International Development Enterprises

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Project Title:

Creating New Markets For The Poor With

Micro Irrigation Technologies In Maharashtra, India

November 22, 2004

1. INTRODUCTION

International Development Enterprises (IDE) on September 30, 2004 completed its program on "Creating New Markets For The Poor With Micro Irrigation Technologies In Maharashtra, India**".** Launched in October 2001 in the state of Maharashtra in India, with support from USAID, the program over three years has directly reached over 28,000 smallholder farmers through 278 service providers in the irrigation supply chain alone. Several other private sector service providers providing agriculture related services such as seedlings, saplings, inputs, skill upgradation and knowledge transfer, etc., have helped reach these and many more MSEs both directly and indirectly.

2. BACKGROUND

IDE was launched in 1981 by a handful of socially conscious businessmen, believing that through a business-like approach they could affect poverty around the world. From its inception, IDE has used a "market creation" approach to development. Since 1992, IDE-India's (*herein after referred to as* IDE) major programmatic focus has been the treadle pump. In 1997, using USAID/BHR/PVC Matching Grant funds, IDE initiated a new program to expand into a new product line, "Affordable Micro-Irrigation Technologies" (AMIT). IDE viewed AMIT as having the potential to address the needs of small horticulturalists in semi-arid regions that constitute three-fourths of the country and are un served by the treadle pump program.

AMIT, comprising essentially of drip irrigation, applies water slowly to keep the soil moisture within the desired range of plant growth, vastly improving the ability of the farmers to manage the soil, water and crops so as to obtain optimum yields. Under the Matching Grant program, the AMIT program developed, field-tested, and market-tested micro irrigation products[1] adapted to the needs of small horticulturalists. While still at a preliminary stage, program sales provided evidence of farmer demand and a willingness to pay for the technology. From 1998-2000, AMIT sales of over 10,000 kits far exceeded the target of 3,200. Nearly 5,000 of these AMIT kits were purchased by MSE horticulturalists in Maharashtra and Gujarat. The current AMIT plus program built upon this past effort.

Using a Business Development Services (BDS) approach and focusing on the states of Maharashtra and Gujarat, IDE proposed a program to scale up dissemination of the AMIT technologies – combined with complementary horticulture-related services. AMIT Plus had three objectives. First, it was to further develop the market for AMITs, building on past product and market testing results (for tailoring products to customers), on relationships and linkages developed with and among BDS providers, and on a significant level of customer awareness of micro irrigation as a result of IDE and Government of India (GOI) investments. Second, the proposed program would develop the market for a package of horticultural services designed to meet the needs of small

[1] The program conducted field and market tests in seven states, including Maharashtra and Gujarat.

entrepreneurs. IDE and GOI experience shows that producers with access to drip irrigation and horticultural services – including access to saplings or seedlings, affordable fertilizer and pesticides, and appropriate agronomic advice – are most successful. Third, AMIT Plus was to experiment with market facilitation. IDE would facilitate others to provide demand-creation and supply services, and then exit. With substantial experience in market facilitation under the AMIT and treadle pump programs, IDE aimed to develop the market with less direct involvement, more efficient use of available scarce resources, and an exit strategy that is inbuilt into IDE's very approach.

3. SELECTION OF PROGRAM AREA

The program started on October 1, 2001 and was designed to cover the entire state of Maharashtra, serving 56,368 MSEs (Micro and Small Enterprises) across the state. The initial few weeks in the field quickly revealed the need for a well-defined area focus. Since the program focus was on horticulture, there was a need to focus specifically on the horticulture pockets within Maharashtra. Therefore, area identification was done on the basis of IDE's previous experience in the state of Maharashtra and the assessment carried out. Subsequent to the newly defined area for implementation and the rapid market assessment (explained in section 4 below), IDE in consultation with the USAID Microenterprise Office agreed to scale the outreach targets over three years to 28,750 MSEs.

The criteria for selection of areas were:

- Watershed activities in the region and the presence of NGOs
- Horticulture belts
- Smallholder farmers (MSEs) perception about the scarcity of water

To create demand for AMIT Plus products, IDE decided to collaborate with NGOs working in watershed management. Since these NGOs have significant outreach, they were expected to provide IDE with ready access to the target group. IDE explored the feasibility of leveraging promotional efforts through this network of NGOs who have their own staff and resources. Presence of active NGOs in such areas had an added advantage in that they realize the importance of efficiently distributing the scare water available and thereby the relevance of drip irrigation. Horticulture areas were selected since the markets for horticulture output were well developed, sale of produce and linkages with output markets did not pose an immediate constraint for promotion of drip systems, and smallholder farmers did not have access to affordable drip irrigation systems which were largely constraining their entry into this sub sector.

On the basis of the above mentioned criteria we selected the following 15 districts out of 35 districts in Maharashtra: In the first year we worked in 12 districts, but in subsequent years another three districts were added. The final 15 districts that the program worked in are:

- Solapur

- Osmanabad
- Latur
- Amravati
- Akola
- Yavatmal
- Buldhana
- Jalgaon
- Nasik
- Nandurbar
- Ahmednagar
- Aurangabad
- Jalna
- Beed
- Parbhani

4. RAPID MARKET ASSESSMENT

The program did not have the luxury of conducting a detailed market assessment (MA) followed by a pilot before launching the implementation phase. However, a rapid MA was done so that the implementation team could gain adequate baseline information as well as gain an understanding of the issues and constraints faced by smallholder farmers.

