about wild animal menace to the Forest Department (as represented by the darkest coloured cell), none of these farmers has found this measure to be effective (represented by the value '0' in Table 4-2).

To address the challenge of wild animal menace, DSC has recently experimented with group fencing in its Visnagar and Himmatnagar project locations, the cost-benefits of which are quite encouraging. Against a total investment of Rs. 15,000/- per acre for permanent group fencing of farmland, crop savings worth Rs. 3,000/- per season or about Rs. 7,500/- over the entire year have been achieved. Hence, it is possible to recover the entire investment of Rs. 15,000/- over two years. Besides group fencing, use of solar alarm fencing is also being piloted and results of its costs and benefits are awaited.

Table 4-1: Measures adopted to deal with wild animal menace

	Reg. complaint with FD	Poison	Bio-pesticide	Natural fencing	Wire fencing	Electric fencing	Cloth fencing
Visnagar							
Himmatnagar							
Modasa							
Meghraj							
Vehlal							

Table 4-2: Effectiveness of measures to deal with wild animal menace

	Reg. complaint with FD	**Poison**	**Bio-pesticide**	**Natural fencing**	**Wire fencing**	**Electric fencing**	**Cloth fencing**
Visnagar		88	90	62			
Himmatnagar			100	100			100
Modasa			88	88	57		89
Meghraj	0	100	100				100
Vehlal	0	73					100

Note: Figures indicate percentage of farmers

4.2 Effectiveness of agriculture extension services

Agriculture extension information

As part of the survey, project beneficiary farmers were asked about usefulness of the different mediums through which they had received agriculture extension information from DSC. Respondents were asked to rate their responses on a scale of 1 to 5 where '1' indicated 'least useful' and '5' indicated 'most useful'. A composite matrix based on the received responses has been prepared and is presented below.

Table 4-3: Composite matrix of usefulness of information received from DSC

Project location	Mobile SMS	Awareness campaign	Farmers meet/ workshop/ training	Para workers/ DSC staff	Print material	Video Films	Field days, exposure visits	Overall rank
Visnagar	3.3	3.0	3.5	4.5	3.4	3.0	4.1	**3.5**
Himmatnagar	3.3	4.6	4.3	3.9	3.4	4.1	4.1	**4.0**
Modasa	2.7	2.2	3.9	3.8	2.0	2.5	2.7	**2.8**
Meghraj	3.9	3.5	4.4	4.5	4.8	4.1	3.8	**4.1**
Vehlal	3.0	1.5	3.8	2.4	4.6	4.0	3.9	**3.3**
Overall rank	**3.2**	**2.9**	**4.0**	**3.8**	**3.7**	**3.5**	**3.7**	

As can be seen from the matrix, mobile SMS services are perceived to be most useful in Meghraj and least useful in Modasa. This may be due to the information vacuum faced by Meghraj farmers since no other developmental agency works in this remote, tribal area unlike Modasa which is more centrally located. Services of DSC staff and para workers are perceived as most useful in Visnagar and Meghraj but least useful in Vehlal as it has recently faced high turnover of para workers. Usefulness of awareness campaigns is seen to be highest in Himmatnagar but poor in Vehlal since DSC lacks human resources in this location which can ensure the effective design and delivery of such campaigns. Farmers' meets, workshops and trainings are found to be more beneficial in Meghraj but of least value in Visnagar. The most likely reason for this could be 'exposure fatigue' of farmers considering that Visnagar is DSC's earliest PIM location and has already witnessed a large number of such events. Print material consisting of pamphlets, crop booklets, *Divadandi*, farmer diary etc. are of high utility in Meghraj but of low utility in Modasa. Video films on the other hand are most effective in Himmatnagar and Meghraj but least effective in Modasa. Field days and exposure visits were found to be most useful in Visnagar and Himmatnagar, where farmers are more progressive and open to new knowledge and information, but least useful in Modasa.

The overall rank of usefulness of information by medium shows farmer meets/workshops/trainings as being most useful and campaigns as being the least useful source of information from DSC. Overall ranking of usefulness by project location shows Meghraj - where farmers have traditionally been information-deprived - benefitting the most and Modasa - where farmers seek higher order extension services and support - the least from information provided by DSC.

Willingness to pay for the information is extremely low among farmers across all project locations except in Himmatnagar where 90% of the farmers said they were willing to pay (Figure 4-5). In Modasa, none of the surveyed farmers was willing to pay. In terms of the amount they could pay for the information, Vehlal farmers said they could to pay a maximum of upto Rs. 130/- per month as compared to Rs. 84/- in Himmatnagar, Rs. 63/- in Visnagar and Rs. 41/- in Meghraj.

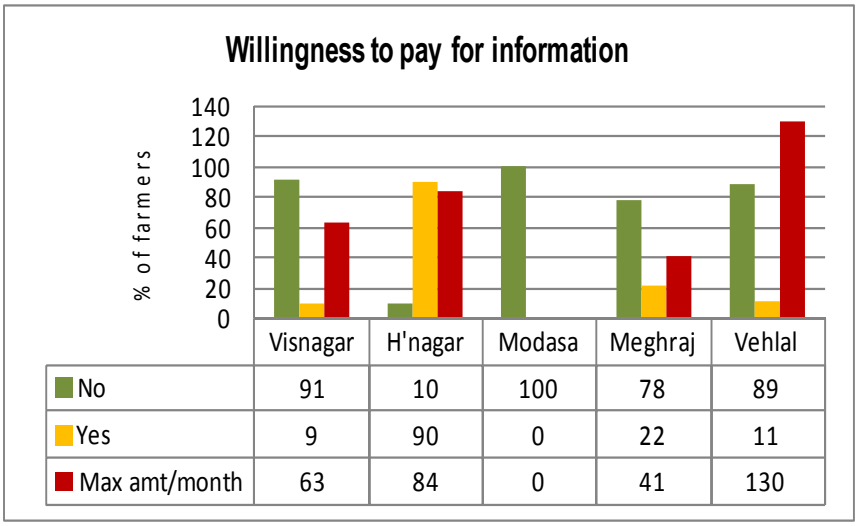


Figure 4-5: Farmer willingness to pay for information

Suggestions were received from farmers on how DSC could improve usefulness of the extension services it provides to farmers. While a majority (41%) of respondents said that they were satisfied with DSC's services, 21% of the farmers expressed the need for more advice and information, 10% want a specific set of services from DSC and 27% feel that the organisation should expand its outreach activities as can be seen from Figure 4-6. The suggestions received can be broadly divided into three categories:

i. Need for more information and advice – Farmers want DSC to provide more information, especially related to crops like cumin, fennel, castor, fruits etc. They would also like exposure to improved seed varieties, latest/low-cost agriculture techniques, more experience-sharing by successful farmers as well as information about available government subsidies. One of the key suggestions received was that DSC should make farmers more aware about the importance of putting such advice and information to use.

ii. Need for specific services – Farmers have expressed a need for DSC to provide a bouquet of specific services which could serve them better in the long-term. While some of these services like grading facilities for wheat and paddy, supplying good quality certified seeds and pesticides, helping farmers deal with wild animal menace by setting up fencing etc. are already being undertaken by DSC on a pilot or mainstream basis, a decision about other suggested services will have to be taken. These include distribution of fertiliser and assisting in the marketing of farmers' produce either through direct buying or facilitating market linkage so that farmers are able to get good prices.

iii. Need to expand outreach – Farmers feel that DSC needs to focus on expanding the outreach of its services by increasing KPCL's shareholder strength, setting up more Kisan Clubs and KPCL outlets, encouraging women's participation in meetings and organising meetings at times which are more convenient to farmers. They would also like the interaction with DSC – whether it is through

workshops, field days, exposure visits, trainings or video films – to increase and even non-member farmers to be brought under the fold of DSC's services.

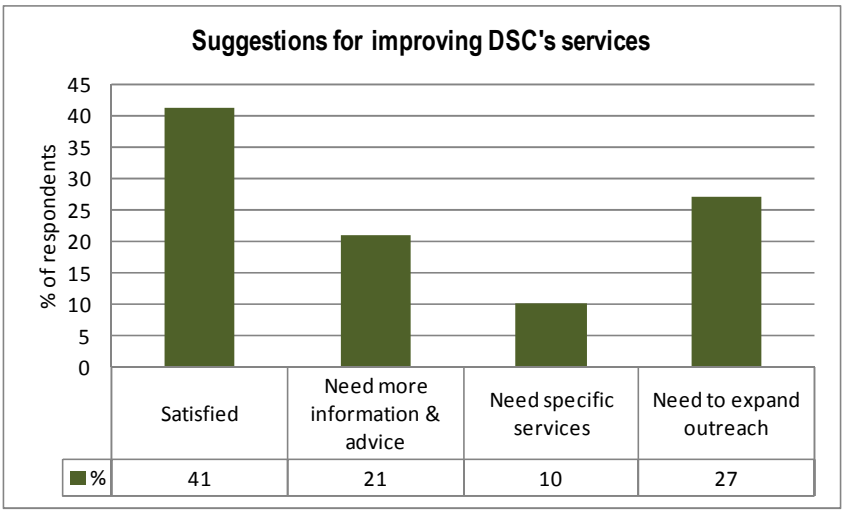


Figure 4-6 Suggestions for improving DSC's services

Membership of peoples' institutions

In order to better understand the effectiveness of project interventions, farmers were asked about their reasons for not joining a vermi-compost, bio-pesticide production group or a Kisan Club promoted under the project. These reasons are elaborated below:

Reasons for not becoming vermi-compost group member

Visnagar: Of the 20% farmers who responded, 47% claimed absence of vermi group in the village and another 47% said that they made their own vermi or bought FYM
Himmatnagar: Of the 74% farmers who responded, 92% said they have no time or space for vermi activity
Modasa: Of the 67% farmers who responded, 71% claimed absence of vermi group in the village and 21% had no time
Meghraj: Of the 67% farmers who responded, 40% said they do not have information and another 40% made their own vermi or bought FYM
Vehlal: Only 6% farmers responded, hence results not usable

Reasons for not becoming bio-pesticide group member

Visnagar: Of the 12% farmers who responded, 40% had no time; 30% claimed absence of bio-pesticide group/non-availability of *desi* cows in village and another 20% were not interested
Himmatnagar: Of the 11% farmers who responded, all respondents indicated that they were too busy and had no time for joining bio-pesticide group

Modasa: Of the 19% farmers who responded, all respondents claimed absence of bio-pesticide group or *desi* cows in the village
Meghraj: Of the 79% farmers who responded, 36% said they did not have information about bio-pesticide group; 36% made their own bio-pesticide or bought from KPCL outlet and another 27% were not interested
Vehlal: No response received

Reasons for not becoming Kisan Club member

Visnagar: Of the 57% farmers who responded, 50% were not interested and another 50% did not have information about Kisan Club
Himmatnagar: No response received
Modasa: Of the 43% farmers who responded, 67% had no time and another 33% were not interested
Meghraj: Of the 75% farmers who responded, 67% were already members of Sangam Mandli and another 33% did not have enough information
Vehlal: No response received

Farmers were asked to provide feedback on which activities of their Kisan Club they found most useful. According to the farmers, facilitation of agriculture input supply was the most useful activity undertaken by the Club, followed by savings and internal lending, crop advisory/information and exposure visits in that order.

Table 4-4 maps the reasons why farmers have not become a Krushi Dhan member. In the case of Visnagar, 28% of farmers are not interested in joining, another 26% do not have enough information about KPCL's activities and 24% are not even members of Kisan Clubs – a pre-requisite for KPCL's membership. In Himmatnagar, as high as 81% of the surveyed farmers claim that since they do not have adequate information about KPCL's activities, they do not feel inclined to become its member-shareholders. In Modasa, 78% of the farmers are not interested in becoming members while 22% feel that the membership fee is too high. The question of affordability becomes more pronounced in the case of Meghraj - a rain-fed area with poorer agricultural incomes – where 86% of the farmers are unable to pay KPCL's membership fee. 57% of farmers in Vehlal claim that the producer company outlet is too far whereas another 29% are not interested.

65% of the farmers feel that women should have greater participation in Krushi Dhan. However, of these farmers, only 24% would like to see women becoming a KPCL Governing Board member. 53% would like them to remain shareholders while 43% feel that women should only be service receivers in KPCL.

Table 4-4: Reasons for not becoming KPCL member

Project location	Cannot pay membership fee	Not member of KC	Inadequate info about KPCL's activities	Not interested	Outlet is too far	Interested in becoming member/paid share
Visnagar	13	24	26	28	2	7
Himmatnagar	0	0	81	19	0	0
Modasa	22	0	0	78	0	0
Meghraj	86	0	14	0	0	0
Vehlal	0	0	14	29	57	0

Note: Figures indicate percentage of farmers

Suggestions were also received from farmers regarding other services that KPCL should provide to its members. These include:

a. Creating a market for farmers' produce, preferably through direct procurement by KPCL
b. Having a permanent agriculture expert within KPCL to offer timely advice and information on how to deal with diseases and pests in different crops.
c. Advice on how to carry out animal husbandry scientifically
d. Assistance in grading, packing and marketing of spices and vegetables

Agriculture input supply

100% of the farmers in Himmatnagar and Meghraj, 92% of the farmers in Visnagar and Vehlal and 88% of the farmers in Modasa claim that agriculture input supply has improved as a result of the formation of KPCL. Table 4-5 shows the products in which input supply has improved in each project location. It can be seen that farmers across all locations have mostly experienced an improvement in supply of seeds and chemical pesticides due to KPCL, followed by bio-pesticides. Overall, KPCL's benefit in terms of bringing about an improvement in agriculture input supply is felt most clearly in the case of seeds, followed by chemical pesticides, bio-pesticides, vermi-compost and agriculture tools.

Table 4-5: Products whose supply has improved due to KPCL

Project location	Seeds	Chemical pesticides	Bio pesticides	Agriculture tools	Vermi compost
Visnagar	91	81	28	11	1
Himmatnagar	78	80	58	7	20
Modasa	75	33	25	17	13
Meghraj	75	75	50	30	25
Vehlal	45	55	10	0	20

Note: Figures indicate percentage of farmers

Farmers were also asked about the parameters on which they prefer KPCL over other market players for purchase of agriculture inputs. As per Table 4-6, fair prices, good quality of input and better after sales service are the predominant factors for farmers of Visnagar and Himmatnagar to choose KPCL. Reasonable prices and better accessibility to KPCL's outlet/s seem to be the key parameters influencing farmers in Modasa. In Meghraj, 50% of the surveyed farmers buy from KPCL because they feel it is their own company while fair prices, quality of inputs and good accessibility of outlets seem to be the other important factors for farmers. Farmers in Vehlal prefer buying from KPCL (Ekta Cooperative) primarily because of good quality of inputs and better prices than the market.

Table 4-6: Parameters for preference to KPCL

Project location	Better accessibility	Fair price	Good input quality	Better after sales	Your own company
Visnagar	52	90	89	76	33
Himmatnagar	13	78	78	73	16
Modasa	46	67	29	4	8
Meghraj	35	55	55	25	50
Vehlal	15	30	55	0	20

Note: Figures indicate percentage of farmers

Figure 4-7 highlights the percentage of farmers who are not members of KPCL but still prefer to buy agriculture inputs from its outlets. It can be seen from the figure that a large proportion of non-member farmers in Visnagar, Modasa and Meghraj purchase agriculture inputs from its outlets. This is primarily due to two reasons – first, farmers feel assured about the quality of seed sold through KPCL and second, agriculture inputs are available at more reasonable rates from KPCL outlets than the market. 98% of farmers across the five project locations have not got support for marketing or selling their produce since this is a service that KPCL does not currently offer.

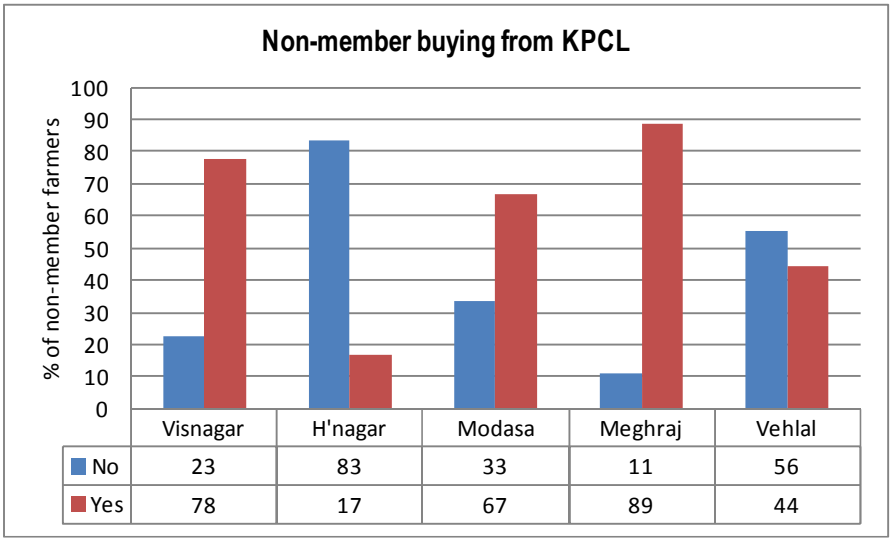


Figure 4-7: Purchase of agri inputs from KPCL by non-members

4.3 Study area level impacts

This section examines the extent to which DSC's agriculture extension services have had an impact on the quantity of agriculture inputs used, crop productivity and adoption of sustainable agriculture practices. The findings present results of a sample survey of 200 project beneficiary and control farmers and record change in impact parameters over a 3-year period i.e. before and after the implementation of the second phase of the project using recall method. The analysis is presented crop-wise for the major crops grown in each cropping season – Kharif (monsoon), Rabi (winter) and Zaid (summer).

At the outset, Table 4-7 below presents details of the cropping pattern across the five project locations.

Table 4-7: Cropping pattern across project locations

	Visnagar		Himmatnagar		Modasa		Meghraj		Vehlal	
Total area under cultivation (Ha)	1.8		2.3		2.0		1.0		1.9	
	Area (Ha) under	**% of total area under cultivation**	**Area (Ha) under**	**% of total area under cultivation**	**Area (Ha) under**	**% of total area under cultivation**	**Area (Ha) under**	**% of total area under cultivation**	**Area (Ha) under**	**% of total area under cultivation**
Kharif										
Cotton	0.5	31	1.1	46	0.5	23	0.4	40		
Castor	0.5	26	0.9	38	0.7	35				
Maize							0.4	40		
Paddy									1.0	49
Vegetables									0.4	21
Rabi										
Wheat	0.3	18	1.2	50	0.7	35	0.4	40	0.7	37
Fennel	0.4	22								
Zaid										
Vegetables									0.3	17

Note: Figures in table are per farmer

Quantity of agriculture inputs

Before impact of extension services on the quantity of agriculture inputs is discussed, it is important to highlight a few points.

i. Expense on bio-fertiliser - of which Farmer Yard Manure (FYM) constitutes a major part - has not been considered since farmers rarely buy FYM from the market and instead use what they get from their own animals. Also, the frequency of application of FYM is not yearly but every 2-4 years.
ii. The total number of waterings refers to both canal and borewell waterings.
iii. Labour costs include the cost incurred by farmers on hiring labour for land preparation, sowing, spraying of fertilisers, pesticides and weedcides, watering, harvesting etc. while miscellaneous costs refer to rent for agricultural machinery like tractor, rotavator, thresher etc.
iv. For certain agriculture inputs such as chemical pesticides, fertilisers and weedicides, farmers were only asked to report their expenses before and after the project. The quantity of each of these inputs has been derived on the basis of these expenses. For each crop, only the pesticides, fertilisers and weedicides specific to that crop have been considered.

KHARIF CROPS

Cotton

Cotton is one of the important Kharif crops across Visnagar, Himmatnagar, Modasa and Meghraj where it covers 31%, 46%, 23% and 40% of total area under cultivation respectively.

As part of better management practices for cotton, farmers were advised to put only one seed per hole while sowing. As a result, seed use has declined by about 200 gms per Ha after the project as can be seen in Table 4-8. Also, use of bio-pesticide has increased from 13 lit/Ha before the project to 21 lit/Ha after the project. Chemical pesticide and fertiliser use has increased by 3% and 8% respectively on account of higher incidence of pest attack and disease over the past 2-3 years. Weedicide use has come down by as much as 29%, a major reason for which is adoption of practices such as mulching and use of decomposed FYM by farmers, which help prevent weed growth. The number of waterings required for cotton has also reduced owing to adoption of water saving practices such as land leveling before sowing, preparation of modified bed and furrow, drip irrigation and mulching.

Table 4-8: Project impact on cotton

COTTON	Before project	After project	% diff
Seed (kg)	2.3	2.1	-9
Bio-pesticide (lit.)	13	21	67
Chemical pesticides			3
Imidacloprid (ml)	353	363	
Regent (ml)	882	908	
Acetamiprid (gms)	176	182	
Phorate (kg)	10.6	10.9	
Monocrotophos (ml)	1764	1817	
Acephate (gms)	882	908	
Chemical fertilisers			8
Urea (kg)	357	386	
DAP (kg)	214	231	
Weedicide			
Targa Super (ml)	2142	1735	-29
Total no. of waterings	38	37	-2
Labour & Misc. costs (Rs.)	21177	23458	11

Note: All figures are average per farmer per hectare values

Labour and miscellaneous costs account for the highest proportion of input costs and have seen an increase of more than 11%, largely due to more expensive labour and higher rents for agriculture machinery like tractor, thresher, rotavator etc.

Castor

Castor is the other prominent Kharif crop in Visnagar, Himmatnagar and Modasa along with cotton and covers 26%, 38% and 35% of total area under cultivation respectively.

Table 4-9 shows that while seed use has gone up by by 5%, the level of bio-pesticide use has remained constant before and after the project. Like cotton, castor crop was also more vulnerable to pest and diseases over the past 2-3 years, which is reflected in an increase in the quantity of chemical pesticides and fertilisers used before and after the project. Weedicide use has come down by 11% due to greater FYM decomposition and a gradual shift to vermi-compost. While the number of waterings required for castor has remained nearly the same, labour and miscellaneous costs have shown an increase of 16% due to higher labour and rentals for agriculture machinery.

Table 4-9: Project impact on castor

CASTOR	Before project	After project	% diff
Seed (kg)	5.7	6.0	5
Bio-pesticide (lit.)	14	14	0
Chemical pesticides			11
Quinalphos (ml)	1491	1655	
Acetamiprid (gms)	298	331	
Chemical fertilisers			12
Urea (kg)	302	339	
DAP (kg)	181	203	
Weedicide			-11
Targa Super (ml)	1313	1168	
Total no. of waterings	70	71	1
Labour & Misc. costs (Rs.)	14189	16508	16

Note: All figures are average per farmer per hectare values

Paddy

In Vehlal, paddy is the predominant Kharif crop and covers 49% of total area under cultivation.

The System of Rice Intensification (SRI) method of paddy cultivation was introduced in Vehlal in 2013 as one of the initiatives under LEPNRM Phase II. This method focuses on adoption of better agriculture practices by farmers and aims at improving productivity of irrigated rice while reducing quantity of inputs. From Table 4-10, it is evident that a greater impact has been witnessed due to SRI in Vehlal as compared to other crops. The project has led to a 42% drop in seed use by farmers as well as adoption of bio-pesticide which they were not using previously. The quantity of chemical pesticides, chemical fertilisers and weedicides used has come down by 11%, 18% and 58% respectively. An important impact - especially with respect to a water-intensive crop like paddy - is that there are 8 fewer waterings now required per hectare as compared to before the project. The decrease in inputs has also contributed to a 9% reduction in labour and miscellaneous costs borne by farmers.