The team spent a couple of weeks collecting *taluk* level data from 12 districts on various parameters. An attempt was made to focus on water scarce taluks where horticulture is predominant. The rapid MA included the following information:

- Rainfall levels and water tables
- Classification of the block based on ground water availability[2]
- Key horticulture crops in the area
- Total area under horticulture
- Number of smallholder farmers in horticulture
- Water source
- Water lifting devices
- Area under drip irrigation
- Horticulture area not under drip irrigation
- Constraints faced by smallholders in entering the horticulture sub sector

Based on the above data, the total area under horticulture but not under drip was estimated. During field visits by staff, it was observed that most of the large farmers had access to drip systems and usually it was the smallhold farmers typically owning around 2-3 hectares of land who did not have access to drip. Some key findings were:

[2] The Central Ground Water Board has classified the taluks based on their ground water development status as Dark, Grey or White – Dark being one where the groundwater draft for irrigation exceeds 85% of the utilizable groundwater recharge, i.e., a dark block suffers from groundwater over exploitation.

- Only about 25 percent of the area under horticulture was under drip irrigation. It was primarily the large farmers who had adopted drip irrigation.
- More than 60 percent of farmers had full or partial access to water. They either owned a well or shared it with other family members.
- Hardly any farmers were cultivating summer crops (i.e. vegetables) which give the highest returns, due to water scarcity and lack of an efficient mechanism to use the limited water available.
- Existing drip systems were unaffordable by the poor.
- Smallholders had inadequate access to quality inputs – seeds, saplings, improved crop varieties.
- They also lacked skills/knowledge on production and cultivation techniques, best practices, etc.
- High gestation periods in horticulture also were a constraint for the very poor to enter this sub sector.

Subsequently, a new constraint emerged that IDE decided to address on a pilot basis. This was:

- Smallholders had inadequate access to information and markets

Based on the area assessment data and the suitability of the crops to drip irrigation, the following area specific horticulture crops were identified:

Amrawati, Yavatmal and Wardha	-	Orange, Mango, Sapota
Solapur, Osmanabad and Latur	-	Pomegranate, Lemon, Sapota, Guava, Drumstick
Aurangabad, Jalna and Ahmednagar	-	Sweet lime, Lemon, Guava, Amala
Nashik, Jalgaon, Nandurbar	-	Mango, Banana, Pomegranate

Since the very poor were not necessarily a part of the horticulture subsector, the program decided to expand the scope to also include and promote high value vegetables. Consequently, in addition to the fruit trees, the following vegetables and spices were included – Tomato, Chili, Eggplant, Cauliflower, Gourd, Okra, Pumpkin, Coriander, Spinach, Onion, Ginger, Turmeric, Watermelon.

5. A BRIEF DESCRIPTION OF PRODUCTS AND SERVICES

Water was a key constraint that farmers faced, coupled with lack of access to income enhancing, low cost and high return irrigation technologies. In 2001 when IDE started the program there were two basic types of drip systems available in the market. First, there were the high cost, high end *"ISI"* (a certification mark) systems which cost in the range of $600 - $800 per acre. Alternatively, there were the locally manufactured lower cost non-ISI systems which were priced at around $300 - $400 per acre. While the ISI systems last about 10 years, there is no assurance on the local drip systems which use recycled plastic material. It lasted anywhere from 2 to 7 years depending upon the manufacturer and the input used.

Initially, IDE decided to identify a few manufacturers of non-ISI material, train them and work with them at providing consistent quality at a fair price. The first year of the program, IDE worked with these non-ISI manufacturers of drip to encourage usage amongst the smallholders by ensuring that the material is consistent. Subsequently, in the second year, IDE came about an innovation done by the farmers of Madhya Pradesh (a neighboring state) who were using very thin walled plastic tubes as drip material for pre-sowing of cotton. This was locally called "pepsee" and lasted about 4-6 weeks for the pre-sowing requirement of the farmers.

IDE realized that this idea had immense potential and if the product was further developed for use in vegetables and horticulture it could spread quickly and allow the very poor to shift from subsistence farming to high value cultivation and thereby bring them above the poverty line. With this in mind, IDE worked at product development which was not a part of the initial program plan. IDE worked with a local manufacturer to improve the quality such that it could last 2 years while keeping costs low. Finally, by the end of 2002, program supported manufacturers of drip irrigation brought to the market a new product called **KB drip** which would last 2-4 years and was priced at $100 - $175 per acre.

Given below is a brief description of the type of systems and services that were provided by program supported service providers. Annexure 1 provides details of various service providers for the program.

5.1 Irrigation Technologies

Bucket Kit

It is a pre –assembled and packaged kit which can irrigate up to 20 sqm of area. It is typically used for kitchen gardens to grow vegetables for home consumption. This kit comprises a 20 litre bucket with one or two rows of lateral pipes of 5 to 10 meter length depending on the space available. The bucket can be hung from a tree of a pole at a meter height. This kit is very popular with women who take great pride in growing their own vegetables for the family. IDE has also found that landless farm families often have at least 20 sqm of area around their homes and can avail the benefits of improved nutrition by using these kits.

During the project these kits have been promoted in the tribal areas of Maharashtra. The main objective of promoting such kits in tribal areas is to build awareness among tribal groups about the use of drip. To make these kits available in remote areas, local level NGOs have been involved in training and promotion of such low cost kits. The tribal youths identified with the help of NGOs were trained by IDE to act as assemblers and to provide after sales service to the customers. BAIF–MITTRA, a leading NGO in Maharashtra, has played an important role in promoting these small kits in their project area in Nashik district of Maharashtra.

Drum Kit

The Drum kit can irrigate an area of 100 sqm. It is useful for cultivating small commercial vegetable gardens. This system consists of a 200 liter water storage drum, barrel, or tank placed at a height of 1 to 1.5 meters to allow the water to flow by gravity. It has 5 or more rows of lateral pipes 10 to 20 meters long depending on crop spacing and shape of the plot. By using a larger sized drum, the irrigated area can be expanded to 1,000 sqm.

Unlike Bucket kits, Drum kits have been promoted in both tribal and non-tribal areas. Here tribal farmers having a better water source have been motivated to use these kits. Tribal women that grew tomatoes and eggplant with the help of Drum kits have had better access to markets. Apart from the *haat* (weekly market), they were selling vegetables in nearby towns.

Very small farmers prefer this system as they were earlier excluded from vegetable farming as drip systems were not divisible and flexible to be used on very small plots.

Customized Systems

For slightly larger areas, typically 1,000 sqm and upwards, drip systems can be customized to suit the needs of the farmer, the crop varieties to be grown, and the shape of the field. Farmers can produce different components of the drip system and install the kit on the farm using simple thumb rules. For smallholdings up to two hectares, farmers can easily plan and lay the system in the field with some support from local fitters.

By and large this type of system was more in demand due to its low cost in comparison to other products available by big companies. It has been largely used by small and marginal farmers of program districts. Due to easy availability of these products and availability of IDE trained fitters in the rural area, these products became popular among a wide range of farmers in Maharashtra.

KB Drip

The KB drip has been described above. It is basically the material of the laterals using a combination of LLDPE, LDPE and carbon black that are called KB drip. These low cost laterals simply replace the more expensive and unreliable non–ISI laterals of all the above mentioned systems. After over a year of refinement of the product as per market requirements, this system is now available in 3 thicknesses of 80, 125 and 250 micron with varying life spans of 1-4 years. While the 80 and 125 micron laterals are used for vegetable cultivation, the 250 microns are increasingly being used in horticulture and have already helped save hundreds of acres under horticulture from a drought-like situation faced in parts of Maharashtra in 2003 and 2004.

The biggest advantage of KB drip is that it has brought down the entry barrier costs of drip irrigation and thereby high value agriculture for the very poor. In

fact, the manufacturers of high cost drip have realized that the market for this type of system is on the increase and have introduced low cost variants in the market. Yet, they have not been able to bring the costs down to the level of KB drip.

5.2 Other Services

System installation, repair and maintenance services
Closely associated with the provision of technologies are the services of installation, repair and maintenance. The supply chain dealers and retailers usually have technical staff (fitters/local mechanics) linked to their stores who provide these services at a fee.

Quality agriculture inputs
Smallholder farmers faced the problem of poor access to quality inputs, especially seeds, seedlings and saplings. In the case of horticulture, the quality of the saplings as well as the variety that the market requires becomes crucial. It was found that nursery growers were providing these services and the market for this service existed. However, the nursery growers were not aware of the new varieties that were available in the market.

Skills/knowledge on production techniques, etc.

It was also found that IDE's target segment of low income farmers were not integrated into the horticulture sub sector as they lacked not only access to affordable irrigation technologies, but also knowledge on production techniques for high value fruits and vegetables. The government extension services were not effectively reaching them. There was a need to create a system that could provide this service on a sustainable basis.

Market information/access
Approximately one year into the program, IDE identified that its initial assumption of markets for horticulture goods being well developed was not entirely true. There were areas and instances where the smallholders were not a part of the market system, either because they were growing very limited quantities to access larger markets, or because they lacked price and market information to access urban markets. There was no formal provision of this service through the private sector in most places. IDE worked on a pilot basis with a local entrepreneur in one district to provide this service to small growers as well as new entrants into this sub sector.

6. IDE'S FACILITATION ROLE

IDE's role is summarized in the table below and key aspects are described in the section that follows:

SERVICE	PROVIDER	FACILITATION TASKS
Seeds / Sapling	Agri-Input dealers/ nursery growers	• Convince them to stock appropriate varieties and quality seeds • Suggest saplings as required by the market • Increase awareness on availability, marketable varieties, etc. • encourage group purchase for very small lands
Technology inputs	Manufacturer, Distributor, Dealer / Assembler	• Product development and adaptation • Supply chain creation and linkages across players • Technical training on low cost drip • Stimulating awareness of low cost drip amongst smallholders and demand creation
System installation / Repair and maintenance	Dealer / assembler / Fitter	• Technical Training • Linkages
Training	KVK, Agricultural Universities, Extension workers, farmers	• Identification of resource persons • Organize and manage trainings
Market information	Agri Service Centres/ Information kiosks	• Development of business model (mkt access, bulking, other revenue streams) • Linkage with "*Agriwatch*"/ content providers • Facilitate establishment of other such centres

6.1 IDE's Role in Demand Creation and Enhancing Awareness in a Weak Market

Smallholder farmers in Maharashtra did not have access to drip irrigation due to lack of availability of divisible, affordable, small sized drip irrigation systems. Such MSEs either do not practice horticulture or even if they do, they flood irrigate when water is available.

IDE has been communicating the benefits of using drip irrigation for improved water efficiency, improved productivity, optimal utilization of inputs and gradually they will increase their area under horticulture, or switch to horticulture. Also, many farmers find it difficult to accept that the little water available in their wells is actually enough to grow a crop using drip kits. This aspect needs to be clearly communicated to the farmers.

The IDE team conducted various rural promotions in the program area. IDE classifies these tools into 2 broad categories: static promotions and dynamic promotions. Static promotion tools such as leaflets, banners, and bill boards are typically used as reminder tools. These contain important information about the products and services and also provide the details of the dealer from where it can be purchased. IDE encourages the BDS providers to gradually develop these promotion materials at their end. In case of dynamic tools, these usually take the form of *haat* demos (demos in rural weekly markets), farmer and village meetings, audio campaigns across villages, video shows, etc. IDE has also organized exposure visits for MSEs to successful areas and arranged interaction with progressive farmers. Such farmer to farmer contacts have been found to be an extremely useful tool for enhancing farmer interaction and learning. IDE has also seen that one of the most effective promotion tools is short campaigns in the rural area. In this activity, IDE staff along with a local level BDS provider move from village to village in a jeep/rickshaw to promote the concept of low cost drip irrigation. In addition, IDE has developed a video film for viewing by MSEs that communicates the concept in an interesting way. This generates a high level of interest among smallholders in the program area and on a typical screening over 500 farmers attend the show. Further details of demand creation tools are provided in Annexure 2.