Table 4-10: Project impact on paddy

PADDY	Before project	After project	% diff
Seed (kg)	36	21	-42
Bio-pesticide (lit.)	0	17	NA
Chemical pesticides			-11
Imidacloprid (ml)	571	508	
Phorate (kg)	17	15	
Monocrotophos (ml)	1428	1271	
Acephate (gms)	571	508	
Acetamiprid (gms)	286	254	

PADDY	Before project	After project	% diff
Chemical fertilisers			-18
Urea (kg)	86	70	
DAP (kg)	43	35	
Weedicide			-58
Aniloguard (ml)	1200	504	
Total no. of waterings	97	88	-9
Labour & Misc. costs (Rs.)	21979	20065	-9

Note: All figures are average per farmer per hectare values

Maize

In the case of Meghraj, the other important Kharif crop besides cotton is maize which covers 40% of total area under cultivation.

A look at change in impact parameters for maize before and after the project in Table 4-11 shows that with the introduction of the high-yielding Advanta-740 variety over the past 2-3 years, seed use has nearly halved from 40 kg/Ha to 21 kg/Ha. Also, greater adoption of bio-pesticide and vermi-compost by farmers under the project has made a significant impact on the quantities of chemical pesticides, chemical fertilisers and weedicides used by them which have come down by 49%, 11% and 21% respectively. The new variety of maize also requires lesser water which has led to a 20% reduction in the number of waterings required. The overall decrease in quantity of agriculture input requirement in maize has reduced farmer expenses on labour and miscellaneous costs by 9%.

Table 4-11: Project impact on maize

MAIZE	Before project	After project	% diff
Seed (kg)	40	21	-47
Bio-pesticide (lit.)	0	17	NA
Chemical pesticides			-49
Phorate (kg)	8.7	4.4	
Imidacloprid (ml)	290	148	
Acetamiprid (gms)	145	74	
Chemical fertilisers			-11
Urea (kg)	35	31	
DAP (kg)	18	16	
Weedicide			-21
Pendimethalin (ml)	1880	1485	
Total no. of waterings	10	8	-20
Labour & Misc. costs (Rs.)	21456	19551	-9

Note: All figures are average per farmer per hectare values

Vegetables

Besides paddy, vegetables are also grown in the Kharif season in Vehlal and cover 21% of the total area under cultivation. The main vegetables grown are lady finger, chowli, brinjal and guvar (cluster beans).

As seen from Table 4-12, the project has been instrumental in reducing overall seed use by 20% due to adoption of hybrid seed varieties by farmers. Use of bio-pesticide, which was not seen before the project, has now started, leading to a 19% reduction in the quantity of chemical pesticides required per hectare. Similarly, use of chemical fertilisers and weedicides has come down by 3% and 15% respectively. The number of waterings required for vegetables before and after the project has remained constant whereas labour and miscellaneous costs have come down by 7%.

Table 4-12: Project impact on vegetables

VEGETABLES	Before project	After project	% diff
Seed (kg)	10	8	-20
Bio-pesticide (lit.)	0	34	NA
Chemical pesticides			-19
Imidacloprid (ml)	928	752	
Monocrotophos (ml)	4641	3759	
Acephate (gms)	2321	1880	
Acetamiprid (gms)	464	376	
Profenofos+cyper methrin (ml)	2321	1880	
Chlorpyriphos+cyper methrin (ml)	2321	1880	
Chemical fertilisers			-3
Urea (kg)	78	76	
DAP (kg)	48	44	
Weedicide			-15
Pendimethalin (ml)	1350	1148	
Total no. of waterings	29	29	0
Labour & Misc. costs (Rs.)	16665	15485	-7

Note: All figures are average per farmer per hectare values

RABI CROPS

Wheat

Wheat is the most common Rabi crop across all 5 project locations and covers 18%, 50%, 35%, 40% and 37% of total area under cultivation respectively in Visnagar, Himmatnagar, Modasa, Meghraj and Vehlal.

Change in impact parameters for wheat before and after project can be noted in Table 4-13 where quantity of seed required per hectare has fallen by upto 10% from 173 kg to 156 kgs but is still higher than the seed rate of 120 kg/Ha recommended by DSC. Use of bio-pesticide has also increased from 16 lit./Ha to 27 lit./Ha. Despite this, a small increase of 8% is seen in case of the quantity of chemical pesticides used over the 3 year project period. On the other hand, greater use of bio-fertilisers such as vermi-compost and FYM by farmers has resulted in a plateauing of demand for chemical fertilisers like urea and DAP. Weedicide use has also shown a decline of 11% along with a reduction of 2 waterings per hectare before and after the project. On the other hand, labour and miscellaneous costs have shown a small increase of 6%.

Table 4-13: Project impact on wheat

WHEAT	Before project	After project	% diff
Seed (kg)	173	156	-10
Bio-pesticide (lit.)	16	27	69
Chemical pesticides			8
Chlorpyriphos (ml)	2331	2517	
Chemical fertilisers			0
Urea (kg)	66	66	
DAP (kg)	42	42	
Weedicide			-11
Algrip (gms)	20	17	
Total no. of waterings	44	42	-5
Labour & Misc. costs (Rs.)	16298	17260	6

Note: All figures are average per farmer per hectare values

Fennel

Fennel is another important Rabi crop besides wheat in Visnagar and covers 22% of total area under cultivation.

Seed use in the case of fennel has increased by 400 gms per Ha over the 3 year project period (Table 4-14). While no bio-pesticide use has been reported by farmers cultivating fennel, the quantity of chemical pesticides used has come down by 11%. On the other hand, an increase of 13% and 4% is seen in the quantity of chemical fertilisers and weedicides respectively. Adoption of water saving practices

has resulted in reducing upto 4 waterings per Ha. However, increase in inputs such as seeds and fertilisers have also pushed up labour and miscellaneous costs by 16%.

Table 4-14: Project impact on fennel

FENNEL	Before project	After project	% diff
Seed (kg)	3.4	3.8	12
Bio-pesticide (lit.)	0	0	0
Chemical pesticides			-11
Imidacloprid (ml)	410	365	
Acetamiprid (gms)	205	182	
Chemical fertilisers			13
Urea (kg)	48	54	
DAP (kg)	40	45	
Weedicide			4
Goal (ml)	240	249	
Total no. of waterings	46	42	-9
Labour & Misc. costs (Rs.)	15374	17831	16

Note: All figures are average per farmer per hectare values

SUMMER CROP

Vegetables

Among the 5 project locations, summer cropping is carried out only in Vehlal where farmers are able to grow vegetables such as chowli and guvar using canal water. These vegetables however cover only 17% of the total area under cultivation during the summer season.

As evident from Table 4-15, a 25% reduction in the quantity of seed used can be seen post the project. As in the case of fennel, use of bio-pesticide has not been reported by farmers who have cultivated vegetables in this season. While use of chemical pesticides, chemical fertilisers and weedicides has come down by 7%, 15% and 24% respectively, the number of waterings required for vegetables has shown a slight increase over the three year project period. Labour and miscellaneous costs which account for the highest proportion of input costs have shown a decline of nearly Rs. 1,000/- per Ha due to decrease in inputs.

Table 4-15: Project impact on vegetables

VEGETABLES	Before project	After project	% diff
Seed (kg)	16.8	12.6	-25
Bio-pesticide (lit.)	0	0	0
Chemical pesticides			-7
Imidacloprid (ml)	554	516	
Monocrotophos (ml)	2772	2578	
Acephate (gms)	1386	1289	
Acetamiprid (gms)	277	258	
Profenofos+cyper methrin (ml)	1386	1289	
Chlorpyriphos+cyper methrin (ml)	1386	1289	
Chemical fertilisers			-15
Urea (kg)	53	45	
DAP (kg)	38	32	
Weedicide			-24
Pendimethalin (ml)	720	547	
Total no. of waterings	46	50	9
Labour & Misc. costs (Rs.)	15275	14322	-6

Note: All figures are average per farmer per hectare values

Productivity

After discussing changes in the quantity of agriculture inputs for the main crops grown in the project locations, Table 4-16 examines impact of the project on productivity of these crops by looking at differences in productivity before and after the project for beneficiary and control farmers. It can be seen from the table that 'after project' productivity figures for all crops are significantly higher for beneficiary farmers as compared to control farmers. Even though crops such as cotton, castor and paddy have witnessed a slight decline in productivity over the past three years, a huge increase in productivity can be seen in case of maize and vegetables. This is largely due to use of new high-yielding variety seeds, such as the Advanta-740 variety in maize and hybrid variety in lady finger.

Over the past 3-4 years, productivity of cotton and castor has been largely affected by adverse weather conditions such as irregular, insufficient or excess rainfall as well as incidences of disease (like wilting in cotton and castor) and pest attack (eg. pink bollworm in cotton). Even so, project beneficiary farmers seem to have fared much better than control farmers, who have suffered greater yield losses.

Table 4-16: Project impact on productivity

	Project beneficiaries			Control farmers		
Productivity (kg/Ha)	Before project	After project	% diff	Before project	After project	% diff
Cotton	2321	2129	-8	2348	1976	-16
Castor	2826	2721	-4	2882	2574	-11
Paddy	3818	3752	-2	4242	3570	-16
Maize	2205	3551	61	1966	2402	22
Wheat	3078	3221	5	3079	2947	-4
Vegetables	8527	10930	28	5390	8225	53
Fennel	1797	1873	4	1785	1869	5

In the case of wheat, while project beneficiary farmers have recorded a marginal gain in productivity, control farmers have reported a 4% decline. According to the farmers, wheat production has suffered on account of unusually warm weather coupled with strong winds which led to wheat stalks falling. Also, late/less sowing of wheat due to unfavourable weather also affected its production.

Greater adoption of new maize seeds, access to scientific Package of Practices and availability of crop advisory services has resulted in an impressive productivity gain of upto 61% among project farmers as compared to a more modest 22% among control farmers. In vegetables, productivity figures for control farmers seem to be higher than project beneficiaries; however, this is due to the fact that some control farmers who did not grow vegetables three years back have started doing so now. In the case of fennel, productivity gains of beneficiary and control farmers before and after the project are similar.

Adoption of sustainable agriculture practices

Impact of DSC's agriculture extension services on adoption of sustainable agriculture practices has been measured through a comparison between levels of adoption of project beneficiary farmers (which include KPCL shareholders and Krushidhan members) and control farmers who have not received any services from DSC.

Figure 4-8 shows that about 70% of project beneficiary farmers have made efforts to save irrigation water as compared to only 50% of control farmers. This is being done through measures such as land leveling, replacing 'flood' irrigation with 'furrow' irrigation, adopting seeds that require less water, using vermi-compost and FYM, harvesting rain water etc. What is interesting to note is that the project has been able to bring about greater awareness about efficient water use among farmers (Figure 4-9) where 51% of project beneficiary farmers (as against 39% of control farmers) are using only as much irrigation water as they need.

Prevalence of drip and sprinkler systems is seen to be higher among control farmers than beneficiary farmers (Figure 4-9). This could be attributed to a lack of awareness of low-cost methods of water saving

among control farmers. However, other factors such as availability of government subsidy for drip systems and the mandatory requirement of installation of drip when applying for new electric connections may also be strong drivers for farmers to take these higher-cost alternatives in absence of adequate awareness of more cost-effective measures.

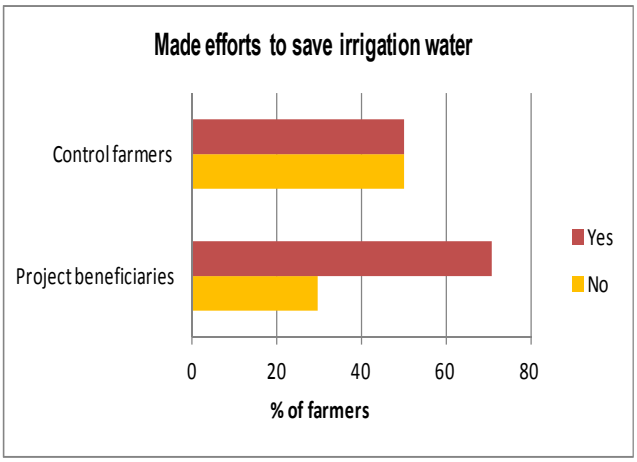


Figure 4-8: Efforts to save irrigation water

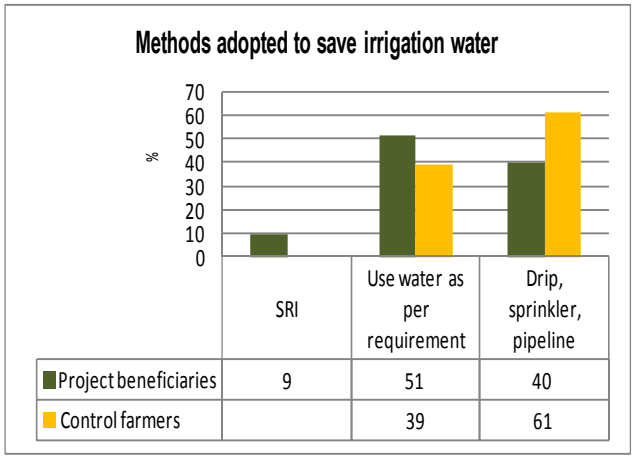


Figure 4-9: Methods adopted to save irrigation water

In addition to low-cost methods of water saving, an increasing number of project farmers are now installing drip irrigation systems for saving irrigation water as can be seen from Figure 4-10 where the proportion of project farmers adopting drip irrigation over the past 3 years has increased from 9% to 19% but reduced from 8% to 5% for control farmers. A much larger percentage of beneficiary farmers has also been able to irrigate additional area using drip as compared to control farmers.

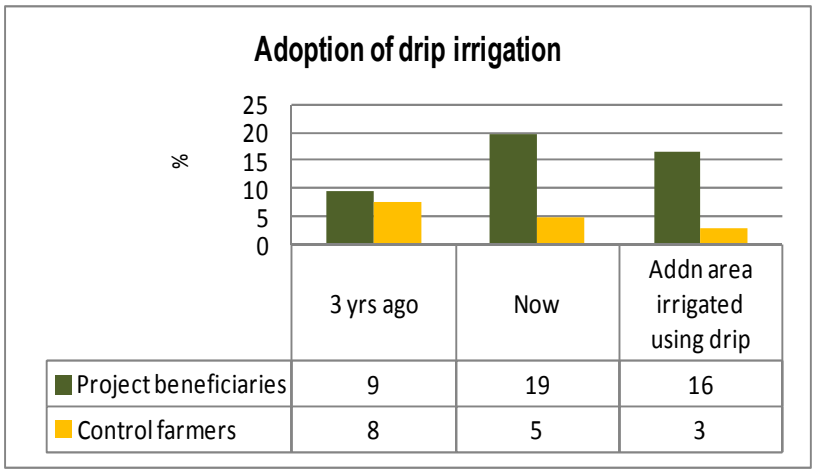


Figure 4-10: Adoption of drip irrigation

The survey also asked farmers about whether they got their soil tested and were aware of how to produce bio-pesticide, vermi-compost and organic manure. Figure 4-11 shows that 38% of project beneficiary farmers used to get their soil tested before joining the project as compared to 26% of

control farmers. Of these 38% farmers, a third used DSC's services for soil-testing, indicating that even before the start of the second phase of the project, DSC's soil testing services had become fairly popular among the farmer fraternity.

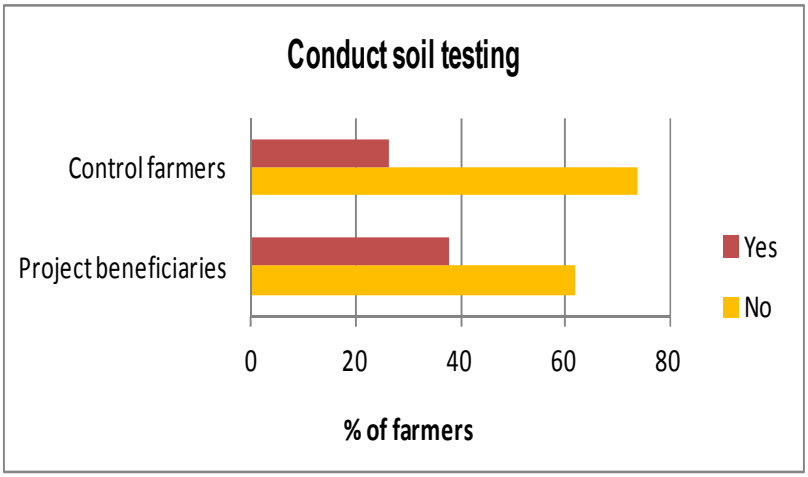


Figure 4-11: Adoption of soil testing

A similar analysis for levels of awareness about producing bio-inputs (Figure 4-12 and Figure 4-13) shows that only 8% of project beneficiary farmers as against 17% of control farmers were aware about how to produce bio-pesticide and vermi-compost. The corresponding figures for awareness about producing organic manure ranged from 7% among project beneficiary farmers and 3% among control farmers.

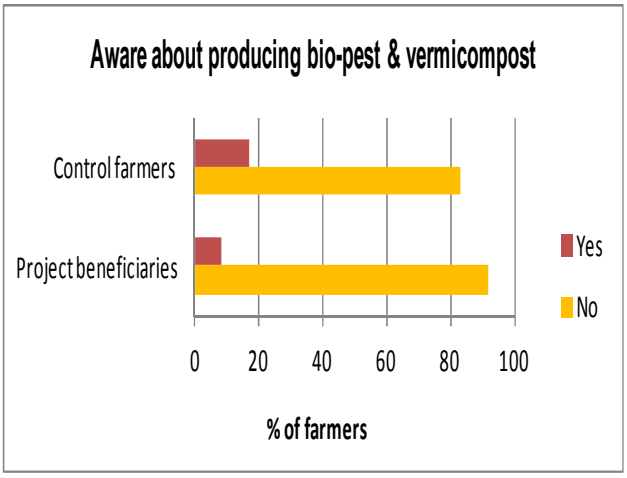


Figure 4-12: Awareness of bio-pest & vermi production

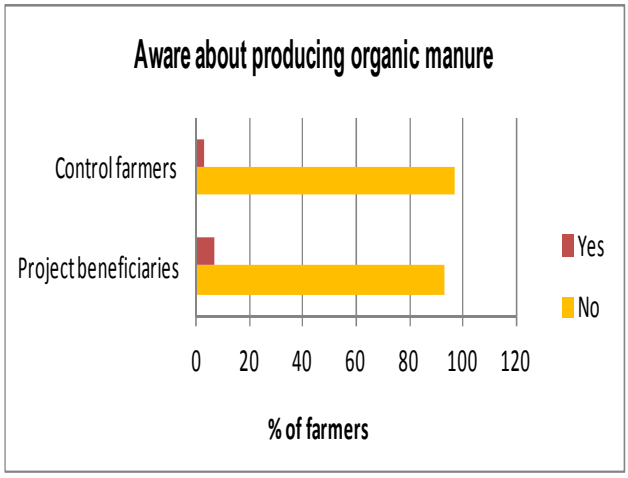


Figure 4-13: Awareness of organic manure production

Although eliminating the use of chemicals in agriculture is not an immediate but a longer term goal under this project, farmers were asked if they had been successful in producing any crop using zero chemicals so that any progress towards this goal could be measured. Responses in Figure 4-14**Error!**

Reference source not found. reveal that the concept of cultivating crops without using any chemicals has still not gained popularity among farmers, which is understandable, given the focus of DSC's extension services on reducing chemical inputs. However, the fact that 6% of project beneficiary farmers have already initiated zero-chemical cultivation in crops like wheat, castor, pearl millet and corn is an encouraging start.

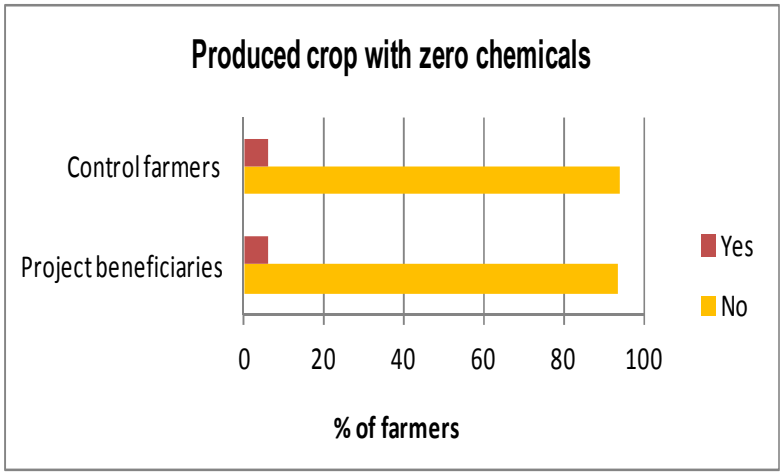


Figure 4-14: Producing crop without chemicals

Figure 4-15 and Figure 4-16 highlight the status of adoption of trichoderma viride and neem oil. It can be seen that 28% of project beneficiary farmers have started using trichoderma viride for control of wilting disease after joining the project as against 21% of control farmers. Similarly, 45% of beneficiary farmers are using neem oil for biological control of pests after coming under DSC's fold as compared to only 19% of control farmers who use this method of pest reduction.

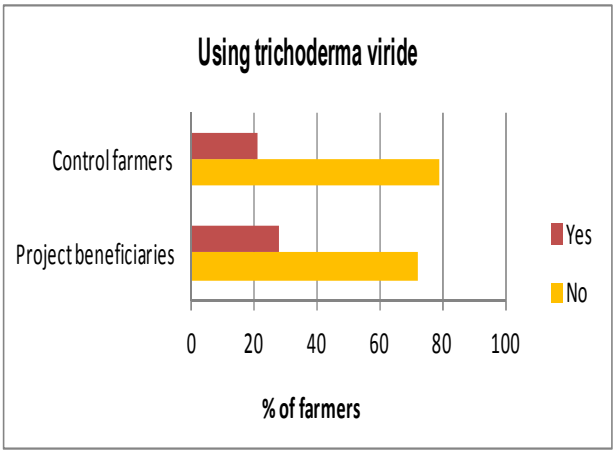


Figure 4-15: Adoption of trichoderma viride

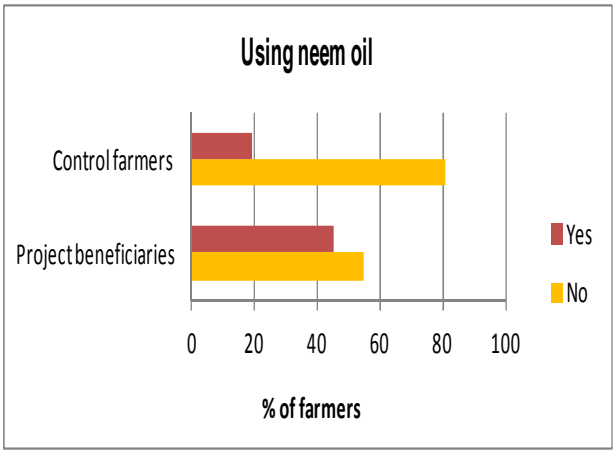


Figure 4-16: Adoption of neem oil

Another biological means of pest control involves use of yellow sticky trap, adoption of which is seen to be at similar levels among both project beneficiary and control farmers (Figure 4-17). A significant difference is however seen between the two categories of farmers as far as use of micro-nutrients like

zinc and sulphur is concerned. 84% of project beneficiary farmers reported initiating use of micro-nutrients after joining the project as compared to only 47% of control farmers.