It was observed during the program that there was increased participation by the BDS providers in these activities. For example, the short campaigns and haat demo's are typically conducted by the drip dealer along with an IDE staff member. In case of video van shows, the dealer is almost always present to talk to the farmers and answer their queries prior to and after the movie. It was always perceived within IDE that some dynamic activities, especially the video van show, would not be carried out by BDS providers after the program. However, we have experimented by distributing copies of the movie CD to supply chain members as well as several NGO partners. It has been observed that some of them are now showing this movie in alternate platforms and forums such as farmer days, SHG meetings, etc. Most of IDE's demand creation activities are undertaken along with BDS providers such that they take on these activities after IDE's exit from the program. The accompanying BDS provider shares the cost of the activity by contributing his/her time. They are willing to bear these costs from the margins they earn.

Some innovative promotions were also designed during the peak selling seasons. One such innovation was the promotion on *ration* cards. These cards are issued by the Government of India to families Below Poverty Line (BPL). These cards are then used for procuring food grains through the public distribution system (PDS) stores. To maintain this paper card, often the users cover it with a polythene sheet. IDE decided to use this opportunity to promote the KB drip as well as provide useful technical

information. IDE provided the users with ration card covers with crop water requirements over different seasons printed for all key crops grown in the region. Besides acting as a tool for promoting the product, it also provides MSEs relevant information about their crops. IDE also took advantage of local festivals to promote the products and services. For example, during the annual kite festival, printing of the logo was done on kites.

6.2 IDE's Role in Capacity Building of MSEs and BDS Providers

IDE organizes training programs at the village level for NGOs, BDS providers and MSEs. Training has been imparted across a varied range of topics such as system design and installations, best practices in horticulture and vegetable crops, control of various pest and diseases, organic farming or zero budget farming and optimal use of water in their wells as well as on IDE's role in facilitation,. While technical training is typically conducted by IDE field staff along with the drip irrigation assembler, training on horticulture best practices and farming practices is done by local level experts such as retired government extension officers, university professors, progressive farmers, etc. In the process, assemblers are being trained in technical training and could be expected to deliver such training subsequently. In the case of training on agriculture, IDE in some cases bears the cost of the trainer while some conduct such training gratis. IDE is of the opinion that if the perceived returns to farmers is substantial then they may be willing to pay for these services.

6.3 IDE's Role in New Crops/ Crop Diversification

IDE has been attempting to facilitate the MSEs to diversify their crop portfolios in favor of higher value – low investment crops, add other crops to reduce risk and introduce newer varieties that the markets require. While the focus was on fruit trees, horticulture farming inherently has long gestation periods. IDE simultaneously encouraged smallholders with limited risk bearing capabilities to look at two options. One, ensure intercropping with high value vegetables for quick returns and also to cultivate part of their lands primarily with high value vegetables which makes the investment in drip irrigation more attractive as it can provide a 100% return on investment within the first crop cycle itself.

Some new crops/ varieties that were encouraged in the area are:

Phule Jyoti – This is a new variety of chili grown in the Solapur area. This variety has been developed by MPKVP, a premier agriculture university of Maharashtra. Many farmers have adopted this and it has helped to increase income for MSEs. Below is data from two of the MSEs who have adopted the new variety.

MSE Name and Chili Crop Area	Net Income to Date (new variety in US$/Rs)[3]	Additional Expected Net Income (US$/Rs)	Total Annual Net Income from New Variety (US$/Rs)	Annual Net Income from Conventional Chili Variety (US$/Rs)
Damodhar Yadhav in 1,000 (SqM)	$132 Rs 6,000	$264 Rs 12,000	$396 Rs 18,000	$264 Rs 12,000
Raghunath Shinde (2,200 Sq M)	$ 330 Rs 15,000	$440 Rs 20,000	$770 Rs 35,000	$462 Rs 21,000

Custard apple - Custard apple (*balanagari* variety) has been introduced as an additional drought resistance crop in the drought prone area of Solapur. It receives a high value both in the local and national markets due to its use in food industries, especially as an important ingredient in ice cream. This variety is sold in the local market at $8.80 (Rs 400 per dozen).

Eggplant (tree variety) – Most Maharashtra farmers grow eggplant as it is a popular food in West India and receives a good price. Recently there have been developments in the eggplant crop in the adjoining state of Karnataka. The Dharwad Agriculture University has developed an eggplant tree that yields fruit year round and lasts several years. A group of farmers were taken on an exposure trip to Karnataka from where they procured the saplings. These saplings were also provided by IDE to the nursery growers. These farmers have planted the saplings. Demand for the saplings has started in these areas and the nursery growers have now started supply of these saplings in their respective areas.

Pomegranates - Aurangabad and Jalna are primarily sweet lime growing areas. In recent years farmers have been experiencing lower returns on their crops. Also, several small farmers with limited outputs have not been able to access larger markets. In this area, with the program intervention, several farmers allocated a part of their lands to cultivating pomegranates. Pomegranates have a good export market and systems for export to the Middle Eastern countries are well established in Maharashtra. This expectation of higher returns made possible with drip irrigation and knowledge on production techniques for growing pomegranates has encouraged a large number of very small farmers to shift to this new crop.

6.4 IDE's Role in Developing Markets for Soil Tests

Over a period of time, soil quality has been deteriorating due to indiscriminate use of fertilizers and pesticides by farmers. Soil testing thus becomes important to understand what the soil requires. However, testing of soil quality for determining input and other

[3] 1 Rupee = US$.022

aspects such as mixed crops for nitrogen fixation, etc., is not a common practice amongst smallholders.

IDE organized awareness camps in Ahmednagar and Aurangabad districts to communicate the usefulness of soil testing amongst MSEs. It was a successful endeavor that motivated over 50 small farmers to collect their samples and get them tested in a private sector laboratory. The proprietor of the laboratory is a farmer himself and has a well equipped laboratory for soil testing. He has now started extending this service to smallholder farmers who so far were not availing of this service. The farmers that used this service found that by using the recommended dosage of fertilizers they could save their input costs as well as get higher yields. It is expected that with a gradual increase in the demand for this service, more private sector players may set up such facilities subsequently.

6.5 IDE's Role in Encouraging Markets for Low Cost Micro Nutrients

As mentioned above, with excessive application of fertilizers and pesticides over a long period of time, the soil quality has been severely affected. Even if the deficiency is small, it reduces the yield considerably and makes the plant more susceptible to disease. In addition, the cost of cultivation has also been going up. Micro-nutrients are easily available with input dealers. The price of the micro–nutrient solutions available in the market are in the range of $3.75-$4.40 (Rs. 170–200) per liter. The small and marginal farmers can't afford to buy micro-nutrients in the market, as they have to be used as foliar sprays or for drenching, etc. A low cost alternative was thus needed. The preparation of vermi-wash at the household level is one such alternative. IDE has initiated the preparation of vermi-wash at household level in consultation with local agencies such as KVK, individual experts, farmers, etc. These resource persons provide the training to groups of lead farmers and nursery growers who prepare these micro nutrients at their homes/nurseries. These lead farmers and nursery growers have now started training other farmers and adoption rates within villages where lead farmers have been trained have gone up to 20–25 percent.

The micro-nutrients found in the vermi-wash are as follows[4]:

- PH of the solution = 6.9
- Nitrogen = 200 ppm
- Phosphorus = 60 ppm
- Potassium = 69 ppm
- Magnesium = 25 ppm
- Zinc = 20 ppm
- Copper = 50 ppm
- Calcium = 40 ppm
- Ferrous = 20 ppm
- Sulphates = 177 ppm

[4] These nutrient and their quantity is dependent on the raw material used.

- Sodium = 122 ppm

The most important thing about vermi-wash is that the micronutrients present are in the dissolved form_so that the crop/plant can use them instantly. It is found that use of vermi-wash:

a) Increases the rate of photosynthesis in crop/plant
b) Increases the number of micro organisms in the soil
c) Increases the crop/plant yield
d) Increases the crop/plant resistance to diseases
e) Increases the rate of decomposition of compost
f) It can be applied through drip irrigation systems.

As a result of more smallholders wanting to set up vermi-wash units on their lands, a supply chain for worms and other material used is now developing in the project areas. Typically, the farmers preparing vermi-compost on a commercial basis have become the suppliers of the worms.

7. MONITORING AND IMPACT ASSESSMENT

Monitoring and impact assessments were done at two levels:

1. IDE carried out baseline and income impact studies on an annual basis.
2. External consultants and international management students conducted impact assessments.

The section below presents a summary of the internal assessment conducted by IDE, while the external consultant reports are provided in Annexures 4 and 5.

7.1 Survey of Participants Farmers in Maharashtra

IDE carried out an in-house survey of participant farmers. The objective of this survey was to understand the impact of the program on net incomes of smallholder farmers over the three years.

7.2 The Survey Sample

A total of 600 farmers were to be interviewed over three years as per the following plan:

Year 1 – 100
Year 2 – 100 new + 100 from year 1
Year 3 – 100 new + 100 from year 1 + 100 from year 2

While 600 farmers were interviewed, due to some interviewing errors, the final analysis for income impact included 514 farmers, selected randomly and followed up across the years.

7.3 Land Holding

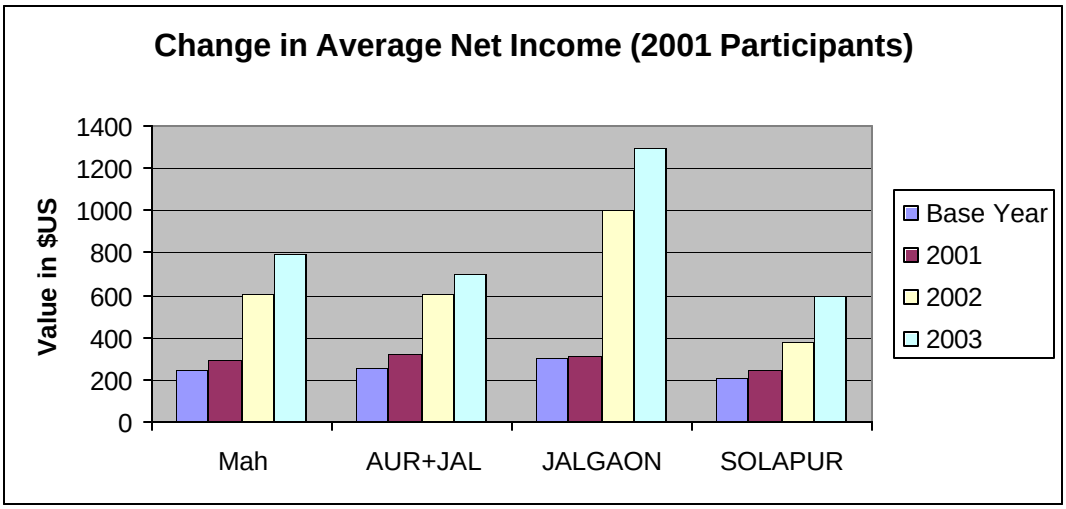
The average landholding of the farmers interviewed was 4.86 acres. Of total landholdings, hardly any farmers cultivate all of their land due to scarcity of water. The survey revealed that, on average, farmers were cultivating not more than 30 percent of their holdings (circa 2 hectares). The average cropped area that farmers participating in the program were able to bring under drip cultivation was 1.58 acres.