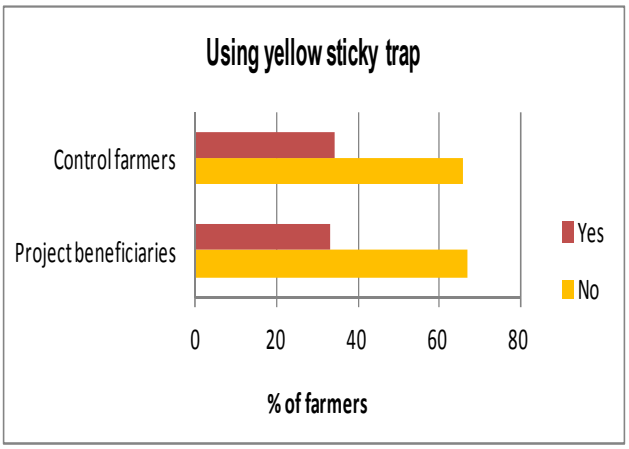


Figure 4-17: Adoption of yellow sticky trap

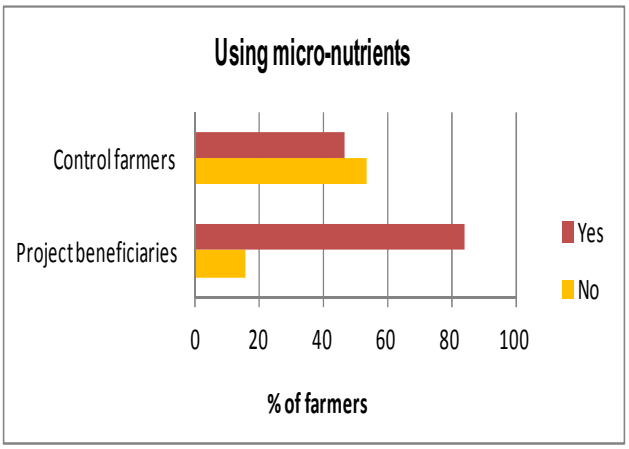


Figure 4-18: Use of micro-nutrients

Post project cleaning and grading of produce is being undertaken by 51% of project beneficiaries as against only 32% of control farmers (Figure 4-19). Some of the crops being cleaned and graded include wheat, vegetables and fennel where average price premiums of Rs. 2/- per kg in wheat, Rs. 5/- per kg in vegetables and Rs. 13/- per kg in fennel have been realised by farmers.

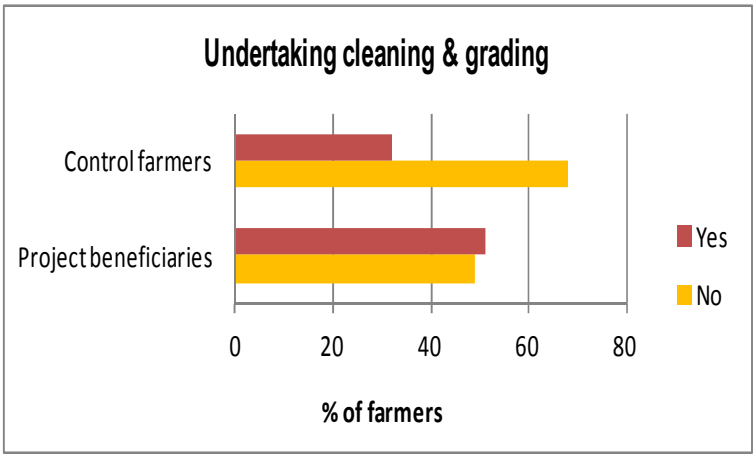


Figure 4-19: Cleaning & grading of produce

4.4 Project level impact

In this section, an attempt is made to estimate the overall impact of agriculture extension activities on the entire 32,300 farmer households from the 151 villages spread across the five project locations. This impact has occurred at two levels – economic and environmental.

Economic impact

Adoption of better agriculture practices under the project has resulted not only in the savings of farmers' expenses on various agriculture inputs but also improved incomes due to higher crop productivity and better price realisation. For calculation of project level impact, figures related to per unit savings in input expenses or per unit increase in productivity and price are taken from the survey findings. Also, since adoption may vary across farmers and project locations, the percentage adoption for each crop calculated on the basis of DSC data (Chapter 3, Table 3-5) has been considered to arrive at the total quantum of savings in agriculture inputs and increase in farmer income.

Farmer expenses have come down due to reduced input quantities of seeds, increased replacement of chemical pesticides, fertilisers and weedicides with bio-inputs, lesser demand for irrigation water and savings in labour and miscellaneous expenses. Savings in expense on seeds are seen in the case of cotton, paddy, maize, vegetables and wheat. At the project level, the total savings achieved are close to Rs. 90 lakhs as can be seen from Table 4-17 **Error! Reference source not found.**. These have been estimated on the basis of the following assumptions:

a. A packet of 450 gms of BT cotton seed costs Rs. 800/-
b. Wheat seed cost is Rs. 25/- per kg
c. Maize seed (Advanta-740 variety) cost is Rs. 90/- per kg
d. Paddy seed (*gujari* variety commonly grown in Vehlal) cost is Rs. 25/- per kg
e. Since lady finger, *chowli* and *guvar* are the commonly grown vegetables in the project area, an average value of Rs. 1300/kg has been assumed on the basis of the following seed costs - Rs. 3000/kg (lady finger hybrid variety), Rs. 400/kg (*chowli*) and Rs. 500/kg (*guvar*).

Table 4-17: Saving in expense on seeds

Crop	Total area under cultivation (Ha)	Saving in kg/Ha	Total saving (kg.)	% adoption	Savings in expense (Rs.)
Cotton	11390	0.2	2278	0.57	23,09,333
Paddy	3070	15	46050	0.48	5,52,600
Maize	1750	18.9	33075	0.77	6,36,694
Vegetables	4455	3.1	13811	0.46	1,58,821
Wheat	19135	17	325295	0.65	52,86,044
Total	39800		420509		**89,43,491**

Saving in expenses on chemical pesticides is seen in the case of paddy, maize, fennel and vegetables with per hectare savings ranging from around Rs. 400/- in paddy to nearly Rs. 1100/- in vegetables (Table 4-18). Even in crops like cotton, castor and wheat where this expense has shown an increase, the actual consumption of pesticides may not have gone up in the same proportion as expense, considering that market prices of some of the commonly used chemical pesticides have risen by an average of 45% over the past 3 years. The total project-level savings on account of reduced use of chemical pesticides by farmers are Rs. 88.76 lakhs.

Table 4-18: Saving in expense on chemical pesticides

Crop	Total area under cultivation (Ha)	Savings in Rs./Ha	% adoption	Total savings (Rs.)
Paddy	3070	408	0.48	6,01,229
Maize	1750	679	0.77	9,14,953
Fennel	6600	559	1.39	51,28,266
Vegetables	4455	1089	0.46	22,31,688
Total	15875			**88,76,135**

A reduction in expense on chemical pesticides has also been possible due to their increased replacement with bio-pesticide by farmers. Bio-pesticide is also cheaper than chemical pesticides – with an estimated expense of Rs. 630/- (@ Rs. 50/- per litre[3] for 1.5 litre requirement per Ha) as against Rs. 1,428/- for Imidacloprid, a common pesticide used in cotton (@ Rs. 170/- per 100ml for 840 ml requirement per Ha) or Rs. 1,050 for Regent, a common pesticide for wheat crop (@ Rs. 300/- per 250ml for a 840 ml requirement per Ha). Factoring in expense on other commonly used chemical pesticides such as Quinalphos, Chlorpyriphos and Acetamiprid, a conservative assumption of saving of Rs. 110/- per Ha due to switch to bio-pesticide has been used for purposes of calculating savings in Table 4-19**Error! Reference source not found.**.

Table 4-19: Saving due to use of bio-pesticide

Crop	Total area under cultivation (Ha)	% adoption	Total savings (Rs.)
Cotton	11390	0.57	7,14,153
Paddy	3070	0.48	1,62,096
Maize	1750	0.77	1,48,225
Vegetables	4455	0.46	2,25,423
Wheat	19135	0.65	13,68,153
Total	39800		**26,18,050**

Savings in expense on chemical fertilisers have been realised in the case of paddy, maize, fennel and vegetables while these expenses have increased for cotton and castor. However, since market prices of chemical fertilisers have increased by nearly 17% over the past 3 years, only a part of this increase may

[3] In fact, after getting trained under the project, farmers have also started producing bio-pesticide by themselves, further bringing down this input expense.

be attributed to a real increase in their consumption. At the project level, the savings in chemical fertiliser expense is worth Rs. 86.42 lakhs (Table 4-20). It is important to note here that unlike bio-pesticide which can effectively substitute chemical pesticides, vermi-compost or FYM can only be used as supplementary fertilisers. This is because they contain insufficient quantity of N,P,K needed for crops, thus necessitating application of chemical fertilisers such as urea and DAP. Also, a large quantity of vermi-compost or FYM is generally required – for instance, in place of 50kg of urea costing Rs. 320/-, 500kg of vermi-compost may be needed, which costs Rs. 2,500/-. It is for these reasons that chemical fertilisers prove more difficult to be completely replaced.

Table 4-20: Saving in expense on chemical fertilisers

Crop	Total area under cultivation (Ha)	Savings in Rs./Ha	% adoption	Total savings (Rs.)
Paddy	3070	1165	0.48	17,16,744
Maize	1750	540	0.77	7,27,650
Fennel	6600	559	1.39	51,28,266
Vegetables	4455	522	0.46	10,69,735
Total	15875			**86,42,395**

As in the case of chemical pesticides and fertilisers, expense savings have also been realised by farmers in weedicides. Preparation of modified bed and furrow, mulching, decomposing the FYM before use etc. are some of the practices which have helped to naturally reduce the incidence of weeds and bring down farmers' dependence on weedicides. This has resulted in a cost reduction of over Rs. 1.63 crores across nearly all major crops grown in the project area as shown in **Error! Reference source not found.**.

Table 4-21: Saving in expense on weedicides

Crop	Total area under cultivation (Ha)	Savings in Rs./Ha	% adoption	Total savings (Rs.)
Cotton	11390	699	0.57	45,38,118
Castor	10390	155	0.69	11,11,211
Paddy	3070	1412	0.48	20,80,723
Maize	1750	719	0.77	9,68,853
Fennel	6600	559	1.39	51,28,266
Vegetables	4455	462	0.46	9,46,777
Wheat	19135	126	0.65	15,67,157
Total	56790			**1,63,41,103**

Table 4-22 highlights the expense savings achieved by farmers as a result of reduced number of waterings required for crops post the project. Here, it is important to note that the biggest saving in irrigation water has been achieved in the case of paddy, a highly water-intensive crop, although savings are seen in other crops as well and are a result of better water management practices as well as

adoption of drip irrigation[4] by farmers. Although both canal and borewell water is used conjunctively for irrigation in all project locations except Meghraj, only saving in expense on borewell water has been taken into account to arrive at estimates of saving since canal water is not available across all three cropping seasons. Assuming one borewell watering to be of 4 hours duration and hourly rental for diesel pump to be Rs. 60/-, a saving of Rs. 240/- per watering per Ha has been considered for calculation of total savings which are estimated to be nearly Rs. 2 crores for the overall project.

Table 4-22: Saving in expense on irrigation water

Crop	Total area under cultivation (Ha)	Savings in no. of waterings per Ha	% adoption	Total savings (Rs.)
Cotton	11390	1	0.57	15,58,152
Paddy	3070	8	0.48	28,29,312
Maize	1750	2	0.77	6,46,800
Fennel	6600	4	1.39	88,07,040
Wheat	19135	2	0.65	59,70,120
Total	41945			**1,98,11,424**

Labour and miscellaneous expenses at the project level are estimated to have come down by more than Rs. 75 lakhs. This is on account of reduction in quantities of agriculture inputs (as discussed above) as well as adoption of new agriculture tools, equipment and technology such as *chipiyas* (see Chapter 3 for more details) and drip irrigation by farmers, the latter helping save labour costs for watering and administering fertiliser/pesticide (since these can be done through drip itself).

Table 4-23: Saving in labour and miscellaneous expense

Crop	Total area under cultivation (Ha)	Savings in Rs./Ha	% adoption	Total savings (Rs.)
Paddy	3070	1914	0.48	28,20,470
Maize	1750	1905	0.77	25,66,988
Vegetables	4455	1067	0.46	21,86,603
Total	9275			**75,74,061**

Thus, while agriculture input expenses have reduced on the one hand, farmer incomes have also improved owing to an increase in crop productivity and better price realisation. Over the past 3 years, productivity has increased, especially in maize and vegetables by 1350 kg/Ha and 2400 kg/Ha. This alone has provided more than Rs. 26.67 crores of additional income to farmers at the overall project level (Table 4-24). Simultaneously, farmers have been able to realise better prices due to improved quality of produce (for example through SRI paddy in Vehlal and Advanta maize in Meghraj) and cleaning and grading, especially in the case of fennel, wheat and vegetables (Table 4-25).

[4] Nearly 20% of project farmers have adopted drip irrigation over the past 3 years

Table 4-24: Increase in income due to higher productivity

Crop	Total area under cultivation (Ha)	Increase in productivity (kg/Ha)	Project level increase in productivity (kg)	Prevailing market price (Rs./kg)	% adoption	Total increase in farmer income
Maize	1750	1346	2355500	16	0.77	2,90,19,760
Fennel	6600	76	501600	78	1.39	5,43,83,472
Vegetables	4455	2404	10709820	30	0.46	14,77,95,516
Wheat	19135	143	2736305	20	0.65	3,55,71,965
Total	31940		16303225			**26,67,70,713**

Table 4-25: Difference in crop prices before and after the project

Crop	Price before project (Rs./kg)	Price after project (Rs./kg)	Diff. in price realisation (Rs./kg)
Cotton	46	44	-2
Castor	41	32	-9
Paddy	13	15	2
Maize	12	16	4
Fennel	72	78	6
Vegetables	23	31	8
Wheat	14	20	6

At the project level, the compounded effect of higher productivity and increase in price realisation has resulted in an additional income of Rs. 55.28 lakhs reaped by farmers as shown in Table 4-26.

Table 4-26: Increase in income due to better price realisation

Crop	Total area under cultivation (Ha)	Productivity (kg/Ha)	Increase in price realisation (Rs./kg)	% adoption	Total additional income to farmers
Paddy	3070	3752	2	0.48	1,10,57,894
Maize	1750	3551	4	0.77	1,91,39,890
Fennel	6600	1873	6	1.39	10,30,97,412
Vegetables	4455	10930	8	0.46	17,91,90,792
Wheat	19135	3221	6	0.65	24,03,71,957
Total	35010				**55,28,57,945**

Table 4-27 summarises the combined economic impact of cost reduction in agriculture inputs and increase in farmer incomes, which is to the tune of almost Rs. 90 crores for the overall project. It can be seen that increase in farmer income due to higher productivity and price realisation is about 11 times the savings achieved by them in agriculture input expenses. Distributing the total value of economic impact equally among all 32,300 project beneficiary farmers, **the aggregate value of economic gain to each farmer household under the project is to the tune of more than Rs. 27,000/-.**

Table 4-27: Economic impact of project

Expense savings	**Rs.**
Seeds	89,43,491
Chemical pesticide	88,76,135
Bio-pesticide	26,18,050
Chemical fertilisers	86,42,395
Weedicides	1,63,41,103
Irrigation water	1,98,11,424
Labour & misc	75,74,061
Sub-total	**7,28,06,658**
Increased income	
Higher productivity	26,67,70,713
Better price realisation	55,28,57,945
Sub-total	**81,96,28,658**
Grand Total	**89,24,35,316**

Environmental impact

Besides the above discussed quantitative economic impacts, the project has also had a number of qualitative environmental impacts which play a crucial role in ensuring the long-term sustainability of agriculture.

The first among these is reduction of chemical inputs such as pesticides, fertilisers and weedicides and their replacement with bio-inputs. This has been possible due to DSC's extensive farmer training programmes on production of bio-pesticide and vermi-compost and setting up a distribution network for these products through KPCL. As a result, a gradual shift towards more organic cultivation has started. Already, farmers across various project locations are beginning to report loosening up of soil, better water retention capacity, reduction in salinity and rise in micro-biological activity which can be seen as definite indicators of an improvement in soil health. A more detailed analysis of the impact of the project on soil health is presented in the next chapter.

Secondly, adoption of better water management practices and drip irrigation technology – which can help save upto 80% water and increase productivity by 1.5 times - has resulted in significant water savings. Further, improved crop productivity due to drip is preventing farmers from resorting to excessive use of harmful chemical inputs to maximise production from their land.

5 Impact on Sustainability of Agriculture

While assessing sustainability of a farming system is an elaborate exercise and beyond the purview of this study, since the project specifically aims at improving sustainability, an effort was made by DSC to assess the state of soils before and after the project. Soil health can be taken as a proxy for agricultural sustainability as soil is the living medium that supports the entire agro-ecosystem of a given region. A major limitation of this approach is that it does not consider the biodiversity of the agro-system and the balance of species within this system, which are important indicators of sustainability as well. A comprehensive assessment of soil health is also an elaborate affair going into several parameters drawn from physical, chemical and biological domains of soil. However, given the limitations of time and resources of the project only a few chemical indicators were taken up for assessment. Hence the results may be considered indicative at best.

5.1 Assessment of Soil Health: Sampling Frame

A soil survey was carried out with a sample of 60 farms selected from 4 project units – 15 from Modasa, 17 from Meghraj, 13 from Visnagar and 15 from Himmatnagar. The soil samples were taken from among the fields which were part of the benchmark study carried out in 2011-12. The purpose was to compare the results with the benchmark to see if selected chemical indicators of soil health showed any significant changes over a period of four years.

Although DSC has been operating a mobile soil testing van under the project, to avoid any scope of bias, it got the samples tested at the Gujarat Agricultural University. In this section we present the main findings.

Parameters selected

Although Nitrogen (in available form) is one of the most important macro-nutrients consumed by plants it has not been included mainly because nitrogen is available in nitrate form which is easily leached and therefore often not found in the topsoil. Also since it is extracted by the crop plants from the soil it has to be replenished after crop harvest in any case. In the case of the other two macro-nutrients, viz. Phosphorous and Potash, there is a build up in the soil if the amount provided externally is more than the amount extracted by the crops. The soil being a living system is also composed of numerous varieties of micro-organisms which work on the bio-mass and convert nutrients into forms available to the plant. The extent of microbial activity also affects the net build-up of nutrients in the soil. Hence an increase in P and K content can be seen as an improvement in soil nutrient status. In fact recent research emphasises the need to maintain a certain *nutrient buffer* in the soils to make agriculture more sustainable.

Organic carbon is an indicator of the biomass available for decomposition. This would happen if the conditions are conducive. One of the conditions is PH which is a measure of acidity and alkalinity. While a neutral PH of around 7 to 7.5 is considered ideal, both extremes are undesirable. A high level of electrical conductivity indicates excess salts in the soil. This can prove harmful to plant growth in various

ways including toxicity and imbalance of available nutrients. Such a situation may arise if the soil has been subjected to high chemical farming over several years or innundated with saline water. It can be reversed by reducing chemical inputs and increasing the use of organic fertilizers. Hence both PH and EC are important indicators of soil health.

5.2 Findings of Soil Survey

Table 5-1 provides an overview of the average results before and after the intervention on five different parameters of soil health.

Table 5-1: Overview of Soil Health Indicators before and after the project

No.	Soil Parameter	2011-12	2015-16	Change (%) over base year
1	PH	7.32	7.30	negligible
2	Electrical Conductivity (mmhos/cm)	0.65	0.66	negligible
3	Organic Carbon (%)	0.05	0.08	60.0
4	Phosphorous (Kg/ha)	58.37	80.61	38.1
5	Potash (Kg/ha)	394.24	421.73	7.0

The table shows that the paramaters of PH and EC have remained largely unchanged. The level of EC is also very low and the PH is very close to neutral which is good for the normal growth of plants.

Organic carbon levels are rather low but there is a significant improvement. Although the percentage change is high in absolute terms it is not very big. Hence more emphasis on use of biomass and bio-inputs needs to continue. There has been a significant increase in Phosphorous content of close to 40% and a moderate increase in Potash content. Since Indian soils are generally rich in Potash content, it is never a cause of concern. However, the increase in Phosphorous content may be seen as a significant development.

Capturing the Variability in Results

It is worth noting that the above table gives only an average picture. Hidden behind these average pictures could be variations across regions as well as farmer's fields. Table 5-2 shows the average results for the four different regions.

Table 5-2: Soil Indicators for the four regions

No.	Region	PH	EC	Organic C	P	K
1	**Modasa**					
	Before	7.61	0.55	0.06	67.8	379.9
	After	7.48	0.57	0.09	99.31	504.2
	Change	+0.13	-0.03	+0.03	+31.51	+124.3
2	**Meghraj**					
	Before	6.76	0.50	0.01	88.55	573.18
	After	6.93	0.62	0.04	86.55	433.24
	Change	+0.13	-0.12	+0.03	-2.00	-139.94
3	**Visnagar**					
	Before	7.67	1.25	0.05	31.58	265.7
	After	7.58	1.07	0.08	58.85	339.1
	Change	+0.09	+0.18	+0.03	+27.27	+73.4
4	**Himmatnagar**					
	Before	7.35	0.40	0.08	37.94	317.18
	After	7.27	0.44	0.11	74.02	397.82
	Change	+0.08	-0.04	+0.03	+36.08	+80.64

***+** Indicates positive direction of change while – indicates negative movement

The following inferences can be drawn from the table regarding the impact of the project on soils of different regions participating in the project:

- There has been significant improvement in PH of soils across all regions. In the case of Meghraj it has moved from acidic towards neutral while in all other cases it has moved from alkaline towards neutral condition. This may be considered a significant gain within a short period of 4 years.

- EC levels have been maintained at fairly low levels in all project areas. In the case of Visnagar, EC was on the higher side at 1.25 mmhos/cm before the project started as compared to other regions, which has been brought down by 14.4 %.

- Both the above changes can be considered positive from the view point of environmental sustainability and can be attributed to conjunctive use of chemical and bio-fertilizers being promoted by DSC.

- Among the nutrients, organic carbon has shown a marginal increase across project areas. Promotion of greater use of bio-fertilizers, incorporation of crop waste into the soil instead of burning, practice of cover crops and green manuring etc. are some of the time tested methods of increasing organic carbon, which has a direct impact on soil texture, water holding capacity, microbial activity and productivity of soils.

- In the case of the two macro-nutrients, both P and K have seen significant gains in all regions except Meghraj. In Meghraj, the level of P is almost the same while there has been considerable loss of K. However, even after this loss the soil has a good buffer of 433 kg/ha which is better than some of the other regions. Depletions of upto 25-50 % of the nutrient buffer can be attributed to the previous crop. Some crops extract more potassium than others.

To check the variation within farmer's fields, standard deviation is a good measure. However, we have taken the range as it shows the extreme values from both sides. In the case of PH for instance very low value (3-4) would indicate high acidity and very high value (9-10) would indicate alkalinity of the soil. Both the extremes are harmful and such soils need to be treated with suitable amendments to restore the PH value to neutral levels.

Table 5-3: Extent of Variation in Soil Test Results across Fields

No.	Soil Parameter	2011-12		2015-16	
		Average	Range	Average	Range
1	PH	7.32	6.10-8.80	7.30	6.30-8.50
2	Electrical Conductivity (mmhos/cm)	0.65	0.08-5.25	0.66	0.18-3.25
3	Organic Carbon (%)	0.05	0-0.20	0.08	0.02-0.25
4	Phosphorous (Kg/ha)	58.37	3.11-444.75	80.61	9.33-161.72
5	Potash (Kg/ha)	394.24	67.20-1021.44	421.73	134.40-1048.32

The following inferences may be drawn from Table 5-3 regarding variability across farmers' fields:

- Although the average PH is at a healthy 7.32, like the average depth of a river it is deceptive. There are some plots which are clearly alkaline as the reading is close to 9. On the other hand there are some plots which are some what acidic with PH close to 6.