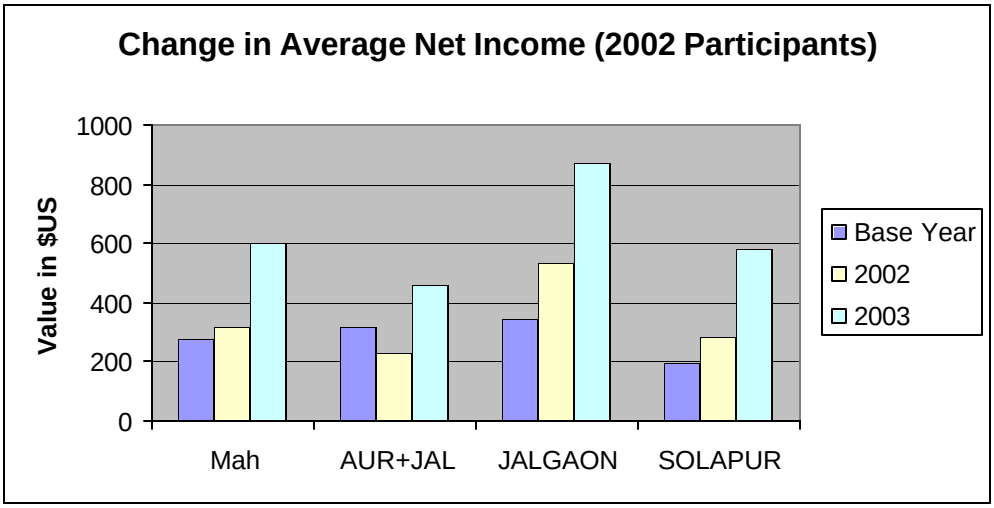
7.4 Changes in Net Incomes

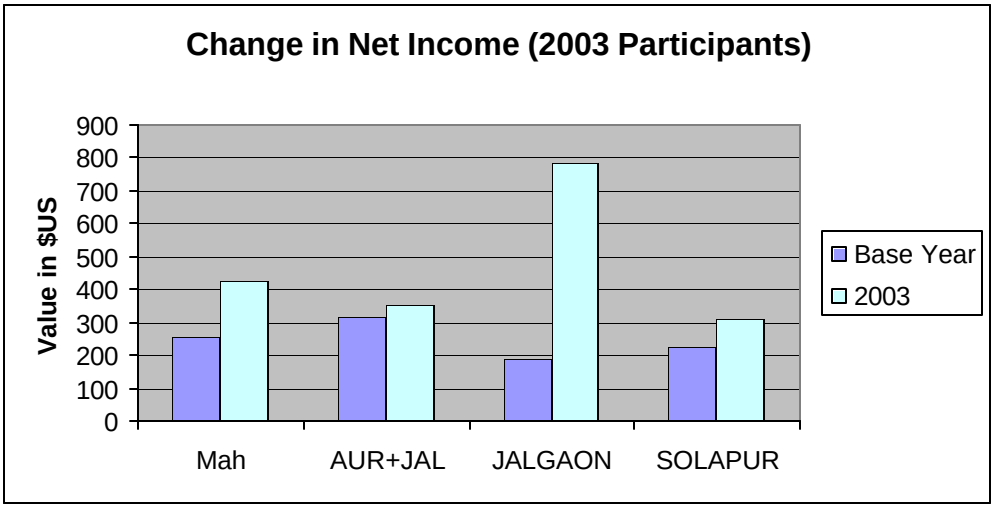
The survey reveals that net income has increased during participation in the project.

The three graphs below show the net increases in income levels in year 1, year 2 and year 3. These graphs show these income levels in the state of Maharashtra as a whole as well as across the three regions of Aurangabad and Jalna, Solapur and Jalgaon, covering 12 districts. The key findings reflected in the data are:

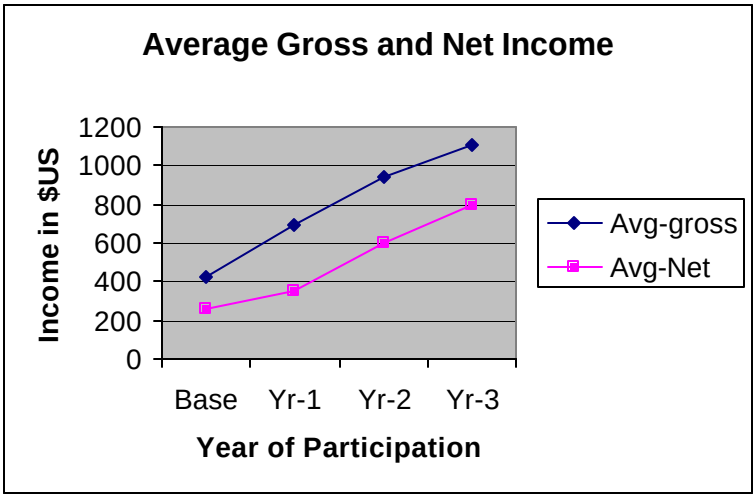
- All participant farmers were under $ 1/day when they entered the program. In India, this corresponds to about $ 400 per annum for a family of five (adjusted for PPP).
- The variations in the baselines were on account of the crop they were cultivating, whether they were already in horticulture or a new entrant into the sub sector.
- In all three years, famers in year 1 made marginal income increases. This was due to the fact that they had to invest in drip irrigation systems in year 1. However, in spite of this investment, these farmers showed income increases even in year 1 which clearly show that KB drip systems result in 100 percent return on investment in the very first year per crop.
- By year 2, using drip systems and associated services, farmers were able to pull themselves above poverty levels.
- Jalgaon region showed higher returns in year 2 for all participants. This was because the farmers in that region are cultivating banana which yields within 12-18 months as against other crops such as sweet lime and pomegranate which are high gestation crops.


Change in Average Net Income (2001 Participants)
Value in $US
1400
1200
1000
800
600
400
200
0
Mah
AUR+JAL
JALGAON
SOLAPUR
Base Year
2001
2002
2003


Change in Average Net Income (2002 Participants)
Value in $US
1000
800
600
400
200
0
Mah
AUR+JAL
JALGAON
SOLAPUR
Base Year
2002
2003


Change in Net Income (2003 Participants)
Value in $US
900
800
700
600
500
400
300
200
100
0
Mah
AUR+JAL
JALGAON
SOLAPUR
Base Year
2003

The graph below shows the trend in gross as well as net incomes over the three years. While gross incomes increased from $400 to about $1,100 per family, net incomes have increased from $250 to $800. By year 3, farmers are in a position to recover their investments, gain sufficient experience of new methods of cultivation and marketing of new crops and are comfortably able to pull themselves out of poverty. These figures represent average figures for the program. For farmers already practicing horticulture, these figures may be higher. In the case of new entrants, the figures reflect incomes from intercropping and/or vegetable cultivation. For such farmers, income from horticulture, especially sweet lime or pomegranate, will be determined only by year 2006 and beyond.
Annexure 3 provides a collection of a few case studies.



8. TABLE 1: PERFORMANCE MEASUREMENT INDICATORS

TABLE 1 - MEASURING PERFORMANCE AGAINST TARGETS

ASSESSING THE MARKET FOR GOODS & SERVICES (Final Sales)			
		Year 3 Progress	**Cumulative 36 Month Progress**
Only applicants targeting a specific subsector	***MARKET-LEVEL***		
	1. Annual value of sales (in US$)		
	PROGRAM-LEVEL		
	2. Annual value of sales (in US$)		

ASSESSING THE DEVELOPMENT OF THE BDS MARKET			
		Year 3 Progress	**Cumulative 36 Month Progress**
All appli Cants	***MARKET-LEVEL***		
	3. Total number of BDS providers, by service		
	a. Service 1 (AMIT systems dealers/assemblers)		
	b. Service 2 (Agri-inputs)		
	c. Service 3 (Nursery growers)		
	PROGRAM-LEVEL		
	4. Number of BDS providers participating in the program, by service		
	a. Service 1 (AMIT systems dealers/assemblers)	93	278
	i. Percent private, for-profit providers		100%
	b. Service 2 (Agri-inputs)	185	411
	i. Percent private, for-profit providers		100%
	c. Service 3 (Nursery growers)	15	76
	i. Percent private, for-profit providers		100%
	5. Total number of firms acquiring BDS from program-supported providers, by service		
	a. Service 1 (AMIT systems dealers/assemblers)	21,393	38,500
	b. Service 2 (Agri-inputs)		
	c. Service 3 (Nursery growers)		
	6. Number of microenterprises acquiring BDS from program-supported providers, by service	16,430	28,203
	a. Service 1(AMIT systems dealers/assemblers)	16,430	28,203
	b. Service 2 (Agri-inputs)	16,430	28,203
	c. Service 3 (Nursery growers)	6,572	11,280
	7. Microenterprises as percent of total firms (line 6/line 5) for service 1 (drip systems)		73%
	8. Number of woman-owned microenterprises acquiring BDS from program-supported providers, by service	2,972	4,904
	a. Service 1 (AMIT systems dealers/assemblers)	2,972	4,904
	b. Service 2 (Agri-inputs)	2,972	4,904
	c. Service 3 (Nursery growers)	750	1,226
	9. Woman-owned microenterprises as percent of total microenterprises (line 8/line 6)		17.4%

ASSESSING THE FACILITATOR'S COST-EFFECTIVENESS (PROGRAM-LEVEL INDICATORS)			
		Year 3 Progress	**Cumulative 36 Month Progress**
All applicants	10. Total program costs	$419,000	$750,000
	11. Total program costs per microenterprise served (line 10/line 5)	$25.50	$26.60
ASSESSING THE BDS PROVIDER			
		Year 3 Progress	**Cumulative 36 Month Progress**
12, 13 &14 are only for direct Providers of BDS. 15 is for all Other applicants.	12. Total earned revenues (do not include any grants or donor contracts)	-na-	
	13. Total expenses	-na-	
	14. Return on operations (line 12/line 13)	-na-	
	15. BDS Providers' profitability (please suggest appropriate indicator(s) to measure the profitability of the BDS providers with whom you work and/or services they provide, and explain/justify this measure in the narrative section)	Total Profit: $ 240,621 Profit per BDS: $821 Refer in narrative section for details	Total Profit: $ 416,378 Profit per BDS: $544
ASSESSING THE IMPACT ON THE MICROENTERPRISE CLIENT (Program Level)			
		Year 3 Progress	**Cumulative 36 Month Progress**
All applicants	16. Annual value of sales by micro enterprises participating in program (in US$)		Base year: $ 250 Year1: $ 300 Year2: $ 600 Year3: $ 800
	17. Microenterprise client satisfaction (see "Guidelines" for further explanation):		
	a. Service 1: number of referrals	9,858 (60%)	16,922
	b. Service 2: number of repeat clients	13,144 (80%)	22,562
	c. Service 3: number of referrals	3,286 (50%)	5,640
OTHER INDICATORS			
		Year 3 progress	**Cumulative 36 month Progress**
All applicants	18. Exchange rate used to calculate US$ figures		INR 45 = $ 1
	19. Estimated percentage of microenterprises on line 6 who have poverty loans from any source	70%	70%

8.1 NOTES TO TABLE 1

Line 6: Number of microenterprises acquiring BDS from program-supported providers

In the third year, program supported BDS providers have sold 16,430 AMIT kits to MSEs. Program supported BDS providers also sold drip systems to an additional 4,963 medium and larger farmers. Product-wise breakdown of the 16,430 kit sales is asfollows:
Bucket kits - 1,454
Drum kits - 23
Customized horticulture systems – 11,449
KB drip - 3,504