- PH and EC should be seen in conjunction as both are inter-related. Here again there are some plots which show an EC of 5.25. Any value higher than 4 is indicative of salinity in the soil. This salinity is caused due to accumulation of salts in the soil, which in turn could be because of excess use of chemical fertilizers. Sometimes it could be due to use of brackish water, or due to overirrigation resulting in salts from lower reaches of soil being brought to the top. This problem can be tackled by leaching of the salts from the soil with good quality water and proper drainage. When high EC is combined with high PH (9-11) it is indicative of alkalinity. Here too the problem is of excess salts, but is more difficult to solve because the salts have altered the chemical composition of soil micells and are difficult to leach away. The conventional treatment is to add gypsum to the top soil. The University has not recommended the use of this additive in any of the samples. This impliies that

alkalinity is not a problem in this area and the salts can be leached away with proper water management.

- The variation in organic carbon is within a narrow band. This is to be expected because the farming practices are almost uniform with only a tiny fraction of the farming population claiming to have adopted organic farming, and completely doning away with chemicals.

- In contrast to carbon, the variation seen in P and K buffers is very high. This again is to be expected because farmers are not in the habit of adjusting dosage based on soil analysis. Some farmers apply higher doses in the hope of getting higher yields, others apply sub-optimal doses. The residual fertilizer contributes to the buffer. Proper management of the nutrient buffer is now considered important for sustainable yields.

The soil test reports also provide a set of recommendations depending on what crop the farmer wants to grow. The recommendations are common for a particular region and particular crop, since the scientists do not consider the variability significant enough to modify the recommendation unless there are some extreme values that come to their attention. Hence farmers get to apply doses of fertilizer and FYM which approximately meet the requirements of the region rather than their specific field. In a country with scarce resources and poor farmers, this may seem appropriate. It can prove misleading in a few cases in case of high variability which is often found in soils. Perhaps one way to reduce this risk would be to identify the different soil types within a region and to take samples from each soil type. In this way, recommendations could be made separately for different soil types as well as proposed crops.

5.3 Indicators for Monitoring Soil Health

In February 2015, the GoI launched an ambitions scheme of creating Soil Health Cards for over 14 million farmers with a generous budget. However, the so called soil health card is a mis-nomer as it covers only the five chemical parameters that have been used above. The general practice is to report only on macro-nutrients and PH, EC. When dealing with large number of samples this is the best that can be done.

However, it should be made clear that this falls short of measuring soil health in more ways than one. Firstly, the seven micro-nutrients that are equally important for soil health are not covered. Deficiency of nutrients like Zn, Fe, Mo, Co etc. can produce disease like symptoms on the plant and stunt their growth. Micro-nutrient defeciency is common in soils subjected to chemical farming and mono-cropping for several years without a break as the nutrient buffer in the soil is completely depleted due to continuous extraction. Testing micro-nutrients is both expensive as well as time consuming. Hence it is taken up only in cases where plants show defeciency symptoms.

Secondly, as all studies on soil health indicators have emphasised, soil health is governed by several factors over and above the chemical conditions. Some of these parameters relate to physical conditions of the soil such as porosity, water holding capacity, soil structure, soil depth etc. More importantly, soil being a living eco-system supports a large variety of micro-organisms which interact with the chemical

and physical components in the process modifying them. Hence ideally soil healh indicators should be drawn from all three aspects of soil. For a comprehensive coverage of the subject, DSC may refer to Cardoso et. al. (2013)[5] which is an open access resource.

Needless to say this makes monitoring soils for their health and sustainabiliy is a lot more cumbersome and expensive. Understandably, such indicators are used only for academic studies and projects where it is important to monitor soil health. The authors recommend that during the third phase of LEPNRM, sufficient funds be alloted to monitor soil health on all three categories of soil health indicators.

[5] Elke Jurandy Bran Nogueira Cardoso et. al. "Soil health: Looking for suitable indicators." In *Scientia Agricola,* Vol. 70, no. 4. Piracicaba July/Aug. 2013, accessed at www.scielo.br

6 Krushidhan Producer Company: Key Accomplishments and Strategic Plans

6.1 Overview of Achievements

This section provides an overview of the progress made so far by the FPO on various fronts including coverage, activities undertaken and profitability. The focus is on the economic and financial dimensions of the company rather than the governance and social dimensions which are covered in the following section.

i) Coverage

As shown in **Error! Reference source not found.**, the company had a base of over 2035 farmer families by the end of March 2016 as shareholders. The number of families who actually benefitted from the services of the company however, was more than twice the membership in 2014-15 and more than thrice the membership in 2015-16.

The geographical coverage of LEPNRM remained the same, covering 11 blocks in 4 districts of central and northern Gujarat. The coverage of villages was reduced to 165 last year as some of the villages had to be dropped on account of lack of response from the farmers there.

Table 6-1: Coverage under LEPNRM - II

Particulars	2014-15	2015-16
No of Districts	4	4
No. of Blocks	11	11
No. of Villages	170	165
No. of Farmers	4000	6000
No. of Shareholders	1560	2035

ii) Financial Performance

The audited report of the year just completed is awaited. However, the unaudited statements reveal that the company has made a profit of Rs. 8.43 lakhs during the financial year 2015-16. This has helped KPCL to wipe out the burden of losses worth Rs. 7.34 lakhs which were carried forward from the previous avatar of the company in 2013. The highlights of financial performance from 2013 till 2016 are provided in Table 6-2.

Table 6-2: Financial Performance of KPCL over the past three years

Particulars	31st March 2016	31st March 2015	31st March 2014	31st March 2013
Total Revenue	**10,632,654**	4,630,623	2,909,874	1,540
Total Expenses	9,789,420	4,462,728	2,529,272	250,998
Profit Before Tax	**843,234**	167,895	380,602	(249,458)
Profit After Tax	**843,234**	167,895	380,602	(248,796)
Share Capital	780,000	780,000	538,000	100,000
Reserves and Surplus	(139,603)	(185,589)	(353,484)	(734,086)
Long-term Borrowings	**303,000**	-	-	-
Revolving Fund	10,00,000	10,00,000	10,00,000	10,00,000
Fixed Assets including investments	**74,466**	28,480	34,470	35,254
Current Liabilities	**2,100,317**	1,257,245	974,369	1,057,908
Current Assets	**3,773,668**	2,637,262	1,959,789	228,332

Some of the highlights of the performance can be summed up as follows:

- The total revenue increased from a miniscule Rs. 1540/- in 2013, to Rs. 100.6 lakhs in 2016.
- The PAT during the past three years of operation ranged from Rs. 1.68 lakhs in 2015 to Rs 8.43 lakhs in 2016.
- Operations were managed without incurring long term debt so far, which is commendable. In the absence of such borrowings, the funds required for carrying on business were raised from various internal sources including share capital, a revolving fund from a donor agency, advances from SHGs, Kisan Clubs and some individual farmers and accumulated profits. The long term loan of about Rs. 3 lakhs shown during the current year can also be considered an internal source as it represents the loans taken from different Kisan Clubs.
- Current assets more than cover current liabilities in 2016, which was not the case in 2013. The CL:CA ratio dropped from 4.6 to a healthy 0.56.
- Share capital increased significantly over past three years by 7.8 times. This needs to continue growing if the company has to expand at the rate that it desires.

- The fixed asset base is very small. The absence of collateral makes it difficult for the company to get commercial loans. Investment in godowns and processing units would help not only to improve price realization for the farmers but also to serve as collateral for accessing commercial credit.

iii) Product Portfolio

KPCL has a highly diversified product portfolio as it has to meet the needs of farmers with different cropping patterns in different agro-ecosystems. As of now the portfolio is dominated by agri-input products indicating that the work on establishing backward linkages has progressed to a large extent. The same cannot be said about forward linkages and this would be the next frontier to tackle.

The data on agri-input sales by KPCL over the past three years is shown in Table 6-3. Within input supply it appears that seeds take the lion's share with over 70% of the sales coming from it. Again, within seeds, cotton dominates at Rs 44.86 lakhs with grains a poor second at Rs 11.47 lakhs and castor taking the third place at Rs 7.88 lakhs.

New fodder seeds that have come into the market recently have bright prospects because of attractive qualities and high animal husbandry base in the project area. However, this will need to be combined with support for fencing as the problem of ungulates (neelgai and wild boars) has become acute in many places, forcing farmers to switch to crops that do not attract such animals to the farm.

The sale of bio-products dipped in 2014-15 but recovered in 2015-16. The reverse trend was observed for pesticides. The dip may have been due to heavy pest attack which could not be controlled by regular bio-pesticides forcing farmers to take resort to chemical pesticides. Farm equipment has acquired a significant position with a share of almost 12 %, coming close to bio-products.

Table 6-3: Product Profile of KPCL (agri-inputs)

Product Line	**2013-14**		**2014-15**		**2015-16 (unaudited)**	
	Sales (Rs. lakhs)	**%**	**Sales (Rs. lakhs)**	**%**	**Sales (Rs. Lakhs)**	**%**
Seeds	19.92	72.45	40.42	87.56	76.54	71.37
Cotton	9.89		28.29		44.86	
Castor	3.41		6.2		7.88	
Maize	0.29		0.39		0.09	
Grains	1.32		0.36		11.47	
Pulses	0.34		0.27		0.85	
Fodder	3.56		3.8		6.42	
Vegetable	0.48		0.82		1.52	
Groundnut	-		0		2	
Others	0.63		0.29		1.45	
Bio Products	4.54	16.54	2.27	4.91	13.47	12.56

Product Line	2013-14		2014-15		2015-16 (unaudited)	
	Sales (Rs. lakhs)	%	Sales (Rs. lakhs)	%	Sales (Rs. Lakhs)	%
Bio-pesticides	0.96		0.04		4.06	
Bio-fertilisers	1.55		0.84		9.41	
Bio-culture	2.03		1.39		?	
Pesticides	0.76	2.76	3.32	7.2	4.45	4.15
Farm Equipment	2.23	8.12	0.13	0.28	12.78	11.91
Total	**27.45**		**46.14**		**107.24**	

The data on collective marketing of output is summarized in Table 6-4.

Table 6-4: Product Profile of KPCL (Commodities)

Product Line	Sales (2013-14)		Sales (2014-15)		Sales (2015-16)	
	Quantity	Value (Rs. lakhs)	Quantity	Value (Rs. lakhs)	Quantity	Value (Rs. lakhs)
Groundnut	379 MT	150.00	-	-	-	-
Spices	-	-	100 Kg	0.04	105 Kg	0.13
Pulses			1150 Kg	0.28	528 Kg	0.34
Total		150.00		0.32		0.57

In February 2014, DSC was faced with a major crisis of farmers in Dhari region not finding remunerative prices for their groundnut produce. The price of Rs. 30-33/kg was not enough to even cover the basic cost of production. The crisis got converted into an opportunity when Government of India announced a minimum support price of Rs. 40/kg for groundnut. The scheme was routed through Small Farmers' Agribusiness Consortium, of which KPCL was a member. Within a space of 17 days, produce of over 100 farmers was aggregated and sold after ensuring that it met all the quality standards stipulated by the agency. Produce of 378.44 MT worth over Rs. 150 lakhs was aggregated from 15 villages.

Although the groundnut was sold to the government and not in the open market, the entire experience provided a wealth of learning, working with different agencies while ensuring that the interest of the marginal farmer was not compromised. At first the farmers were asked to bring their produce to the APMC at Dhari. Enforcement of strict quality measures (see Table 6-5) led to high initial rates of rejection, causing much hardship to the marginal farmer who had to bear the additional cost of loading-unloading and transportation. In the interest of the farmers, DSC and KPCL prevailed on the partner agencies to arrange for procurement at the village level. The farmers too learnt to segregate their produce in order to meet the quality specifications. Thereafter it became a win-win situation for all the partners involved.

Table 6-5: Quality Specifications under MSP scheme for Groundnut

No	Parameter	Specification
1	Humidity	< 8%
2	Net weight of kernel	> 65%
3	Mixed with other variety of groundnut	< 4%
4	Underdeveloped nuts	< 4%
5	Damaged and decayed nuts	< 2%
6	Foreign elements	< 2%

The entire experience has been well documented by Center for Integrated Development (CfID) which has written a case study on KPCL. Figure 6-1 taken from the case study shows the role of different agencies involved and the flow of produce, money and information within the arrangement.

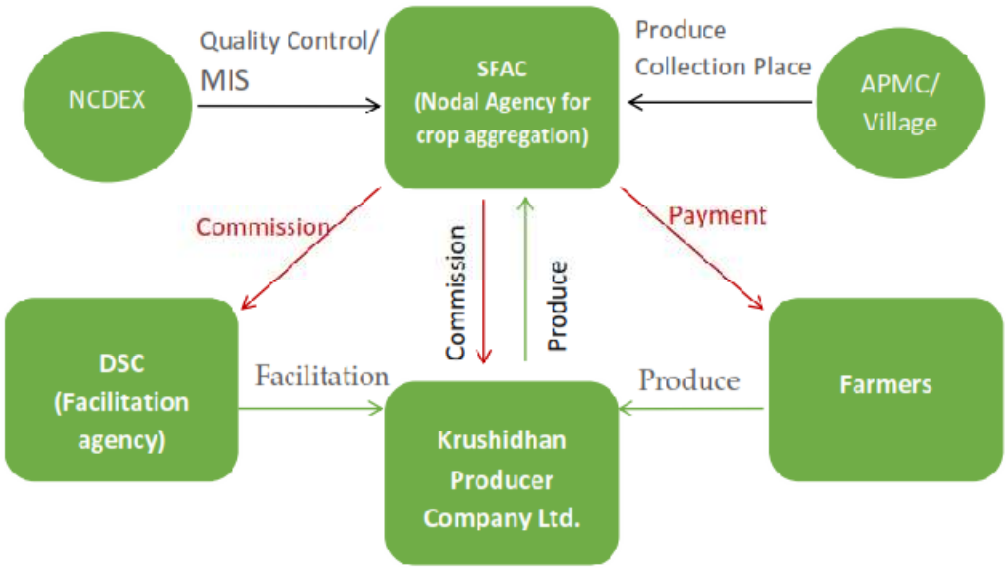


Figure 6-1 Roles of Different Agencies involved in Groundnut MSP Scheme

iv) Margin Analysis

To understand the contribution of different products better, it becomes necessary to examine the margins offered by different product lines. Some products may have high volume but low margin while others may contribute more to profitability of the company on account of high margins. An attempt was made to estimate the margins obtained in different product lines over the past three years (see Table 6-6). The main findings are summarized below;

- *Seeds:*

  Except for cotton and maize where margins are going down over time, in all crops the margins are seeing an upward trend.

  Pulses, grain, fodder and vegetables show healthy margins ranging from 20-30% and possibly are the crops to target in future if seen only from the profitability point of view.

  Although cotton has the highest share in sales, the margins are the lowest having gone down from 8.9 % in 2013-14 to about 2 % on 2015-16. The reasons for the severe drop need to be examined and steps taken to improve bargaining power for realization of better margins.

- *Bio-pesticides*

  Bio-pesticides have a high margin (40-50%) as compared to bio-fertilizers where margin is only about 10%. This may be due to shortage of cow urine and the fact that production of bio-pesticides is more knowledge intensive while production of bio-fertilizer is more labour intensive. Also, bio-pesticides compete with chemical pesticides which command a high price.

- Chemical Pesticides provide very low margins (< 4%) while farm equipment margin ranges from 10-15%

Table 6-6: Margin Analysis of Agri-input Products

Product Line	2013-14	2014-15	2015-16 (unaudited)
Seeds			
Cotton	8.90	3.18	2.05
Castor	8.50	8.55	11.42
Maize	24.14	10.26	11.11
Grains	15.91	22.22	29.21
Pulses	17.65	14.81	28.24
Fodder	14.33	10.79	18.38
Vegetable	18.75	28.05	12.50
Groundnut	-	-	4.00

Product Line	2013-14	2014-15	2015-16 (unaudited)
Others	15.87	3.45	2.76
Bio Products			
Bio-pesticides	5.21	50.00	39.90
Bio-fertilizes	9.68	0	11.90
Bio-culture	2.46	10.07	-
Pesticides	3.95	1.81	3.37
Farm Equipment	4.48	15.38	10.80

v) Wheat Seed Production

DSC initiated a pilot for seed production in wheat crop as early as 2013-14. Production of truthful and certified seed was seen as an attempt to improve the price realization for the seed producer on one hand and greater control over supply of seed to farmers on the other.

In 2015-16, the project continued to remain on pilot scale with a production of about 45 tonnes of seed material. However, one major difference was the qualitative difference in the type of seed produced. The last two years have witnessed a shift from production of truthful seed to certified and foundation seed (Table 6-7), signifying the growing confidence of farmers in seed production.

Table 6-7: Production of Wheat Seed on Pilot Scale

Year	Truthful Seed	Certified Seed	Foundation Seed
2012-13	30,090	-	-
2013-14	88.070	-	-
2014-15	92,160	-	-
2015-16	-	19,200	1,960
2016-17	-	24,700	900
Total (kg)	130,320	42,900	1,860
Total (tonnes)	170.32	42.90	1.86

Table 6-8 shows the contribution of different project units to wheat seed production over time. Interestingly, there has been a shift from Vadnagar/Visnagar to Modasa for certified seed, but for foundation seed the locus has shifted back to Vadnagar. The main reason cited was the average size of plots. Since certified seed requires larger plots, the base had to shift from Vadnagar to Modasa and

Himmatnagar. Also the quality of grain produced in Visnagar is somewhat inferior since the farmers use canal water there. The grain is bolder and better in Modasa where farmers use water of bore-wells. The shift back to Vadnagar for production of foundation seed was attributed to the linkages established between the field unit there and the Vijapur Wheat Research Center because of which it was able to access breeder seed.

Table 6-8: Contribution of Different Project Units to Seed Production (Kgs)

Block	Truthful Seed	Certified Seed	Foundation Seed	Total
Vadnagar /Visnagar	124,200	-	1,960	126,160
Himmatnagar	21,150	7,200	900	29,250
Modasa	24,400	35,700	-	60,100
Meghraj	570	-	-	570
Total	**170,320**	**42,900**	**2,860**	**216,080**

vi) Sales Analysis

There has been an exponential growth in sales over the past three years as seen in Figure 6-2, with total sales crossing Rs. 80 lakhs in 2015-16. In order to understand the source of growth, further analysis of sales data was carried out. Break-up and trend of sales was analysed for a) members versus non-members and b) different project locations (units).

Members vs. Non-members

Krushidhan has a policy of supplying its goods and services to all farmers in the project region irrespective of their being a share-holder of the company. Hence the actual reach of the company goes far beyond its 2035 members (share-holders). In order to understand the actual reach of the company and the trends in expanding reach, data on sales to members versus non-members was compiled for the past three years. The trend is presented in the graphs in Figure 6-2. As seen in the figure, sales to members during 2013-14 (year of reconstituting the company) were more, but subsequently non-member sales has overtaken and shot up far more than sales to members. This can be attributed to the growing popularity of products supplied by Krushidhan in the project area.

These non-members who have already benefitted from the services of the company can be targeted as potential future share-holders.

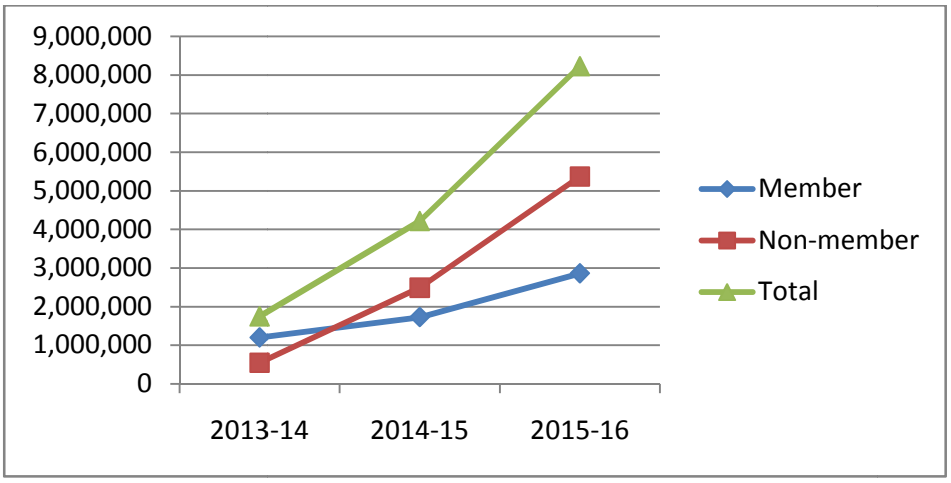


Figure 6-2 Trends in Sales to Members vs. Non-members

Share of Different Project Locations

The contribution over time of the different project units is shown in Figure 6-3**Error! Reference source not found.**. Visnagar/Vadnagar area has contributed the most followed by Himmatnagar. The growth pattern of Visnagar, Himmatnagar and Meghraj are almost the same. However, Modasa has fallen back this year. The Modasa team leader explained that they were facing severe competition from private dealers in Modasa town. These competitors have developed a modus of binding their customers by giving them credit. As the company has decided not to go down this route (of providing products on credit), they are unable to attract the customers. His suggestion was to move down further to more distant villages where the need of the company was greater.

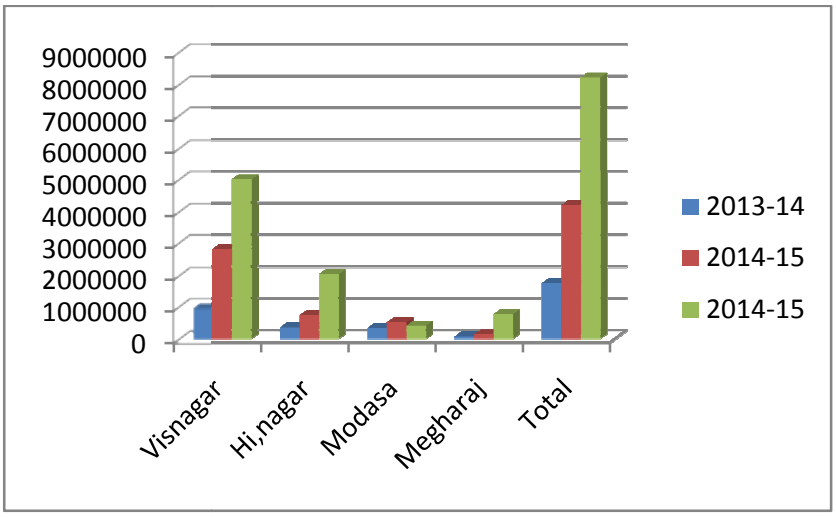


Figure 6-3 Contribution of Different Regions to Total Sales

vii) Working Capital Management

Working capital management in Producer companies is critical for its success. This is because most agri-inputs and outputs are a) bulky, therefore demanding good logistics and storage b) high value therefore requiring high doses of credit c) perishable nature of commodities vulnerable to market risks.

During the initial stages, the company finds it difficult to access credit from commercial sources which demand collateral. Commercial loans carry high interest rate burden. Even if the company manages to get such funds, if it does not have professional management or if the management makes mistakes due to lack of experience it could end up in erosion of working capital. This would directly affect the balance sheet leading to a vicious cycle.

It is heartening to note therefore that KPCL has come through the first three years raising working capital entirely through internal sources and managing it well enough to be able to earn moderate profits. While the official statement on sources and uses of funds is being compiled, back of the envelope figures indicate how the working capital was raised:

- Grant from donors (revolving fund) – Rs 10 lakhs
- Share capital money – Rs 9 lakhs
- Previous year's profits – Rs 5 lakhs
- Advance from SHGs, Kisan Clubs and individual farmers – > Rs 10 lakhs (see Figure 6-4**Error! Reference source not found.**)

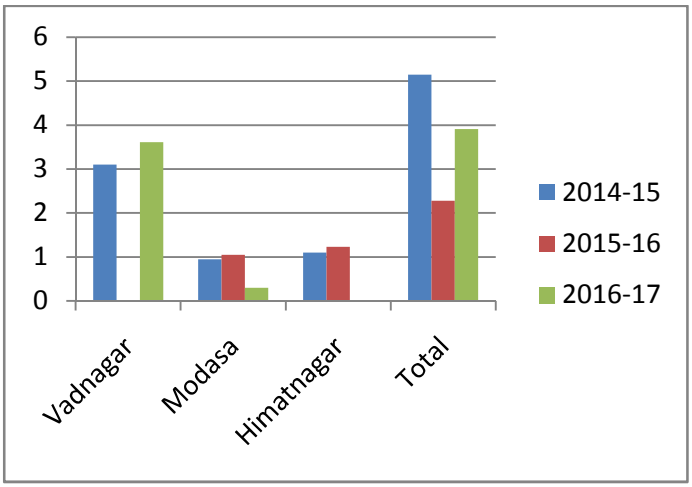


Figure 6-4 Contribution of SHGs/KCs/Farmers to WC (Rs. lakhs)

Figure 6-4 shows how farmers and their institutions have been contributing to the working capital of the company. As in all other cases, the contribution of the Vadnagar/Visnagar unit is far greater than those of the others. Meghraj farmers did not contribute as they did not have SHGs. Their credit needs were being met through a women's credit cooperative. The cooperative is doing well and has a total savings

of Rs 50 lakhs. However, it is by law restricted from taking part in enterprise and is therefore unable to provide loans to the company.

viii) Issue of high growth with financial sustainability

The company has showed an exponential growth during the first three years of operation. In order to maintain this growth, it would need to increase its sales turnover to over Rs. 3 crores in the coming financial year. The challenge is to do it in a manner that is financially sustainable. So far it has done well by utilising its own funds and managing it well. To continue growing, it will need to increase membership and resultant share capital. Increase in equity will enable it to get long term debt from financial institutions. So far it has been difficult to approach the financial institutions to ask for collateral in order to cover their risk. Although KPCL does not have any significant assets to offer as collateral, it now has a clean balance sheet and professional team to show, which should provide the necessary assurance to prospective financial agencies.

Past efforts of KPCL to procure godowns for its commercial activities did not meet with success. However, looking at the future plans of expansion as well as the need to invest in assets, KPCL will need to intensify its efforts to procure/ build godowns at central places. DSC may like to explore the support of donor agencies or government for the purpose. It was felt that centers located at cross-roads which can be easily accessed by farmers from maximum number of villages in a given region would serve the purpose. We would add that godowns when not used for storage could double up as training centers and/or retail outlets for supply of agri-inputs as well as other commodities that the farming communities need.

Use of financial incentives to members

In a recent scholarly article in Economic and Political Weekly (Feb 20, 2016), eminent researcher Dr. Tushar Shah built the case for rapid growth of FPOs through clever use of economic incentives to their members. Drawing upon the experience of five MPCs (Milk Producer Companies) established by NDDB (touted as the new generation Milk Producer Cooperatives), which have experienced dramatic growth and achieved scale of operations within a short space of three years, Shah attributes their success to good design thinking and a compelling business model.

Chief among the drivers of growth are the economic incentives that reward those members who contribute more to the business of the company. Therefore shareholders are graded into A, B, C classes according to their economic contribution. Those in A category are given a bigger say in decision making in the company. While at face value the proposition appears attractive, one must bear in mind that the FPO also has certain social goals. Its primary objective is to lift the poorest farmers out of poverty and make marginal farmers viable. Given the heterogenous composition of the company, giving too much emphasis to economic contribution could in the long run create a culture of decision making where the needs of the poorest are neglected the most. Hence while economic incentives can boost growth, judicious use is called for so as to balance economic growth with social equity and justice.

6.2 Governance of Krushidhan

A collective enterprise such as Krushidhan FPO faces two types of risks. The first is vertical in nature which is actually the enterprise risk or risk of doing business in a competitive market. The second is horizontal risk which is the risk of a large number of members coming together with a common purpose where good governance becomes the key to success. Failure of governance has often led to breakdown of collective enterprise institutions leading to their ultimate decline or closure. Therefore it is absolutely imperative to keep close track of the governance systems in place, which include among other things, a representative and enlightened leadership, a professional cadre that understands the needs of the market as well as its members/shareholders, a committed and growing membership base that develops high member allegiance and shows loyalty to the company in the face of adversity.

To understand the system of governance at Krushidhan, we adopted the following methods:

a) Preliminary analysis of share-holding pattern and membership profile
b) Interaction with the elected board of directors
c) Interaction with the ex-president and key staff from DSC who facilitated the company during its formative stages

The findings from the above three sources enabled us to assess the level of governance as well as the emerging issues before the leadership that need to be tackled for greater member satisfication and social impact.

i) Share-holding Pattern

Understanding the share-holding pattern in a member-based commercial enterprise is important because this determines the power base and ultimately affects decision-making and governance of the institution. To start with, an analysis of the share-holding by project locations was done (see Figure 6-5). As seen in the diagram, Visnagar has the lion's share followed by Himmatnagar.

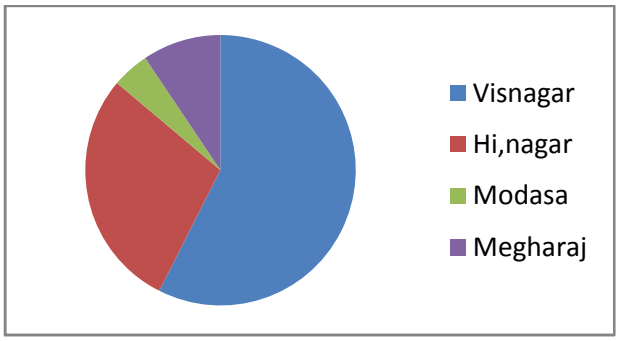


Figure 6-5 Share-holding Pattern of KPCL (2015-16)

The growth in share holding across project locations is captured in **Error! Reference source not found.**. As seen, all regions are growing at the same pace except Modasa. KPCL's management will need to verify whether the lack of growth both in sales and membership is because of the reasons cited by the unit manager, or due to lack of sufficient efforts in reaching out to the farmers of the region.

At the moment the share-holding pattern is in proportion to the contribution of sales. This gives them greater say in decision making. As of now, decisions are made keeping in view the needs of all five regions. However, there is no guarantee that in future the dominant region would not try to assert itself leading to the marginalization of one or more regions. This is an issue that needs to be considered while expanding share holding pattern in future.

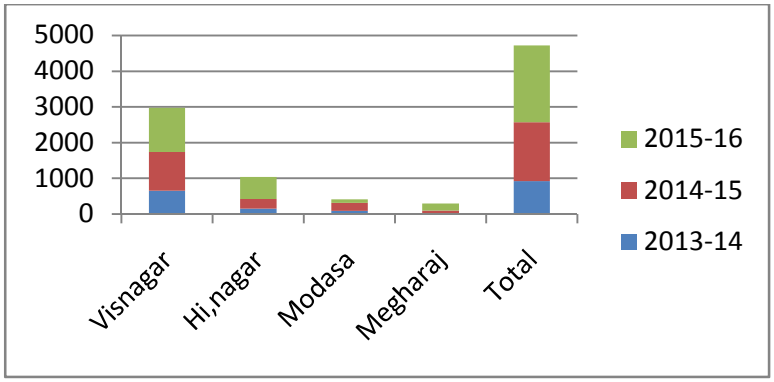


Figure 6-6 Growth pattern in Share-holding across Project Locations

ii) Profile of Share-holders

KPCL aims at creating an inclusive society by serving the needs of small and marginal farmers. An analysis of member farmers based on size of their land-holding in 2015-16 (Figure 6-7) confirms that more than 72 percent of the members are small and marginal. Only 10 farmers representing 0.5% are large farmers.

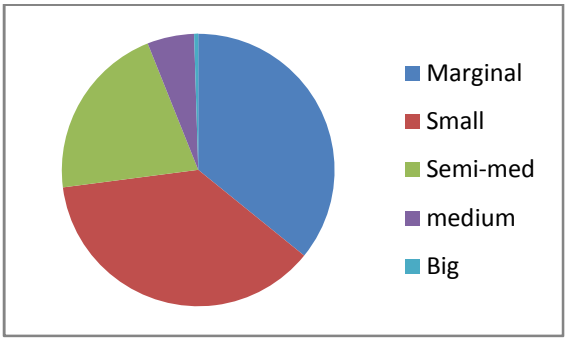


Figure 6-7 Profile of Share-holder as per Land-holding for 2015-16

According to the Program Director, Mr. Mohan Sharma, since there was an organic growth of the company, inclusion of certain farmers who fell in medium or big category was unavoidable. Excluding them would have been counter-productive for the local institution being created. In any case, it was observed that the large farmers came to KPCL to access only certain services which they knew were better than what the market could offer. They were mainly engaged in producing cash crops for which the input supply was of a different nature and accessed through different channels including contract farming. On the whole, the large farmers had not proved to be a problem - rather they were often helpful in their own ways. A few large farmers had even provided loans to the company in their individual capacity. However, it is not clear whether such large farmers will in future try to extract their pound of flesh and ask for greater control over the affairs of the company.

The gender profile of share-holders (Figure 6-8) shows clearly that the company is male-dominated. In 2015-16, only 19 % of the members were women. Currently KPCL has initiated a drive to increase the proportion of women share-holders. These women are mainly from the SHGs that have initiated some productive activity or the other.

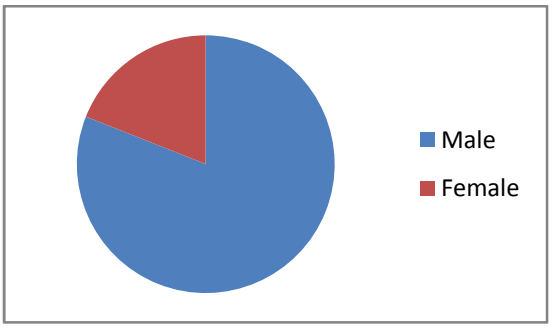


Figure 6-8 Gender Profile of KPCL Shareholders

iii) Board of Directors

Representatives from different clusters were sent to the Board. Two main criteria were used for selecting board members: a) membership with a Kisan Club[6] and b) active participation in the work of the company and Kisan Club. The composition of board members is also based on the extent of farmer participation in different areas as shown in Table 6-9 below.

[6] An exception was made for Vehlal, where a cooperative already existed. It was decided to invite the cooperative to join the company which has a state level stature, as it would help the cooperative in reaching the market better.

Table 6-9: Representation Pattern in Board of Directors

Area	No of Villages*	No of Kisan Clubs/cooperatives	No. of Directors
Visnagar	69	60	5
Himmatnagar	28	37	2
Modasa	18	38	2
Meghraj	18	33	1
Dhari	20	30	1
Vehlal	18	1 cooperative	1
Total	151		12

*These figures have undergone minor changes since the beginning of Phase II as a few villages have been added while some have dropped out; hence the discrepancy between figures shown in Table 1.1 and this table.

Hence Visnagar which has the maximum participation of farmers also has the maximum number of Kisan Clubs and is therefore eligible for a larger representation in the Board.

Regarding gender balance within the Board, at present there are only two women board members. This is a good beginning considering that farming decisions are traditionally dominated by the men. In due course this ratio would also change as more women shareholders join the company.

iv) Professional staff and organisational structure

The company is currently staffed by 17 employees which are of three categories. The break-up is as given below:

Office staff – 3
Supervisory staff – 7
Field staff - 7

The CEO looks after four departments as shown in the organogram in Figure 6-9.

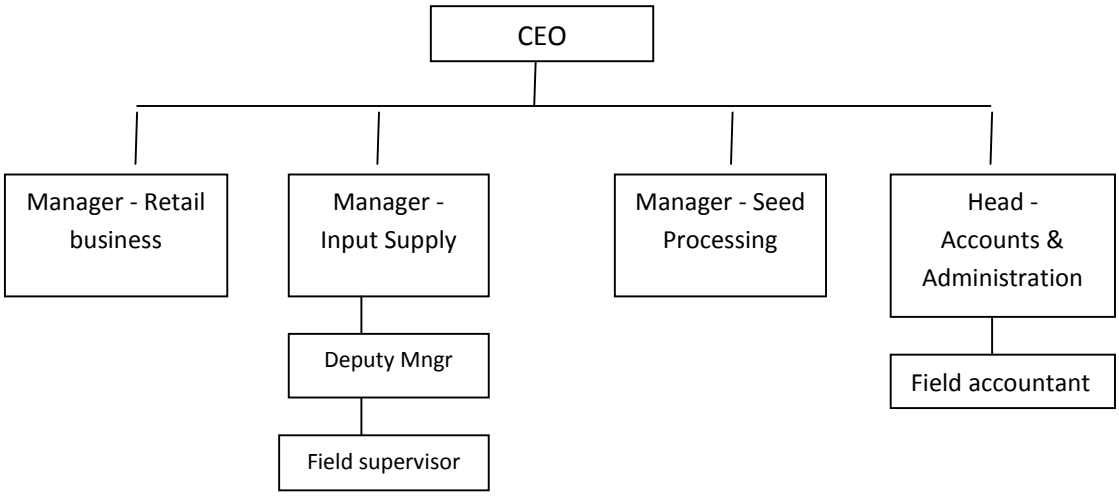


Figure 6-9 Organogram of Krushidhan's Professional Staff

The cost of the CEO, managers and accountant is borne by DSC while the supervisory staff is supported by Krushidhan. The total salary bill per year comes to approximately Rs. 13 lakhs which represents about 70% of the office overheads in the year 2014-15, but is increasing year on year.

The present field and supervisory staff appears to be comfortable in the tasks that have been given to them. The most challenging task is that of the CEO as he has to balance the needs of the market and enterprise on one hand and the needs of the members and elected representatives on the other. The present CEO spends considerable time in assessing markets for various products, establishing both forward and backward linkages in the market. In the near future, as the company moves into collective marketing in a bigger way, there may be a need to appoint a separate manager for forward linkages. This would leave enough time for the CEO to keep track of the performance on different aspects of the enterprise. Within the administration, the sub-accountant may be trained to maintain data on monitoring indicators and prepare reports from time to time, which would serve as the basis for review meetings of the FPO.

It is suggested that a separate review of all staff and their training needs may be carried out internally or with the help of an HR consultant. The same may be done for Board of Directors. This is linked to the issue of leadership of Krushidhan discussed in point number v) below.

v) Member Satisfaction and Allegiance

In 2015-16, a team of three students from School of Rural Management, NLRI (GVT), Ratlam, M. P. carried out a consumer survey of both member and non-member farmers within the target area[7]. The study was useful in understanding among other things, the farmer as a consumer of agri-input services provided by KPCL. The responses of both shareholders and non-shareholders were provided. The relevant findings are reported below in an effort to understand the extent of member satisfaction and allegiance to their company.

Satisfaction with SMS Service

One of the privileges that members (share-holders) of KPCL enjoy is the free SMS services provided by the company. The service provides messages about the availability of various products in the retail outlets as well as short technical advisories in a timely fashion. This service has largely met with the approval of the members, although as shown in Figure 6-10, there is some scope for improvement. About 9.9 % were not able to access the messages. This may be because they stay outside the coverage of the telecom service provider. This situation may improve in future as the companies are constantly trying to expand their area of coverage. Of the 90% who are able to access the messages, about 7.5 % remained unsatisfied while the large majority (92.5 %) expressed satisfaction.

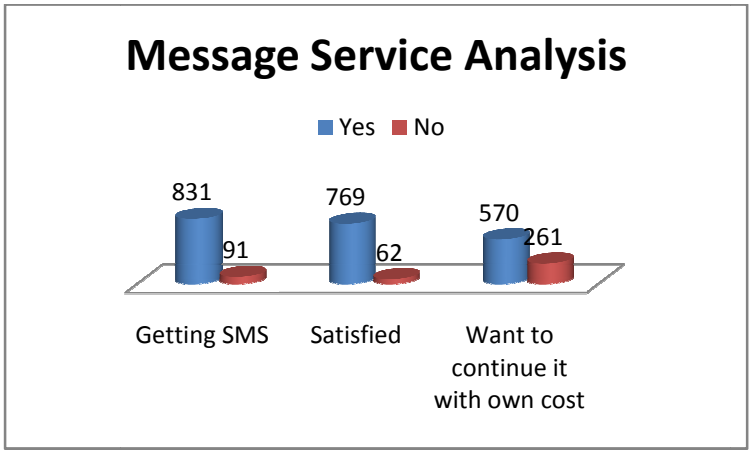


Figure 6-10 Satisfaction Level with SMS Service

Loyalty of Members Expressed in Buyer Behaviour

The buyer behaviour of shareholders (**Error! Reference source not found.**) varied from product to product. In general, a very high loyalty was shown when it came to seeds, where KPCL has established its credibility. Loyalty was not very strong for pesticides and vermi-compost. In the case of pesticides, shareholders may be accustomed to purchasing on credit from the usual dealers. In the case of vermi-

[7] Bhartendre Singh, Varun Kumar and Ashok Tandi, *Customer Review of Krushidhan Producer Company Ltd. and Demand and Supply Analysis of Vermicompost*, a report submitted to Mr. Mohan Sharma, DSC and NLRI in partial fulfillment of the Post Graduate Diploma in Rural Planning and Management (2016).

compost, the company only sells the surplus material produced by producer groups. Hence most farmers purchase it locally from the producer groups.

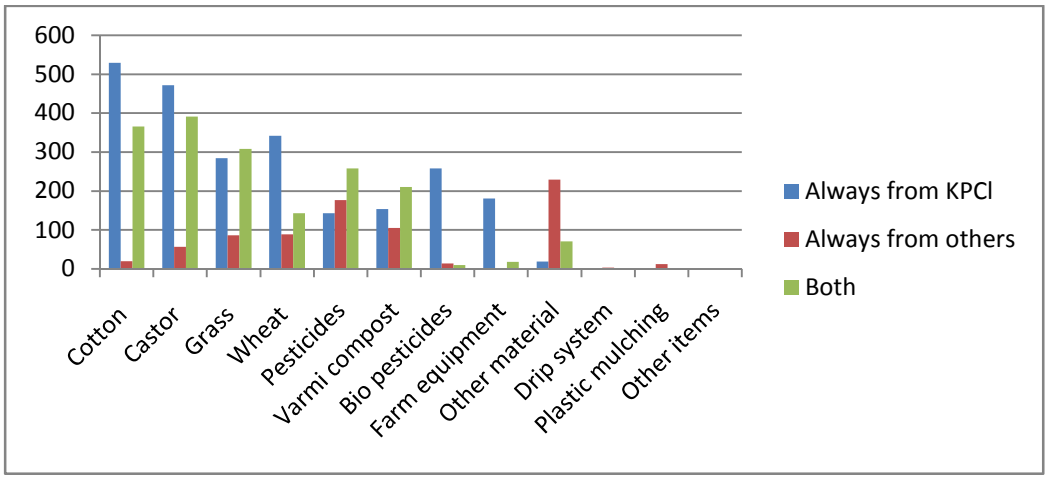


Figure 6-11 Buyer behaviour of shareholders

In another section of the study, the authors conclude that 98% of all farmers in the target area have started accessing products from KPCL outlets. The primary reason is not accessibility but a perception and experience of high quality of services provided by the company. This should be a matter of great satisfaction for the professional staff of the company. One may conclude that one way to ensure member allegiance is to provide them with high quality of services. The fact that the company does not insist that members purchase only from its outlets provides them flexibility of accessing other services in the market when they feel that they are not getting what they want from their own company. This too augurs well for member allegiance as it builds respect for the company policy and board of directors.

vi) Emerging Issues of Governance

In order to understand the Governance issues better, it is necessary to provide to the reader a little background to the producer company in its present form. This background is drawn largely from a process documentation on the evolution of Krushidhan brought out by DSC in 2015[8]. It is worth mentioning that Krushidhan is a re-incarnation of an earlier FPO promoted by DSC in 2005 at Dhari where it had been implementing its watershed plus programme. Taking advantage of the recently enacted Act on Producer Company under Companies Act (1956) DSC sought to transform the watershed federation at Dhari into a producer company. Hence the Dhari Krushak Vikas Producer Company Ltd. (DKVPCL) was registered on 23rd June 2005, being the first such company to be registered under the

[8] Authored jointly by Mohan Sharma and Jasvant Chauhan from DSC with Center for Integrated Development, Ahmedabad

new enactment. At that point in time, DSC had little to nil experience in facilitating the incubation of such an enterprise. Not surprisingly, it made several mistakes and the company began to decline till it became non-functional.

Around the same time, LEPNRM Phase I was completed where a need was clearly felt for a people's organisation which would provide the services of collective input supply and collective marketing of farmers' produce. Rather than to create a new institution with attendant start-up costs, DSC decided to restructure DKVPCL into a multi-district, state level producer company under LEPNRM Phase II. DSC's facilitators had by now learnt the ropes on facilitating such an institution and were fully aware of the various pitfalls involved. It was determined to make the company in its new avatar a success by overcoming all the previous shortfalls – see Table 6-10 for a summary.

Table 6-10: Measures taken by DSC while incubating KPCL from its previous avatar

No.	Limitations of DKVPCL	Measures taken for KPCL
1	Shareholding provided externally, lack of ownership of farmers	Emphasis on farmer's shareholding in order to build their stakes in the company; institutional support provided to strengthen shareholding which is critical for leveraging commercial funds
2	Coverage limited to Dhari region	Geographic coverage was expanded from just one block to 11 blocks covering north and central districts of Gujarat, in order to increase shareholding as well as business opportunities
3	Services lmited to input supply	Services expanded to include technical advisory, collective marketing, value addition etc.
4	Limited women's involvement	Women involved at all levels in the three tier structure of the company
5	Lack of collaborative initiatives	Increased partnerships with various technology institutions, market players, government agencies, NGOs etc. in order to provide comprehensive services to the marginal farmer who was the central focus of all activities
6	Lack of sufficient inputs for capacity building of the governance body	Increased involvement of DSC staff to build capacities of board as well as professional staff with training and handholding
7	Poor leadership of the board	Revamped entire structure and governance of the company with an approach to build from bottom upwards; criteria for allowing only interested and apolitical farmers as shareholders; focus on building a three-tier pyramid structure with a broad base
8	Lack of professional management	Deployed professional staff from day one with financial support under LEPNRM, with a clear plan of the company paying for the salaries once it had reached financial self-sufficiency

From the above background the following points become very clear:

i) KPCL is a re-incarnation of an earlier failed attempt at promoting an FPO
ii) KPCL is a crafted institution with DSC as its incubation center
iii) The earlier experience of failure had proved invaluable to DSC staff in learning the science and art of facilitating a collective enterprise institution

Hence it is not surprising that KPCL had posted positive financial results during the first three years of its operation and had grown not only in terms of membership and ownership but also in terms of the range and scale of services provided to members, member allegiance and loyalty and a larger vision among members for self-reliance on a sustainable basis.

The important role of expert facilitation/mentoring in creating such crafted institutions cannot be over-emphasised. DSC provided intensive capacity building and hand-holding support including exposure visits for directors of Krushidhan and staff members. This helped the DSC field staff as well as that of Krushidhan to learn from other agri-enterprises across the country. In addition, structured training programmes on business plan development, accounts and administration etc. was provided. Continuous guidance provided by Mohan Sharma, the then Programme Director, helped in building the confidence of Jasvant bhai, CEO of Krushidhan and other Krushidhan staff. All this contributed to the success of the start up which had grown largely on its internal resources, managed its working capital in a professional manner and steered clear of all the known pitfalls of such a collective enterprise.

Not withstanding the above, the company was at this point in time facing a few governance issues which are discussed below.

a) *Leadership*

While professional guidance and mentorship provided by the Programme Director continued to support the FPO from outside, in the initial stages it was felt that an expert director should be inducted to the Board of the Company to provide leadership, help establish systems and take strategic decisions. To this end, Mr. Arvind Gupta, a retired professional with expertise in cooperative management was appointed as external chairperson but actually served as a mentor and advisor.

About a year ago, Mr. Gupta tendered his resignation due to personal reasons. The Board was not able to identify a suitable person to fill the shoes of the previous chairperson from within. Among the available choices, the perception was that Vasantbhai lacked consensus. Lalitbhai on the other hand, had both, the capacity and acceptability, but was preoccupied with his own business and would therefore not be able to give time to the affairs of the company. The Board in its wisdom, decided on collective leadership with temporary chairpersons elected for each board meeting. This arrangement has continued for about a year.

By default the leadership was provided by professionals in the form of CEO appointed by DSC (Jasvant bhai) and mentoring provided by the Program Director. As long as this support from the professionals was forthcoming, the Board members did not feel the absence of a chairperson and felt comfortable allowing the professionals to call the shots. However, it is suggested that the issue of local leadership

should be resolved at an early date as it has an important psychological bearing on the people's institution. If the institution is perceived to be 'headless' it can affect the morale of the members. Even if the ideal candidate for chairperson is not found, the chair should not be allowed to go vacant. Over time the person would grow into the role and if not, some other aspirant would challenge him and come forward to take the leadership.

It is in this context that the discussion on the role of leadership and alternative models for leadership that we had with Mr. Arvind Gupta is both relevant and instructive. A few excerpts from the interview are given below:

> "The chairman plays the role of balancing the professional group with the elected representatives. Getting a Chairperson who understands both and plays the balancing role is therefore a big challenge."

"The Chairperson plays a role of providing leadership in the following ways:

- Strategic thinking for the business of the company
- Vision building
- Motivating the professional team and
- Managing the balance between professional staff and the board"

"The day-to-day responsibilities of the leader include the following:

- To sign documents
- To respond to audit inquiries
- To carryout dispute resolution
- To represent the organization at various forums
- To chair board meetings"

Mr. Gupta added that the Chief Executive Officer (CEO), a professional appointed by the Board, also played a critical role of providing leadership as well as educating and empowering the members:

> "The CEO must become the member secretary. The leadership of paid employees is equally important. In fact Dr. Kurien retained the secretary position of Gujarat Milk Marketing Federation precisely to maintain this balance between professional staff and elected representatives, between business and social goals."

Hence this represents a different model of leadership which could be termed 'Social Intrapreneurship Model' as opposed to the 'Empowerment Model' of leadership which is generally followed by most NGOs. This model requires hand-holding of the Board over a long time frame. The nature of support changes gradually from hand-holding to one of "friend, philosopher and guide" as the leadership of the elected representatives matures over time.

DSC's previous director Mr. Sachin Oza, felt that the organization was fortunate enough to have the support of a donor agency like RBS Foundation which was quick to grasp this fact and was willing to give a long term commitment so necessary for an intervention like this. In his words:

> "Unlike a paper-tight project which hardly gives any flexibility to a facilitating agency as well as the FPO, RBS helped Krushidhan to grow at its own pace. They provided guidance when required and did not prescribe or micro-manage the project. Given the uncertainties of production and markets, such flexibility is required if the FPO has to grow and adapt to changing times."
>
> "In addition, RBS gave the space to DSC to develop and disseminate Information Education and Communication (IEC) material such as *Divadandi*, crop specific booklets, video films etc. for agriculture extension and promotion of good practices. This is one of the critical elements often overlooked and not supported by funding agencies."

The scaling up by Krushidhan would entail a need for modifications in its present systems – financial, HR, project monitoring and management. As the FPO moves into collective marketing and value addition, it will need set up a dedicated team to handle market research and marketing of the produce. If it gets into backward integration for seed production which needs greater technical expertise, it may need to hire the part-time expertise of a suitable scientist. But these are strategic decisions that the organisation has to make after evaluating the performance of different pilots and assessing the markets for these options.

b) *Member Satisfaction and Allegiance*

Although the study carried out by students of NLRI (GVT) shows very positive results, the professional team must constantly monitor member satisfaction and strive to increase the value of services provided to them. The next move of the company will be to establish forward linkages so that farmers realise a higher price in the market for their produce. When this happens member satisfaction and allegiance is likely to increase further.

Other ways to improve allegiance is to improve the stakes of the farmer member in the organisation. This means increasing the share holding per member and establishing a sense of belonging and pride in the institution. Constant dialogue of the board of directors with common members is a pre-requisite. The ability of the leadership in creating a shared vision for all members and farmers of the region would also go a long way in creating higher member allegiance. This is important because when the organisation faces a backlash from market forces, the professional team should be backed up by the members. Willingness to forego short term gains in order to ensure the success of the enterprise in the market place would indicate that the members have truly imbibed the vision and spirit of the company.

c) Increasing shareholders for future growth

Clearly there is a need to improve share-holding if the company is to grow aggressively. The debate on how to go about it has brought out various considerations that impinge on the design and architecture of a pyramid institution such as an FPO like Krushidhan. In the short run it would be easy to grow by expanding the number of villages. However, in the long run this would be difficult for the company as it

would be spreading out too thin. This would have implications on the cost of providing services to a clientele that is spread out over a larger area. Another easy way out would be to make women of all male members shareholders. This would double the share capital while improve the gender balance at one stroke. However, most of the staff felt that such a decision may not bring forth gender parity. Instead it would be better to recruit share-holders from women's groups that are active. A third alternative would be to intensify the drive among non-members within the existing project area who have already tasted the benefits of the company's services. One way would be to announce schemes that link provision of shares to the volume of sales. However, this would favour large farmers who tend to buy more than marginal farmers. Decision making in FPOs becomes very complex because the management and the board has to constantly balance the economic growth needs with the social objectives of the company.

In this context, the advice provided by Mr. Arvind Gupta, Ex-Chairperson, KPCL, seems appropriate:

> "Expansion must be done in a cost effective way. It has to be charted out. There should be no compromise on quality and process. New KCs should be set up within the same target area. The screening process for shareholders should continue to be KC membership and active participation of farmers."

6.3 Strategic Planning for Next Phase

Mapping of Activities Undertaken by Krushidhan

The framework described in section 3 was used to first map out all the major activities undertaken by KPCL so far. These activities were further divided into two categories based on their scale viz. a) mainstream and b) pilot. Table 6-11 provides the mapping of activities.

Table 6-11: Mapping of Activities by KPCL (2015-16)

Stage	Mainstream	Pilot	Remarks
Stage 1: Stabilizing Cost and Production			
1) Human Capital-Input Quality Orientation	Mobile Soil Testing Services; awareness about soil health and sustainability		
	Farm Demonstrations; exposure visits; extension activities		
Market Orientation		Wheat processing (cleaning and grading with machine) (Good potential for scaling up) Cleaning, grading (manual) in Vahariali	Pilot not very successful but lot of learning took place
	Groundnut marketing with NCDX quality standards		
Sustainability Orientation	Promotion of bio-fertilizers and bio-pesticides to be produced by SHGs/producer groups and supplied locally		
2) Social Capital	Creation of peoples institutions starting from SHGs and Kisan Clubs to KPCL		
3) Technology		Drip Irrigation	Good potential for scaling up
	SRI initiated in Vehlal		Can be expanded to other crops
		Solar and group fencing	Good potential for scaling up
	Crop and varietal diversification;		

	Improving seed replacement ratio through supply of certified seed		
	Promoting Bio-products and organic farming		
	Promoting improved hand tools to reduce drudgery		
	Supply of micro-nutrients for better crop health based on soil testing reports		
4) Asset Building	Earlier and on-going work on PIM, watershed management	Investments in solar and group fencing, drip irrigation etc.	
Stage 2: Understanding and Dealing with Markets			
1) Backward linkages	Supply of quality seeds at farmers' door-step		
	Supply of micronutrients, chemical, pesticides, bio-pesticides and agri-implements		
2) Forward linkages	Groundnut marketing to government through NCDX	Vahariaii marketing experiment	Not very successful, but potential exists
		Tie-ups with cotton ginners in Dhari	Moderately successful in Dhari, but price difference not significant in other project areas
	Construction of five godowns planned but not accomplished		Need still exists
Stage 3: Backward and Forward Integration			
1) Backward integration	Production of vermi-compost and bio-pesticides by SHGs/individual farmers		
		Certified and Foundation seed production in wheat and groundnut	Very successful and needs to be scaled up; can also diversify into other crops
2) Forward integration		Processing of pulses by women's SHGs	Potential to scale up through mechanization and diversification into processed food snacks

Among other things, the mapping exercise shows that KPCL and DSC are constantly exploring and testing new ideas which could be scaled up in the near future and help the company to graduate to the next level. Some of the pilots that were done during LEPNRM –II which have done well and are therefore worthy of scaling up include:

i) Wheat processing (cleaning and grading with machine)
ii) Drip irrigation to improve both water and land productivity
iii) Solar and group fencing
iv) Certified and foundation seed production, mainly in wheat but also initiated in groundnut
v) Food processing of pulses by women's SHGs
vi) Expansion of SRI methodology to other crops

Activities which did not work out for some reason or the other but are still worthy of consideration were:

i) Godown construction could not be taken up due to difficulty in procuring land for the purpose; however this is an important felt need and must be pursued more vigorously
ii) Vahariali (fennel) processing was not successful manually but can be taken up with proper machines and technology

Processing of Ideas for Scaling Up

A day-long workshop was organized on the 25th of May, 2016 involving key officers of Krushidhan Producer Company and all concerned LEPNRM staff of DSC. The complete list of ideas shortlisted during the meeting is shown in Annexure 2. The participants were divided into two groups, each of which took up the assessment of 14 business ideas. The criteria used to make the assessment are explained below.

Criteria for Selecting Business Opportunities

- *Scalability*

  What is the potential for scaling up production in the project area?

- *Profitability*

  What is the margin for the FPO? What should be the minimum margin to become economically viable?

- *Entry barriers*

  What are the entry barriers such as access to technology, markets, capital, trained manpower etc.? What are the chances that the company can overcome these barriers and make the business opportunity a success?

- *Potential Markets*

  What is the potential market like and what kind of investments will be needed to actually realise that market? Is the market highly competitive and saturated or is it growing fast? What are the

chances of getting a foothold in the market with what kind of market share? KPCL management can use tools such as *BCG matrix* in future if enough information on market is available.

- *Strategic Potential*

  What is the strategic potential of the business opportunity? How much will it contribute to the long term goals set out by KPCL? How well does the new opportunity contribute to any of the following stated goals of KPCL?

  - Self-reliance of small and marginal farmers in project area
  - Timely and cost effective supply of quality inputs to farmer through process of aggregation and planning
  - Value addition to produce through collective marketing and sustainable marketing arrangement
  - Promoting sustainable agriculture
  - Promoting market orientation among farmers

- *Social Benefits*

  What are the potential economic and social benefits to farmer families because of which the opportunity should be included even if profitability is low? How can the company balance the social benefits with economic viability of KPCL? Figure 6-12 provides a matrix as a tool for assessing opportunities such that this balance is maintained).

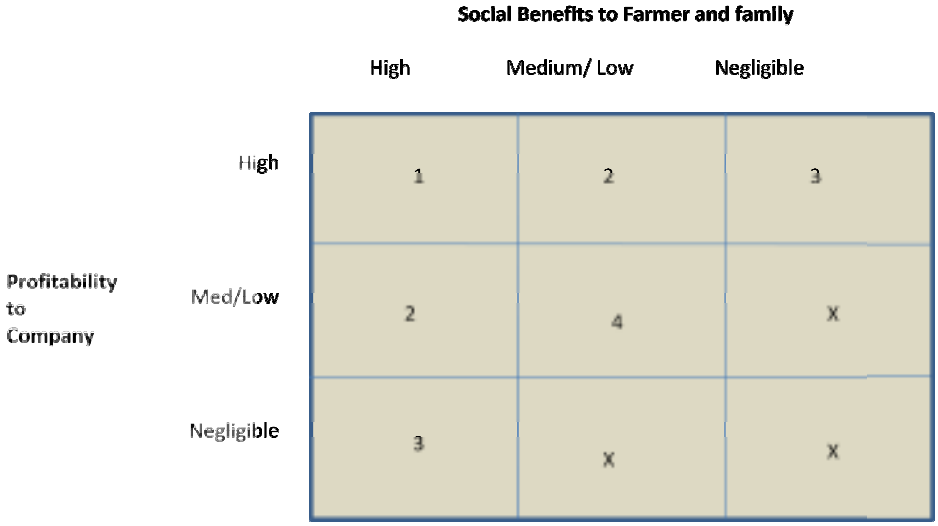


Figure 6-12 Balancing Act for FPO: Social benefits versus economic viability

Selected Business Opportunities

For each opportunity the groups came up with clear recommendations which could be any one of the following:

- Recommended for scaling up as such
- Recommended for pilot testing the idea
- Recommended for feasibility study
- Not recommended in the near future due to XYZ constraints

A three-point scoring system (for high-medium-low) was decided upon giving equal weight to each of the criteria mentioned above. The activities that scored 10 or less points were selected as a first cut. The results of the evaluation are summarized in the chart provided in Annexure 2. The selected opportunities along with rough estimates of the amount of investment needed are indicated in Table 6-12 below.

Table 6-12: Business Opportunities Selected by Workshop Participants

S No	Business Idea	Total	Yes	Scale Up	Pilot	Study	No	Reason
1	Seed trading	11	Y	Y				
2	Wheat / groundnut/ grass Seed Production (truthful/ certified/foundation)	8	Y	Y				
3	Cotton seed / castor seed production with companies	11	Y		Y			
4	Production of organic seed materials	15	Y			Y		
5	Production of bio pesticide/fertilisers	9	Y	Y				
6	Production of trichoderma	12	Y		Y			
7	Production of liquid nitrogenous fertiliser and liquid micro nutrient	14	Y		Y			
8	Production of neem cake/ oil/ trichoderma	10	Y	Y				
9	Fennel seed processing and by products	10	Y		Y			
10	Value addition of spices	11	Y	Y				
11	Market camp of spice selling	17					N	competition/ unavailability of manpower
12	APMC trading	12	Y		Y			
13	Trading of seeds, and other commodities with other states	11	Y		Y			
14	Wheat and gram flour production and marketing	10	Y		Y			
15	Storage facility at cluster level							

Summary of plans for next phase

As communicated by the Programme Director, in the next phase of LEPNRM, DSC would like to:

- Cover 199 villages reaching out to about 35,000-45,000 farmers
- Increase share capital of the company to about Rs. 45 lakhs
- Build fixed assets viz. land and godown worth Rs. 35-40 lakhs
- Achieve average 12-15 % profit annually to accumulate Rs. 55 lakhs net surplus after tax in next three years
- Evolve a business model for achieving these targets while making the company financially sustainable.

7 Conclusions and Recommendations

The authors are of the opinion that during Phase II, LEPNRM project has made considerable progress in terms of improved delivery of extension resulting in significant impacts on sustainability of agriculture in the targeted regions. An important gain has been the establishment of an FPO with strong backward linkages resulting in supply of quality agri-inputs in a timely fashion. DSC as a facilitating organisation has gained valuable experience in promoting a collective enterprise of farmers that has established strong ownership along with professional management. Financially the company has been profitable while providing valuable services to the farmer. It appears that the management of the company has made all the right moves so far and stayed away from the usual pitfalls which such organisations are prone to. When asessed against eight most important parameters of high growth, successful FPOs identified by Dr. Tushar Shah (2016), Krushidhan comes out a winner, having followed intuitively all these eight underlying principles (elaborated in Section 7.2 below). This bodes well for the company.

The authors have taken this opportunity to propose a conceptual model which represents the underlying 'theory of change' of the project. The model underlines the 'value chain approach' adopted by DSC through a multi-tier system of people's institutions, which goes into three distinct stages. The model was designed not only to put in perspective the work done by DSC through LEPNRM but also to provide a roadmap for the future. The framework was used effectively to plan out strategic initiatives for the third phase of LEPNRM. The report also provides details of the brainstorming session held with DSC and Krushidhan staff and the selection of most promising activities for Phase III.

This section provides the emerging conclusions and recommendations separately for DSC's extension system and for Krushidhan the FPO. As the company makes plans to encourage more and more farmers within the target area to join the collective movement, a stronger convergence between the efforts of the extension team and those of the company is envisaged.

7.1 DSC's Extension System

DSC's extension system targets 38,500 small and marginal farmers located in five regions of north and central Gujarat and is therefore organised into five units as per the demands and needs of the regions. An exercise of mapping the social composition, soil types, irrigation facilities and cropping patterns for each area and making explicit the relationships between these, was facilitated during the review, so that the extension teams could plan their future work in a better way. About 6000 of these farmers are estimated to have taken advantage of the services of the company so far. Only about 2000 of these farmers have opted to become share-holders of the company. While data was collected separately for all three categories of farmers, it made more sense to understand the impacts on the sustainability of agriculture in the region by focusing on specific crops where DSC has made interventions.

Characteristics of the sample farmers

- The average per farmer cultivated land is lowest in Meghraj at 1 Ha and highest in Guhai at 2.3 Ha. About 80 to 100 per cent of this cultivated land across the five project locations is irrigated either through bore-wells or canal network or both.

Significant changes in the farming systems

- Over the past 3 years, milch animal population has shown a decline in Dharoi, Guhai and Mazum due to social changes and reduced fodder availability as a result of shift in cropping pattern towards cash crops.
- Decline in number of draught animals like bullock, ox etc. has also been witnessed, especially in Dharoi and Guhai where increasing mechanization in agriculture is seen as the primary reason behind this trend.
- Increase in menace of wild animals like nilgai and wild pig in agriculture has been reported from across all project locations. Farmers' efforts to deal with this menace by adopting a range of different measures have met with varying levels of success. DSC's extension system has also responded to this challenge recently by introducing solar fencing and group fencing on a trial basis. Other adaptations include changes in cropping pattern towards crops that are not attacked by the ungulates.
- The effects of climate change have been felt in the project area during recent years. Some crops like wheat are more sensitive to climate change. Adaptations are being made intuitively by farmers as well as through recommendations from the Agricultural Research Centers located in the area (particularly the Wheat research center). Chief among these are the adoption of shorter duration varieties and varieties more suited to higher temperature. Better soil and water management practices are also recommended.
- The above changes have resulted in an adjusted cropping pattern which was captured as follows: Cotton and castor are the main Kharif crops in Dharoi, Guhai and Mazum. In Meghraj, cotton and maize - which is grown in place of castor – are the predominant Kharif crops whereas in Vehlal, paddy and vegetables are commonly grown. Wheat dominates Rabi season cultivation across all five project locations while fennel is also grown in Dharoi. In Summer, there is some vegetable cultivation that is carried out in Vehlal; however, farmers in other locations are not able to take any crops due to lack of water.

Table 7-1: Percentage of cultivated land under different crops

	Kharif					Rabi		Summer
Project area	*Cotton*	*Paddy*	*Castor*	*Maize*	*Vegetables*	*Wheat*	*Fennel*	*Vegetables*
Dharoi	31	0	26	0	0	18	40	0
Guhai	46	0	38	0	0	50	0	0
Mazum	23	0	35	0	0	35	0	0
Meghraj	37	0	0	40	0	37	0	0
Vehlal	0	49	0	0	21	37	0	17

Impact of DSC's extension services

- DSC's extension services have had an extremely positive impact in terms of reducing farmers' expenses on agriculture inputs like seeds, chemical pesticides, fertilisers, weedicides, irrigation water and labour as well as improving their incomes as a result of higher crop productivity and better price realisation.

- This impact is seen not just across Kharif but also Rabi and summer crops. Adoption of recommended seed rates in cotton, hybrid/high yielding variety seeds in maize and vegetables and SRI in paddy have reduced the quantity of seed required per hectare by 9% in cotton, 47% in maize, 20% in vegetables and 42% in paddy. Similarly, seed requirement has reduced by 10% in wheat and upto 25% in the case of vegetables. This has resulted in seed expense savings of nearly 90 lakhs at the project level.

- Use of bio-pesticide among cotton farmers has gone up from 13 litres to 21 litres per hectare – an increase of 67% - and from 16 litres to 27 litres per hectare in wheat – an increase of 69%. Its use has also been initiated by farmers in crops like paddy, maize and vegetables for the first time after the project. Although chemical pesticides still continue to be used for cash crops like cotton and castor, their gradual substitution with bio-pesticide has reduced the chemical load by 49%, 13%, 11% and 11% in maize, vegetables, paddy and fennel. The reduced requirement of chemical pesticides as well as the lower cost of bio-pesticide has led to significant farmer savings. The combined project-level savings resulting from this are almost Rs. 1.15 crores.

- Similarly, adoption of bio-fertilisers such as vermi-compost and FYM has led to a decrease in the quantity of chemical fertilisers such as urea and DAP in the case of paddy, maize and vegetables by 18%, 11% and 9% respectively. However, due to insufficient N,P,K content and the fact that they are usually required in bulk quantities, bio-fertilisers remain a less effective replacement for their chemical counterpart than bio-pesticide. Nevertheless, a reduction of more than Rs. 86 lakhs in farmer expenses on chemical fertilisers has been witnessed as a result of the project.

- Post-project weedicide usage of farmers has fallen across nearly all crops - by 29% in cotton, 11% in castor, 58% in paddy, 21% in maize, 20% in vegetables and 11% in wheat. This has been possible due to adoption of practices such as mulching, preparing modified bed and furrow and decomposing the FYM before application, which help minimise weed growth. Among chemical inputs, savings in weedicide expenses of farmers have been most significant to the tune of over Rs. 1.63 crores.

- The project has been able to bring about greater awareness among farmers about using water more judiciously. This has had a direct impact on the number of waterings required for crops - for instance, in the case of a water intensive crop like paddy, there has been a reduction of 8 waterings per hectare before and after the project. Although this reduction may be less spectacular in the case of other crops, it is a sign that farmers have started making efforts towards using irrigation water more efficiently.

- Along with low-cost methods of water saving and better water management practices, farmers are also increasingly adopting drip irrigation technology. Over the past 3 years, the proportion of project farmers installing drip systems has increased from 9% to 19% while in the case of control farmers, it has decreased from 8% to 5%. This has led to project-level savings due to reduction in water use of more than Rs. 1.98 crores.

- Labour and miscellaneous (L&M) expenses account for the highest proportion of agriculture input expense for a farmer. Broadly, L&M expenses have come down in the case of food crops like paddy, maize and vegetables, in line with reduction in the quantity of seeds and chemical inputs since L&M expenses are directly proportional to the level of input. Adoption of new agriculture tools and technology such as *chipiyas* and drip irrigation by farmers has also played a part in bringing down these expenses. At the project level, savings of nearly Rs. 76 lakhs have been achieved under this head.

- Significant differences in productivity have been found between farmers who benefitted from DSC's agriculture extension services and those who did not, across all crops surveyed. Higher productivity and better price realisation on account of cleaning and grading of produce have been the biggest contributors of economic impact, totaling about Rs. 82 crores at the project level. Approximately 51% of project beneficiaries have undertaken cleaning and grading of produce under the project and benefitted from average price premiums of Rs. 2/- per kg in wheat, Rs. 5/- per kg in vegetables and Rs. 13/- per kg in fennel.

- The overall impact of DSC's extension services has been extremely positive, not just from an economic but also environmental point of view. The total economic benefit at the project level due to savings in agriculture input expenses and improved income is nearly Rs. 90 crores which translates to about Rs. 23,000/- per farmer household. Similarly, the increasing substitution of chemical inputs with bio-inputs and adoption of water-efficient practices and technologies by farmers has led to improved soil health and water savings, which have begun to reverse some of the harmful effects of sustained and excessive use of chemicals in agriculture.

- KPCL plays a central role in the delivery and effectiveness of DSC's extension efforts, at least in as far as agriculture input supply in concerned. This is corroborated by the fact that 100% of the farmers in Himmatnagar and Meghraj, 92% of the farmers in Visnagar and Vehlal and 88% of the farmers in Modasa claim that input supply has improved after formation of KPCL. The availability of new variety seeds at fair prices from KPCL outlets has been able to bring down seed failure rates, improve productivity and ensure higher savings for farmers. Sale of genuine chemical pesticides and weedicides from the company retail outlets has helped reduce crop damage due to disease and pest attack. Farmers are now able to buy bio-pesticide, vermi-compost and other bio-inputs such as trichoderma viride, *madhyam* etc. from these outlets, bringing down their dependence on chemical inputs and ensuring better soil and plant health. Also, new agriculture tools and equipment such as *chipiyas*, cutters and spray pumps sold through KPCL outlets not only reduce time and effort, but also the drudgery of labour, helping bring down labour costs.

Recommendations for DSC's Extension System

- Despite the expectation of improved productivity due to adoption of scientific agriculture practices by farmers as part of the project, yields of cotton, castor and paddy have suffered. This is due to a variety of factors including adverse weather conditions, disease, pest attack and the growing menace of wild animals. While little can be done in the case of natural events, dealing with the wild animal menace needs to be accorded top priority. Although DSC has initiated a few pilots in the form of group fencing and solar electric fencing, these options will have to be thoroughly evaluated in terms of their scalability and feasibility in order to come up with an effective long-term solution to this problem.

- By and large, the agriculture extension information provided by DSC has been well received, with farmers in each project location deriving varying levels of satisfaction from the different sources of information. Going forward however, it is important to bear in mind that in order to be more effective, a bouquet of different sources of information will have to be offered in each project location, rather than what has been most useful in a particular location. Also, the aim must be to achieve a minimum rating of '3' or higher for each source of information. The challenge though is that with very low levels of willingness to pay among farmers, DSC might have to look for other sources of funding to support its agriculture extension information programme.

- Some of the key suggestions received from farmers to improve usefulness of the extension services include:

  i. Direct procurement of produce by KPCL from the farm-gate
  ii. Assistance in grading, packing and marketing of farmers' produce, especially spices and vegetables.
  iii. Permanent access to services of an agriculture expert
  iv. Greater farmer-to-farmer interaction and experience sharing
  v. Information on improved seed varieties, latest/low-cost agriculture techniques and available government subsidies
  vi. More emphasis on making farmers aware about the importance of putting agri-related advice and information to use.
  vii. Assistance in carrying out animal husbandry in a scientific manner
  viii. Expansion in KPCL's outreach through increase in its shareholder strength, setting up more Kisan Clubs and KPCL outlets, encouraging greater women participation and targeting non-member farmers.

- DSC needs to remodel its extension system to meet the changing needs of farmers in different project locations. While farmers in newer project locations such as Meghraj and Vehlal want extension activities to continue to focus on agri advisory information dissemination, package of practices and knowledge transfer, those in DSC's traditional project locations such as Visnagar, Himmatnagar and Modasa seek a higher level of engagement. This may include services such as assistance in crop diversification, infrastructure in the form of godowns, cold storage facilities etc.,

support for marketing of produce and promotion of entrepreneurship among farmers. By offering differentiated levels of extension services to suit different requirements, DSC will be able to retain its appeal and relevance among its farmer members.

- In order to maintain and strengthen the network of grassroots-level institutions that form the base of its extension efforts, DSC needs to encourage membership of Kisan Clubs, bio-pesticide and vermi-compost groups. According to the primary survey, one of the main reasons for people not joining these institutions was the absence - and therefore lack of information about activities - of bio-pesticide/vermi groups and Kisan Clubs. Greater efforts therefore need to be made to set up more groups/Clubs and increase visibility of the benefits they offer, so that people are able to see value in becoming a member.

- KPCL is currently at a stage of growth where it is well placed to leverage its inherent strengths for expanding its membership base. It enjoys huge appeal not just among its member-shareholders but also non-member farmers who prefer KPCL over other market players, primarily due to the assurance of quality and fair price of agriculture inputs. Considering that a very small proportion of the total project beneficiary farmers are KPCL members, there exists a huge potential for scaling up. To translate this potential into membership, a good starting point will be to consider allowing payment of KPCL membership fee on an installment basis as suggested by some farmers and improve visibility/information about KPCL's activities among non-members to generate their interest in participation.

7.2 Krushidhan Producer Company

In his research paper published in EPW in Feburary this year, eminent researcher Dr. Tushar Shah, reviews the state of FPOs in the country. Dr Shah made a disparaging reference to Krushidhan in an otherwise scholarly and interesting article. We quote from the paper below:

> "In Gujarat, DSC and AKRSP formed FPCs of farmers they were working with; but there was no clarity about how they will grow and become viable."

This has prompted us to look at the article critically, if only to learn a few lessons from it.

Drawing evidence from the rapid growth of the "new generation milk cooperatives" established by NDDB three to four years ago, Shah extracts a set of underlying principles that make Milk Producer Companies (MPCs) successful. It is worth examining these critically to see how far Krushidhan's experience meets these criteria (Table 7-2) and what lessons if any it can learn from the experience of these MPCs.

Table 7-2: Assessment of Krushidhan on Eight Principles of Successful MPCs

No.	Principles used by high Growth MPCs	Krushidhan's Experience	Remarks
1	Direct payment of milk price to member's bank account to ensure transparency and reduce transaction cost	This was done during the groundnut MSP collective marketing exercise	
2	Use of a *sahayog* to operate a frugal village-based milk procurement system in place of the Dairy Cooperative to ensure transparency, cut pooling costs, reduce storage and improve quality	Krushidhan retail outlets are of a similar nature	
3	Asset-light business model of owning low fixed asset and maintaining high asset turnover (i.e. taking assets on rent)	So far Krushidhan has remained asset-light by running outlets from low-rent premises and processing and packaging of seed on custom hiring basis	This suggests that taking several godowns on rent may be a better option than getting stuck with one or two company owned godowns which cannot be easily relocated. However, the assumption here is that such assets are easily available.
4	Low or zero debt capital structure with member equity dominating capital structure*	So far Krushidhan has followed a zero debt capital structure with high contributions from members and KCs	
5	Working capital generation through continuous cash generation and limited use of commercial bank credit	So far Krushidhan has followed this principle	However, in the seed business it is compelled to invest in working capital as this is a precondition for getting high margins
6	Variable cost model that reduces the business risk of sales slowdown (implies minimal overheads)	Overheads are minimal as of now as the staff is supported by DSC and office is frugal and located in rented premises	
7	Healthy retention of earnings to build reserves and net worth to raise credit-worthiness	This has also been practiced by Krushidhan	
8	Constant effort to accelerate value addition by reducing bulk institutional sales and enhancing branded retail sales	This has been practiced on the backward linkages side. On the forward linkage side efforts have been made to add value through cleaning and grading of produce. Branded retail sales have been initiated to a limited extent for produce made by producer groups and for certified seed material produced by farmers themselves.	

*However, even MPCs do not seem to have stuck to this principle fully. It may be noted that NDDB provided medium term loans to all the MPCs, the terms of which are not known. Dr Shah's article states that Maahi MPC had a seven-year loan of Rs 19.26 crore which was due in 2019 but repaid fully by 2015 in order to reduce the interest burden.

The above analysis shows that Krushidhan has followed almost all the principles for success identified by Dr. Tushar in his paper. The only major difference between the MPCs and Krushidhan is the scale of

operations. This could be because of higher membership per village in the case of milk sector and high value of milk as a commodity, readily available on a daily basis for sale. The membership in MPCs ranged from 22,972 in Baani, Punjab to 86,938 in Mahi MPC of Saurashtra and Kutch. In comparison Krushidhan has been able to reach a membership of only 2000. Hence the key to Krushidhan's future growth is to improve the membership in absolute terms as well as ratio of membership/village.

An analysis of business turnover to membership ratio was carried out to examine the relative performance of Krushidhan with MPCs (**Error! Reference source not found.**). The table shows that in general, as the size of the FPO increases, the turnover per shareholder also increases. Hence achieving scale is important for financial stability. However, this is not universally true and much depends on the business strategy as well as sector in which business is being done. For instance, Baani with approximately half the shareholders of Saahaj has achieved a higher turnover than the latter.

Table 7-3: Comparison of Growth Performance with MPCs

Parameter	Paayas, Rajasthan	Maahi, Saurashtra-Kutch	Shreeja, Andhra Pradesh	Baani, Punjab	Saahaj, Uttar Pradesh	Krushidhan
No of members	69,647	86,938	41,292	22,972	44,999	2,035
Business turnover after three years (Rs million)	5,968	9,793	1,381	868	1,582	10.63
Business turnover per shareholder	85,689	112,643	33,445	37,785	35,156	5,224

The table shows that the ratio in case of Krushidhan is almost a sixth lower than that of the lowest among the MPCs. However, it should be noted that there is a qualitative difference between the sales of Krushidhan and MPCs. Most of its sale has been restricted to inputs rather than outputs. When Krushidhan gets into collective marketing of outputs, the trunover is bound to increase significantly as outputs are both bulky and of high value.

This difference has arisen also because Krushidhan works in agriculture with a social mission of making it environmentally sustainable while ensuring the economic viability of the marginal farmer. This mission has guided the portfolio of activities in the first three years where creating backward linkages was considered critical for higher and more sustainable productivity. Also given the diversity of cropping patterns, Krushidhan has to deal with a diverse portfolio of inputs. The company has therefore been more in the service sector rather than commodity business, although it did not charge a penny for its services. The economic benefits derived by farmers due to reduced costs, increased productivity, reduced risk and increased price realisation are to the tune of nearly Rs. 90 crores. When these as well as the enviornmental and social gains are factored in, the figures will look more comparable.

Recommendations for Krushidhan

In summary, Krushidhan needs to continue its trajectory of growth using a value chain approach while adhering to the eight principles identified by Dr. Shah. Two factors will enable it to meet its projected targets; a) increasing its share-holder base and thereby available internal funds for doing business while simultaneously increasing member allegiance b) getting into building collective marketing of produce through aggregation, cleaning and grading, storage, market information based selling, value addition and whatever needs to be done to get the farmer a better price for her or his produce. At the same time DSC will need to make its extension services more aligned and synchronised with the activities of the company so that members perceive greater benefits and experience greater loyalty to the company, which is so crucial for collective action.

Some of the issues related to governance and management of the company being faced by the board and facilitators from DSC were discussed in the report. The possible solutions/ recommendations for these are listed below:

i) Augmenting storage facility:

Past efforts of KPCL to procure godowns for its commercial activities did not meet with success. However, looking at the future plans of expansion as well as the need to invest in assets, KPCL will need to intensify its efforts to procure/ build godowns at central places.

DSC may like to explore the support of donor agencies or government for the purpose. It was felt that centers located at cross-roads which can be easily accessed by farmers from maximum number of villages in a given region would be ideal to set up sub-centers in different regions. These sub-centers could include minimal storage facilities, office and training center, retail outlets for supply of agri-inputs as well as other commodities that the farming communities need etc.. Keeping in view Dr Shah's recommendation, additional godown space could be taken on rent depending on the need.

ii) Use of economic incentives to increase share-holding:

Clearly there is a need to improve share-holding if the company is to grow aggressively. The debate on how to go about it has brought out various considerations that impinge on the design and architecture of a pyramid institution such as an FPO like Krushidhan.

Using economic incentives such as retaining 5% of sales proceeds as member deposit to raise capital has been suggested as done by Mulukanoor Women's Cooperative Dairy Union. However, judicious use of such instruments is called for so as to balance economic growth with social equity and justice.

As suggested by Mr. Arvind Gupta, expansion must be done in a planned and cost effective way. There should be no compromise on quality and process. New KCs should be set up within the same target area. The screening process for shareholders should continue to be KC membership and active participation of farmers

iii) Leadership issues:

After his retirement, the Board of KPCL was not able to identify a suitable person to fill the shoes of the previous chairperson from within. The Board in its wisdom decided not to have a permanent Chairman. It was decided that the Board meetings would be chaired by temporary Chairpersons appointed separately for each meeting.

By default, the leadership is being provided by the present CEO and Programme Director, DSC who has been mentoring and guiding both the professional staff as well as the elected representatives. Hence the model of leadership adopted by Krushidhan and DSC is one of Intrapreneurship which also happens to be the model adopted by Dr. Kurien when he retained the position of secretary of Gujarat Milk Marketing Federation. The role of leadership is to maintain the balance between professional staff and elected representatives, between business and social goals. Under the Intrapreneurship model, an enlightened professional plays this role until such time that the local leadership matures enough to take it up.

This model requires hand-holding of the Board over a long time frame. The nature of support changes gradually from hand-holding to becoming a friend, philosopher and guide, as the leadership of the elected representatives matures over time. Both DSC and RBS Foundation recognize that their commitment to Krushidhan should be a long-term one. This is what separates Krushidhan from other FPOs which are left to fend for themselves after the initial package of support is exhausted. However, it is imperative to identify an internal candidate to assume leadership as a 'headless' organization can give the wrong psychological message to the ordinary members of the company as well as to outsiders.

iv) Improving member allegiance:

There is a need to constantly increase the member allegiance and loyalty in a collective enterprise that has to deal with market forces and win.

Some of the known ways to achieve this is to improve the stakes of the farmer members in the organisation. This means increasing the share-holding per member and establishing a sense of belonging and pride in the institution. Constant dialogue of the board of directors with common members is a pre-requisite. The ability of the leadership in creating a shared vision for all members and farmers of the region would also go a long way in creating higher member allegiance. This is important because when the organisation faces a backlash from the market forces, the professional team should be backed up by the members. Willingness to forego short term gains in order to

ensure the success of the enterprise in the market place would indicate that the members have truly imbibed the vision and spirit of the company.

v) Re-organisation of professional staff:

Given the fact that in the next phase, the company is likely to move into commodity marketing and value addition in a big way, the product mix will undergo a major shift. Establishing forward linkages in different sub-sectors such as food grains, cash crops and spices etc will not be easy and call for at least one more full time manager for marketing. Internal reorganisation would also be needed to reflect the changing portfolio of products.

Annexures

Annexure 1

Questionnaire for Sample Survey

પ્રાથમિક સર્વે પ્રશ્નાવલિ

ની આકારણી(ઇમ્પેક્ટ) પ્રોજેક્ટના બીજા તબક્કાના પરિણામ LEPNRM

તારીખ: _____ સર્વે કરનારનું નામ: _____

પ્રોજેક્ટનું સ્થળ : ધરોઇ ક્લસ્ટર: _____

ગામ: _____

ભાગ 1: સામાન્ય માહિતી

1. ખેડૂતનું નામ _____

2. સંપર્ક માટેનો ફોન નંબર _____

3. ખેડૂતનો વર્ગ (પ્રકાર):

i. કૃષિ ધન હિસ્સા ધારક _____ ii. કિસાન ક્લબના સભ્ય છે પણ હિસ્સા ધારક નથી _____

iii. સામાન્ય ખેડૂત _____

4. ખેડૂતની જમીનની વિગતો (વીઘામાં)

i. ખેતી હેઠળની કુલ જમીન (ખેડાણની) _____

જેમાંથી ii. સિંચિત જમીન _____ iii. બિનસિં-ચિત જમીન _____

5. તમારા પરિવારની માલિકીનાં દૂધાળાં પશુઓ સંખ્યા જણાવો ની(ભેંસ ,ગાય)

i. 3 વર્ષો પહેલાં _____ ii. હાલ _____

6. તમારા પરિવારની માલિકીનાં ભારવાહી પ્રાણીઓ .ની સંખ્યા જણાવો(પાડો ,બળદ)

i. 3 વર્ષો પહેલાં _____ ii. હાલ _____

7. i. શું તમારા ખેતરમાં જંગલી પ્રાણીઓ નો ઉપદ્રવ છે(જંગલી ડુક્કર વગેરે ,નીલ ગાય)? હા/ના _____

ii. જો હાતો શું છેલ્લા ત્રણ ચાર વર્ષમાં આ ઉપદ્રવ ઓછો થયો છે ,? એટલોને એટલો જ રહ્યો છે? કે વધ્યો છે?

a. ઓછો થયો છે _____ b. એટલો જ છે _____ c. વધ્યો છે _____

8. આ ઉપદ્રવ દૂર કરવા માટે તમે કયાં પગલાં ભર્યાં છે?

	ચીજવસ્તુ	ઘણા જ અસરકારક	અમુક અંશે અસરકારક	અસરકારક નથી
i	વન વિભાગમાં ફરિયાદ નોંધાવી છે			
ii	ઝેરનો ઉપયોગ કર્યો			
iii	જૈવિક જંતુનાશકનો ઉપયોગ કર્યો			
iv	કુદરતી ફેન્સિંગ કર્યો નો ઉપયોગ (વાડ)			
v	વાયર ફેન્સિંગ નો ઉપયોગ કર્યો (વાડ)			
vi	ઇલેક્ટ્રિક ફેન્સિંગનો ઉપયોગ કર્યો			
vii	અણગમો પેદા કરે તેવી કાપડની વાડ			

ભાગ - 2 ખરીફ પાકની વિગતો

કપાસ

9. વિસ્તાર (વીઘામાં)_____

10. કપાસ માટેનો તમારો આગત ખર્ચ નીચે દર્શાવો:

	ચીજવસ્તુ	એકમ	વર્ષ પહેલાં 3	હાલ
1	બિયારણ	ગ્રામ/વીઘા		
2	કેમીકલ ફર્ટિલાઇઝર (રાસાયણિક ખાતર)	ખર્ચ .રૂ)/વીઘા(		
3	રાસાયણિક જંતુનાશક	ખર્ચ .રૂ)/વીઘા(		
4	જૈવિક જંતુનાશક	લીટર/વીઘા		
5	જૈવિક ખાતર (વર્મી કમ્પોસ્ટ વગેરે ,છાણ)	કિગ્રા/વીઘા		
6	નીંદણ દૂર કરવા માટેની દવા	ખર્ચ .રૂ)/વીઘા(		
7	સિંચાઈ			
અ	કેનાલ	પાણી આપવું/વીઘા		
બ	બોરવેલ/કૂવો	પમ્પિંગના કલાક/વીઘા		
8	મજૂરી ખર્ચ ,(સ્પ્રેઇંગ) સ્પ્રેનો છંટકાવ ,વાવણી) પાણીનો છંટકાવ(લણણી વગેરે સહિત ,	ખર્ચ .રૂ)/વીઘા(		
9	અન્ય ખર્ચ ,ટ્રેક્ટર ,જેમ કે જમીન તૈયાર કરવી) રોટાવેટર, થ્રેશરનું ભાડું વગેરે(	ખર્ચ .રૂ)/વીઘા(		

.11કપાસનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.i .12સામાન્ય વર્ષોની સરખામણીમાં આ વર્ષનું ઉત્પાદન

.aસામાન્ય કરતાં ઓછું રહ્યું .....

.bસામાન્ય રહ્યું .....

c. સામાન્ય કરતાં વધુ રહ્યું .....

.iiજો સામાન્ય કરતાં ઓછું રહ્યું હોય_____ તો તેનું કારણ જણાવો ,

.13કપાસ માટે તમે કેટલી કિંમત મેળવી શક્યા રૂપિયા પ્રતિ મણ))

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.14કપાસ માંથી તમે કઈ આડ પેદાશ મેળવો છો?.....

.15પ્રત્યેક વીઘાદીઠ આડ પેદાશનું સરેરાશ ઉત્પાદન

ii. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.16આડ પેદાશમાંથી થતી સરેરાશ આવક

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.17ખેતરમાં ઉપયોગમાં લેવાયેલા બિયારણનો પ્રકાર

i. સ્થાનિક બિયારણ .....

ii. મંજૂરી પ્રાપ્ત ગુણવત્તાયુક્ત બિયારણ .....

iii. તમે કેટલાં વર્ષોથી આ બિયારણ વાપરો છો?.....

iv. તમે છેલ્લે ક્યારે બિયારણ બદલ્યું હતું?.....

દિવેલી

.18વિસ્તાર ..... (વીઘામાં)

.19દિવેલી માટેનો વીઘાદીઠ આગત ખર્ચ નીચે દર્શાવોઃ-

	ચીજવસ્તુ	એકમ	વર્ષ પહેલાં 3	હાલ
1	બિયારણ	ગ્રામ/વીઘા		
2	કેમીકલ ફર્ટિલાઇઝર (રાસાયણિક ખાતર)	ખર્ચ .રૂ)/વીઘા(		
3	રાસાયણિક જંતુનાશક	ખર્ચ .રૂ)/વીઘા(		
4	જૈવિક જંતુનાશક	લીટર/વીઘા		
5	જૈવિક ખાતર વર્મી ,છાણ)કમ્પોસ્ટ વગેરે(	કિગ્રા/વીઘા		
6	નીંદણ દૂર કરવા માટેની દવા	ખર્ચ .રૂ)/વીઘા(		

7	સિંચાઈ			
અ	કેનાલ	પાણી આપવું/વીઘા		
બ	બોરવેલ/કૂવો	પમ્પિંગના કલાક/વીઘા		
ક	મજૂરી ખર્ચ ,(સ્પ્રેઇંગ) સ્પ્રેનો છંટકાવ ,વાવણી) પાણીનો છંટકાવ(લણણી વગેરે સહિત ,	ખર્ચ .રૂ)/વીઘા(		
9	અન્ય ખર્ચ ,ટ્રેક્ટર ,જેમ કે જમીન તૈયાર કરવી) રોટાવેટર, થ્રેશરનું ભાડું વગેરે(	ખર્ચ .રૂ)/વીઘા(		

.20દિવેલીનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.21i . સામાન્ય વર્ષોની સરખામણીએ આ વર્ષનું ઉત્પાદન (ઉપજ)

અ..... સામાન્ય કરતાં ઓછું રહ્યું .

બ..... સામાન્ય રહ્યું .

ક..... સામાન્ય કરતાં સારૂં રહ્યું .

i i જો સામાન્ય .કરતાં ઓછું રહ્યું હોય_____ તો તે પાછળનાં કારણો જણાવો ,

_____

.22દિવેલી માટે તમને મળતી કિંમત (રૂપિયા પ્રતિ મણ દીઠ)

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.23દિવેલી માંથી તમે કઈ આડ પેદાશ મેળવો છો?.....

.24આડ પેદાશનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.25આડ પેદાશમાંથી થતી સરેરાશ આવક

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.26ખેતરમાં ઉપયોગમાં લેવાયેલા બિયારણનો પ્રકાર

I. સ્થાનિક બિયારણ .....

II. મંજૂરી પ્રાપ્ત ગુણવત્તાયુક્ત બિયારણ .....

III. તમે કેટલાં વર્ષોથી આ બિયારણ વાપરો છો?.....

IV. તમે છેલ્લે ક્યારે બિયારણ બદલ્યું હતું?.....

ભાગ - 3 રવિ પાકની વિગતો

ઘઉં

.27વિસ્તાર ..... (વીઘામાં)

.28ઘઉં માટેનો તમારો વીઘાદીઠ આગત ખર્ચ નીચે જણાવો

	ચીજવસ્તુ	એકમ	વર્ષ પહેલાં 3	હાલ
1	બિયારણ	ગ્રામ/વીઘા		
2	કેમીકલ ફર્ટિલાઇઝર (રાસાયણિક ખાતર)	ખર્ચ .રૂ)/વીઘા(		
3	રાસાયણિક જંતુનાશક	ખર્ચ .રૂ)/વીઘા(		
4	જૈવિક જંતુનાશક	લીટર/વીઘા		
5	જૈવિક ખાતર (વર્મી કમ્પોસ્ટ વગેરે ,છાણ)	કિગ્રા/વીઘા		
6	નીંદણ દૂર કરવા માટેની દવા	ખર્ચ .રૂ)/વીઘા(		
7	સિંચાઈ			
અ	કેનાલ	પાણી આપવું/વીઘા		
બ	બોરવેલ/કૂવો	પમ્પિંગના કલાક/વીઘા		
ક	મજૂરી ખર્ચ ,(સ્પ્રેઇંગ) સ્પ્રેનો છંટકાવ ,વાવણી) પાણીનો છંટકાવ(લણણી વગેરે સહિત ,	ખર્ચ .રૂ)/વીઘા(		
9	અન્ય ખર્ચ ,ટ્રેક્ટર ,જેમ કે જમીન તૈયાર કરવી) રોટાવેટર, થ્રેશરનું ભાડું વગેરે(	ખર્ચ .રૂ)/વીઘા(		

.29ઘઉંનું વીઘાદીઠ સરેરાશ ઉત્પાદન (મણ)

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.i .30સામાન્ય વર્ષોની સરખામણીમાં આ વર્ષનું ઉત્પાદન

અ..... સામાન્ય કરતાં ઓછું રહ્યું .

બ..... સામાન્ય રહ્યું .

ક સામાન્ય .કરતાં સારૂં રહ્યું .....

.iiજો સામાન્ય કરતાં ઓછું રહ્યું હોયતો તેનાં કારણો જણાવો , _____

_____

.31ઘઉં માંથી તમને મળેલી કિંમત (રૂપિયા પ્રતિ મણ)

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.32ઘઉં માંથી તમે કઈ આડ પેદાશ મેળવો છો?.....

.33આડ પેદાશનું વીઘાદીઠ સરેરાશ ઉત્પાદન (મણ)

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.34આડ પેદાશમાંથી થતી સરેરાશ આવક .રૂ)/વીઘા(

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.35ખેતરમાં ઉપયોગમાં લેવાયેલા બિયારણનો પ્રકાર

I. સ્થાનિક બિયારણ .....

II. મંજૂરી પ્રાપ્ત ગુણવત્તાયુક્ત બિયારણ .....

III. તમે કેટલાં વર્ષોથી આ બિયારણ વાપરો છો?.....

IV. તમે છેલ્લે ક્યારે બિયારણ બદલ્યું હતું?.....

વરીયાળી

.36વિસ્તાર ..... (વીઘામાં)

.37વરીયાળી માટેનો તમારો વીઘાદીઠ આગત ખર્ચ નીચે જણાવો -

	ચીજવસ્તુ	એકમ	વર્ષ પહેલાં 3	હાલ
1	બિયારણ	ગ્રામ/વીઘા		
2	કેમીકલ ફર્ટિલાઇઝર (રાસાયણિક ખાતર)	ખર્ચ .રૂ)/વીઘા(		
3	રાસાયણિક જંતુનાશક	ખર્ચ .રૂ)/વીઘા(		
4	જૈવિક જંતુનાશક	લીટર/વીઘા		
5	જૈવિક ખાતર (વર્મી કમ્પોસ્ટ વગેરે ,છાણ)	કિગ્રા/વીઘા		
6	નીંદણ દૂર કરવા માટેની દવા	ખર્ચ .રૂ)/વીઘા(		
7	સિંચાઈ			
અ	કેનાલ	પાણી આપવું/વીઘા		
બ	બોરવેલ/કૂવો	પમ્પિંગના કલાક/વીઘા		

૪	મજૂરી ખર્ચ ,(સ્પ્રેઇંગ) સ્પ્રેનો છંટકાવ ,વાવણી) પાણીનો છંટકાવ(લણણી વગેરે સહિત ,	ખર્ચ .૩)/વીઘા(		
૯	અન્ય ખર્ચ ,ટ્રેક્ટર ,જેમ કે જમીન તૈયાર કરવી) રોટાવેટર, થ્રેશરનું ભાડું વગેરે(	ખર્ચ .૩)/વીઘા(		

.૩૪વરીયાળીનું વીઘાદીઠ સરેરાશ ઉત્પાદન (મણ)

i. ૩વર્ષ પહેલાં ..... .iiહાલ .....

.i .૩૯સામાન્ય વર્ષોની સરખામણીમાં આ વર્ષનું ઉત્પાદન

અ..... સામાન્ય કરતાં ઓછું રહ્યું .

બ..... સામાન્ય રહ્યું .

ક..... સામાન્ય કરતાં સારૂં રહ્યું .

.iiજો સામાન્ય કરતાં ઓછું રહ્યું હોયતો તેનાં કારણો જણાવો , _____

_____

.૪૦વરીયાળી માટે તમને મળેલી કિંમત (રૂપિયા પ્રતિ મણ)

i. ..... વર્ષ પહેલાં ૩ .iiહાલ .....

.૪૧વરીયાળી માંથી તમે કઈ આડ પેદાશ મેળવો છો?.....

.૪૨આડ પેદાશનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં ૩ .iiહાલ .....

.૪૩આડ પેદાશમાંથી થયેલી સરેરાશ આવક

i. ..... વર્ષ પહેલાં ૩ .iiહાલ .....

.૪૪ખેતરમાં ઉપયોગમાં લેવાયેલા બિયારણનો પ્રકાર

I. સ્થાનિક બિયારણ .....

II. મંજૂરી પ્રાપ્ત ગુણવત્તાયુક્ત બિયારણ .....

III. તમે કેટલાં વર્ષોથી આ બિયારણ વાપરો છો?.....

IV. તમે છેલ્લે ક્યારે બિયારણ બદલ્યું હતું?.....

ભાગ - 4 ઊનાળુ પાકની વિગતો

.i .45ઊનાળુ પાક ..... .iiવિસ્તાર ..... (વીઘામાં)

.46ઊનાળુ પાક 1-માટેનો તમારો વીઘાદીઠ આગત ખર્ચ નીચે જણાવોઃ-

	ચીજવસ્તુ	એકમ	વર્ષ પહેલાં 3	હાલ
1	બિયારણ	ગ્રામ/વીઘા		
2	કેમીકલ ફર્ટિલાઇઝર (રાસાયણિક ખાતર)	ખર્ચ .રૂ)/વીઘા(		
3	રાસાયણિક જંતુનાશક	ખર્ચ .રૂ)/વીઘા(		
4	જૈવિક જંતુનાશક	લીટર/વીઘા		
5	જૈવિક ખાતર (વર્મી કમ્પોસ્ટ વગેરે ,છાણ)	કિગ્રા/વીઘા		
6	નીંદણ દૂર કરવા માટેની દવા	ખર્ચ .રૂ)/વીઘા(		
7	સિંચાઈ			
અ	કેનાલ	પાણી આપવું/વીઘા		
બ	બોરવેલ/કૂવો	પમ્પિંગના કલાક/વીઘા		
8	મજૂરી ખર્ચ ,(સ્પ્રેઇંગ) સ્પ્રેનો છંટકાવ ,વાવણી) પાણીનો છંટકાવ(લણણી વગેરે સહિત ,	ખર્ચ .રૂ)/વીઘા(		
9	અન્ય ખર્ચ ,ટ્રેક્ટર ,જેમ કે જમીન તૈયાર કરવી) રોટાવેટર, થ્રેશરનું ભાડું વગેરે(	ખર્ચ .રૂ)/વીઘા(		

.47ઊનાળુ પાકનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.i .48સામાન્ય વર્ષોની સરખામણીએ આ વર્ષનું ઉત્પાદન

અ..... સામાન્ય કરતાં ઓછું રહ્યું .

બ..... સામાન્ય રહ્યું .

ક..... સામાન્ય કરતાં સારૂં રહ્યું .

.iiજો સામાન્ય કરતાં ઓછું રહ્યું હોય તો તેનાં કારણો જણાવો ,_____

.49ઊનાળુ પાકમાંથી મળતી કિંમત (રૂપિયા પ્રતિ મણ)

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.50ઊનાળુ પાક માંથી તમે કઈ આડ પેદાશ મેળવો છો?.....

.51આડ પેદાશનું વીઘાદીઠ સરેરાશ ઉત્પાદન

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.52આડ પેદાશમાંથી થતી સરેરાશ આવક

i. ..... વર્ષ પહેલાં 3 .iiહાલ .....

.53ખેતરમાં ઉપયોગમાં લેવાયેલા બિયારણનો પ્રકાર

I. સ્થાનિક બિયારણ .....

II. મંજૂરી પ્રાપ્ત ગુણવત્તાયુક્ત બિયારણ .....

III. તમે કેટલાં વર્ષોથી આ બિયારણ વાપરો છો?.....

IV. તમે છેલ્લે ક્યારે બિયારણ બદલ્યું હતું?.....

ભાગ - 4 બહેતર વ્યવસ્થાપન માટેનાં પગલાં અપનાવવાં

.i .54પ્રોજેક્ટના પરિણામરૂપે તમે સિંચાઈનું પાણી બચાવવા માટે તમે કોઈ પ્રયત્ન કર્યો છે? હા/ના _____

.iiજો હા તો વિગતો આપો ,_____

..... (વીઘા) વર્ષ પહેલાંનો ટપક સિંચાઈ હેઠળનો ખેતરનો વિસ્તાર 3 .i .55

.iiહાલમાં ટપક સિંચાઈ હેઠળનો ખેતરનો વિસ્તાર ..... (વીઘા)

.56ટપક પદ્ધતિનો ઉપયોગ કરીને તમે કેટલા વધારાના વિસ્તારની સિંચાઈ કરી શક્યા છો?.....

.i .57ત્રણ વર્ષ પહેલાં ચાસ સિંચાઈ હેઠળનો ખેતરનો વિસ્તાર ..... (વીઘામાં)

.iiહાલમાં ચાસ સિંચાઈ હેઠળનો ખેતરનો વિસ્તાર ..... (વીઘામાં)

.i .58પ્રોજેક્ટમાં જોડાતાં પહેલાં તમે તમારી જમીનનું પરીક્ષણ કરાવતા હતા? હા/ના .....

.iiજો હાક્યાંથી કરાવતા હતા ,? .....

.59શું પ્રોજેક્ટમાં જોડાયા અગાઉ તમે જૈવિક જંતુનાશક અને વર્મી કમ્પોસ્ટ કેવી રીતે તૈયાર કરવું તે વિશે જાણતા હતા? હા/ના .....

.60શું પ્રોજેક્ટમાં જોડાયા અગાઉ તમે તમાકુનાં બી અને લીંબોળીનાં ફોતરાં વગેરેમાંથી ,દીવેલનું ખડ) જૈવિક ખાતર વિશે જાણકારી ધરાવતા હતા (બનાવવામાં આવતા? હા/ના .....

.61શું પ્રોજેક્ટમાં જોડાયા બાદ તમે કોઈ પણ પ્રકારના રસાયણોનો ઉપયોગ કર્યા વિના કોઈ પાકનું ઉત્પાદન કર્યું છે? હા/ના .....

જો હા તો ,

I. પાકનું નામ .....

II. કેટલા વીઘામાં .....

.62i. શું પ્રોજેક્ટમાં જોડાયા બાદ તમે પાક કરમાઈ જવાના રોગને નિયંત્રિત કરવા માટે ટ્રાઇકોડર્મા વાઇરાઇડનો ઉપયોગ શરૂ કર્યો છે? હા/ના .....

ii. જો હાતો તે કેટલી અસરકારક રહી છે ,?

અ..... ઘણી અસરકારક .

બ..... અમુક અંશે અસરકારક .

ક..... કારક નથીઅસર .

શું પ્રોજે i .63ક્ટમાં જોડાયા બાદ જંતુઓને નિયંત્રિત કરવા માટે તમે લીમડાના તેલનો ઉપયોગ શરૂ કર્યો છે? હા/ના.....

ii જો હા તોઆ ઉપયોગ કેટલો અસરકારક નીવડ્યો છે ,?

અ..... ઘણો જ અસરકારક .

બ..... અમુક અંશે અસરકારક .

કઅસરકારક નથી .

શું પ્રોજેક્ટમાં જોડાયા બાદ જંતુઓને નિયંત્રિત કરવા માટે પીળા ચીકણા પાટાનો ઉપયોગ શરૂ કર્યો i .64 છે? હા/ના.....

ii જો હાતો આ ઉપયોગ કેટલો અસરકારક રહ્યો છે ,?

અ..... ઘણો અસરકારક .

બ..... અમુક અંશે અસરકારક .

ક .અસરકારક નથી .....

ઉપયોગ (સલ્ફર વગેરે ,જેમ કે ઝીંક) શું પ્રોજેક્ટમાં જોડાયા બાદ તમે તમારા ખેતરમાં સૂક્ષ્મ પોષણનો i.65 શરૂ કર્યો છે? હા/ના .....

ii જો હા તોપાક પર તેની શું અસર થઈ છે ,?_____

.i .66 શું પ્રોજેક્ટમાં જોડાયા બાદ તમે ઉત્પાદન ની સફાઈ(ઉપજ)/ગ્રેડિંગની કામગીરી શરૂ કરી છે? હા/ના_____

ii જો હાતો કયા પાક માટે આ કામગીરી કરો છો ,? _____

i .67. શું સફાઈ (ક્લિનીંગ)/ ગ્રેડિંગને પગલે તમને મળતી કિંમતમાં કોઈ ફેર પડ્યો છે (ઉપજની)? હા/ના _____

ii. જો હાતો રૂપિયા પ્રતિ મણ માં શું ફેર પડ્યો છે ,? _____

ભાગ - 5 પ્રોજેક્ટની કામગીરીની અસરકારકતા

.68ડીએસસી પાસેથી મળેલી માહિતીની ઉપયોગિતા

	માહિતીનો સ્રોત	ઉપયોગિતાનો ક્રમ 1 રેન્ક) (રેન્ક)= બિલકુલ ઓછી અસરકારક 5 રેન્ક ,= ખૂબ અસરકારક(
1	મોબાઇલ એસએમએસ	
2	જાગૃતિ અભિયાન	
3	ખેડૂતોની બેઠક/ કાર્ય શિબિર/તાલીમ	
4	પેરા વર્કર્સ/ ડીએસસી સ્ટાફ	
5	પ્રિન્ટ સામગ્રી પાક માટેની ,પેમ્ફ્લેટ્સ -માહિતી પુસ્તિકાખેડૂત ડાયરી વગેરે ,દીવાદાંડી ,	
6	વીડીયો ફિલ્મ	
7	એક્સ્પોઝર વિઝિટ	

.69ડીએસસી તમને જે માહિતી પૂરી પાડે છે તેની ઉપયોગિતામાં કેવી રીતે સુધારો લાવી શકાય તે વિશે તમારાં સૂચનો જણાવો _____

.i .70 શું આ માહિતી માટે તમે નાણાં ચૂકવવા ઈચ્છો છો? હા/ના .....

ii તો દર મહિને વધુમાં વધુ કેટલી રકમ તમે ચૂકવી શકશો ,જો હા .? .....

i .71. શું તમે વર્મી કમ્પોસ્ટનું ઉત્પાદન કરતા જૂથના સભ્ય છો? હા/ના .....

ii. જો નાતો તમે શા માટે સભ્ય ન બન્યા ,? _____

i .72. શું તમે મસાલાનું ઉત્પાદન કરતા જૂથના સભ્ય છો? હા/ના .....

ii તો તમે શા માટે સભ્ય ન બન્યા ,જો ના .? _____

શું તમે જૈવિક જંતુનાશક ઉત્પાદન જૂથના સભ્ય છો i .73? હા/ના .....

ii જો નાતો તમે શા માટે સભ્ય નથી બન્યા ,? _____

.74શું તમે કિસાન ક્લબના સભ્ય છો? હા/ના .....

.75જો નાતો તમે શા માટે સભ્ય ન બન્યા ,? _____

નોંધઃ પ્રશ્ન ફક્ત કિસાન ક્લબના સભ્યોને જ પૂછવા 79-76

.76કિસાન ક્લબની રચના કયા વર્ષે કરવામાં આવી હતી? .....

.77તમે કેટલા સમયના અંતરે મળો છો?

અ દર અઠવાડિયે . ..... બ બે અઠવાડિયે એક વાર . .....

ક દર મહિને . ..... ડ દર ત્રણ મહિને . .....

.78તમારી કિસાન ક્લબ કઈ કઈ પ્રવૃત્તિઓ હાથ ધરે છે?

	પ્રવૃત્તિઓ	હા/ના	વિગતો
1	**બચત અને ધિરાણ** • દર મહિને બચાવવામાં આવતી રકમ • કુલ બચત • શું આંતરિક ધિરાણ શરૂ કરવામાં આવ્યું છે?		
2	**ખેડૂતો માટે એક્સપોઝર વિઝિટ** • ક્યાં સ્થાનિક કે અન્ય જિલ્લામાં -? • ચાવીરૂપ શિક્ષણ (જાણકારી)		
3	**રિસર્ચ સ્ટેશન સાથે જોડાણ (સંશોધન)** • કયું રિસર્ચ સ્ટેશન? • જોડાણનું પરિણામ		
4	**બજાર સાથે જોડાણ** • વેપારની ચીજવસ્તુ (કોમોડિટી) • શું તમને વધુ સારી કિંમત મળે છે?		

5	**આગત પુરવઠો - જથ્થાબંધ ખરીદી** • કઈ ચીજવસ્તુ માટે? • કેટલા સમયના અંતરે?		
6	**બીજ ઉત્પાદન જગ્યા (જમીન)** • વેપારની ચીજવસ્તુ (કોમોડિટી) • વર્ષ દરમિયાન ઉત્પન કરેલ બીજ નો જથ્થો		

i .79 કિસાન ક્લબની કઈ પ્રવૃત્તિ તમને સૌથી વધુ ઉપયોગી જણાય છે? .....

ii. શા માટે? .....

i .80 શું તમે કૃષિ ધન ઉત્પાદન કંપનીના હિસ્સાધારક સભ્ય છો? હા/ના .....

ii. જો નાતો શા માટે તમે સભ્ય ન બન્યા ,?

અ સભ્યપદ માટેની ફી નથી ચૂકવી શકતો . ..... બ કિસાન ક્લબનો સભ્ય નથી . .....ક કૃષિ ધનની પ્રવૃત્તિઓથી વાકેફ નથી . .....

ડ રસ નથી . .....ઇ (વિગત જણાવો) અન્ય .....

.i .81 જો તમે સભ્ય ન હોતો પણ શું તમે કૃષિ ધનના આઉટલેટ્સમાંથી ખેતીની આગત ખરીદો છો ,? હા/ના .....

ii. જો હાતો શા માટે ,? _____

.82કૃષિ ધનની સભ્યસંખ્યા કેવી રીતે વધારી શકાય તે માટેનાં સૂચનો જણાવશો _____

i .83 શું તમારી ઊપજ વેચવા માટે તમને કૃષિ ધનમાંથી કોઈ સહાય મળી છે? હા/ના _____

ii તો વિગતો આપો ,જો હા ._____

.i .84 શું કૃષિ ધનની રચના થયા બાદ ખેતીના ઇનપુટ પુરવઠામાં સુધારો થયો છે? હા/ના _____

ii. જો હા તોના ઇનપુટ પુરવઠામાં સુધારો થયો છે (કોમોડિટી) નીચે પૈકીની કઈ ચીજવસ્તુ ,?

અ.....બિયારણ ..... બરાસાયણિક જંતુનાશકો ..... ક જૈવિક જંતુનાશકો ._____

ડ ખેતીનાં સાધનો ..... ઇ વર્મી કમ્પોસ્ટ અને વર્મી કમ્પોસ્ટ માટેનું પાથરણ ._____

.85નીચે પૈકીના કયા માપદંડના આધારે તમે ખેતીની આગતની ખરીદી કરવા માટે બજારના ખેલાડીઓ કરતાં કૃષિ ધનને પ્રાથમિકતા આપો છો?

i. નજીક.....ii.વાજબી ભાવ (કિંમત)..... iii. આગતની સારી ગુણવત્તા.....
iv. વેચાણ બાદની વધુ સારી સેવા ..... v. કારણ કે તે તમારી પોતાની કંપની છે.....

.86તમારા વિસ્તારમાં તમે કેટલા સમયના અંતરે કૃષિ ધન આઉટલેટની મુલાકાત લો છો? _____

.87તમે કૃષિ ધનની સામાન્ય સભા માં કેટલી વાર હાજર રહો છો(જનરલ બોડી મિટિંગ)?_____

i .88 ડીએસસીની સહાયના પરિણામરૂપે શું તમે અન્ય સંસ્થા ,જેમ કે)નાબાર્ડ ,યુનિવર્સિટી ,કેવીકે , માંથી મદદ મેળવી છે(ખાનગી કંપની વગેરે ,સંશોધન કેન્દ્ર? હા/ના .....
ii. જો હાતો તમને મળેલી મદદની વિગતો જણાવશો ,
_____

i .89 . તમારા મતેશું કૃષિ ધનમાં મહિલાઓની વધુ સ ,હભાગિતા હોવી જોઈએ? હા/ના _____
ii. જો હાતો તેમણે કઈ રીતે સહભાગી થવું જોઈએ ,?
અહિસ્સા ધારક તરીકે-સભ્ય.બ ..... વહીવટી બોર્ડના સભ્ય તરીકે .....
ક સેવા મેળવનાર તરીકે .....

.90 તમારા મતેકૃષિ ધને તેના સભ્યોને અન્ય કઈ કઈ સેવાઓ પૂરી પાડવી જોઈએ ,?
_____

Annexure 3

Legal requirements for Production of Bio-pesticides and Bio-fertilizers[9]

For bio-pesticides registration from Central Insecticides Board, Faridabad is required. This is given by a registration committee. Applications can be made online. Data on toxicity (both oral and dermal) and bio-efficacy need to be generated by testing the product for at least two seasons in at least three centres (State Agricultural universities). This process is somewhat expensive as the SAUs will charge at least Rs. 7.5 lakhs for the services of testing the product.

For bio-fertilizers one may approach the organic farming cell of the fertilizer corporation of India, located in Ahmedabad. There are no standards for vermicompost as it is considered a living material where variability is high. However, the acceptable ranges for various parameters have been identified as shown below:

Sl No.	Parameter	Acceptable Range
1	Nitrogen content	1.5 to 2.5 %
2	Phosphorus content	1.2 to 1.8 %
3	Potash content	1.6 to 2.4 %
4	Carbon content	> 30%
5	CN Ratio	1 : 20
6	Ph	7.5
7	Microbial count (colony forming unit – CFU)	10^8
8	Moisture content	20-30%

The major difference between FYM and vermicompost is that microbial activity in FYM is restricted to anaerobic bacteria. The microbial count is around 10^{3-4}. Due to microbial activity various enzymes are available. The decomposting bacteria narrow down the CN ratio making the nutrients available to plants. The calciferous gland that earthworms possess helps to add calcium to the salt.

GAU also produces vermicompost worth Rs. 50 lakhs annually. It is sold at a price of about Rs. 6/kg.

[9] Based on interview with Dr. P.K. Borad, Head of Department, Entomology, on 14th June at GAU, Anand campus.

The production cycle for compost is about 3 months. It is recommended to plant trees around the production facility so that it gets shade thus preventing loss of nitrogen. Cowdung and biomass can be used as inputs in the ratio of 2:8. The expiry for most bio-fertilizers is around one year.

Neem based formulations are also available in the market. NTGCF and other private companies makes azadirachtin. SHGs can produce neem oil and sell to the companies.

GAU has been involved in training of farmers nominated by DSC. Each training lasts for about 3-5 days. 6 groups of 35 farmers (mostly male) each were trained last year. The topics included integrated pest management (IPM), organic farming, integrated weed management and medicinal crops. The farmers showed keen interest and had very good interactions with the trainers.

Some contact details of resource persons were provided as follows:

Name	Affiliation	Phone No	Notes
Raman Oza	GOPCA	9426833660	For bio-pesticide certification
Dr. Mahesh B Patel	Agronomy Dept.	9737071848	
Dr. R.N. Pandey	Pathology Dept.	9925952458	For trichoderma
Dr. R.V. Vyas		9924938018	For bio-fertilizer