Over the three years (October 2001 to September 2004) total MSEs reached was 28,203. Product wise sales are:
Bucket kits - 2,103
Drum kits - 212
Customized horticulture systems – 19,778
KB drip - 6,110

Line 15: BDS Providers' profitability

The total turnover (sales) of the BDS providers over three years is as per calculations below:

Assemblers/drip system dealers

Bucket kit @ $2 X 1,454 = $ 2,908
Drum kit @ $15 X 23 = $ 345
Customized systems @ $140 X 11,449 = $ 1,602,860
Eazy drip @ $ 60 X 3,504 = $ 210,240
Total sales = $ 1,816,353

Horticulture Package (Fertiliser & Pesticides)-per unit cost assumed for half a year

Bucket kit @ $ 0.5 X 1,454 = $ 727
Drum kit @ $ 2.5 X 23 = $ 57.5
Customized systems @ $ 60 X 11,449= $ 686,940
Eazy drip @ $ 50 X 3,504 = $ 17,5200
Total sales = $ 862,925

Horticulture Package (Saplings)-

MSEs need saplings only for horticulture plants and MI systems have been installed for both old and new crops, therefore 40% of total customized systems and 20% of KB drip systems users have been estimated as purchasing saplings.

$ 30 X 4,580 systems = $ 13,7400
$ 30 X 700 systems = $ 21,000
Total sales = $ 158,400

Total Sale Value of BDS Providers to MSEs in year 3 = $ 1,816,353 + $862,925 + $158,400 = $ 2,837,678

Profitability for assemblers/drip dealers has been calculated on the basis of average margin received by them in selling different components used for assembling of kits/systems. On average, assemblers make about 18% gross margin and 10% net margin on drip systems, agri-input dealers make 10% gross and 5 % net profits.

Assemblers/ drip dealers @ 10% of $ 1,816,353 = $ 181,635
Agri-input dealers @ 5% of $ 862,925 = $ 43,146
Net profit by nursery growers @ 10% of $ 158,400= $ 15,840

Total Net profit of BDS providers in year 3= $ 181,635 + $ 43,146 + $ 15,840 = ***$ 240,62****. Net profit per provider is* ***$821****.*

As per above calculations, the cumulative net profits generated by the 3 services over the 3 years is = ***$ 416,378.*** *Net profit per provider during the same period is* ***$544****.*

9. KEY LEARNINGS

9.1 IDE's Facilitation Role

As per the original program design, IDE was to play the role of a national level facilitator and nurture other local NGOs who would be the local facilitators. What IDE learned fairly quickly was that local NGOs were not in a position to take on that role within the BDS framework. Local NGOs had been working in different operating styles and were unfamiliar in working with private sector service providers with a market-based approach. IDE itself thus took on the task of facilitation in Maharashtra.Nonetheless, local NGOs played an important role in other ways. Being familiar with the local people and having built a level of understanding and trust with them, they provided IDE with a good platform to enter a new area. NGOs working in watershed development in particular have realized the need for an efficient water application device for smallholders that can make more productive use of the scarce resource. They thus actively promote IDE's endeavors in their respective areas.

9.2 Facilitation in Weak Markets

IDE's experience with its treadle pump program showed that in very weak rural markets where the awareness is extremely low, the facilitator needs to maintain a fine balance between facilitation and direct service provision rather carefully. In this program, IDE was well aware of this possibility. However, as explained above, the government and the private sector over the previous decade had played an important role in creating awareness about efficient water application devices. The problem was that all systems were designed and available at a high cost which precluded the entry of smallholder farmers into high value agriculture. Therefore, while on one hand farmers were aware of drip irrigation and the poor aspired to it, on the other hand they also knew that not much was available that could be affordable for them. IDE thus still had the task of creating this new market for the poor segment. Facilitation in this context thus required a well thought out market development plan for our target segment.

9.3 Inclusion of the Poor into Mainstream Markets

The development and introduction of KB drip was a boon for the smallholder farmers who had access for the first time to very affordable drip irrigation. As a result, these farmers entered this high value agriculture sector and initiated the shift from subsistence farming to remunerative farming. It was observed that users of program supported customized and KB drip systems were very small landholders, farming 1.2 to 1.5 acres on average.

This land based program in a way eliminated the landless who usually worked as seasonal agriculture labour in other farms whenever work was available and often migrated to other areas when there wasn't sufficient work available within the vicinity. With an increase in agricultural activity year round, it was expected (based on IDE's experience in other parts of the country) that there would be an increase in opportunities available to these landless.

IDE also believed and learned that even the landless have small homestead lands usually at least 20 sqm. This land could be productively utilized to grow vegetables year round for home consumption. The new "Family Nutrition Kit" introduced by the manufacturers cost the farmers a mere $ 1.5 and could be used on 20 sqm of land.

9.4 Importance of Flexibility to Make Mid Course Adjustments

For IDE, working along the value chain was a relatively new experience. Prior program focus had been on developing and managing supply chains only. IDE learned that there was a need to be open to new constraints emerging and old ones becoming relatively less important. Over these three years, there were several such adjustments that IDE had to make to its intervention design:

- One, product development and adaptation with the emergence of KB drip became a critical part of the R&D team's work. Working with the manufacturers, IDE adapted the product for use in vegetables and horticulture while focusing on quality to ensure a two year life span at the least possible cost.
- Two, IDE had assumed that output market linkages for horticulture were well established in Maharashtra. While this was true for large farmers, the smallholders found that they were not in a position to meet with the requirements of the market both in terms of minimum quantities and/or varieties/quality. Smallholders also did not have adequate market information to take informed decisions on market needs and trends. The program thus decided to address this constraint by way of facilitating an information and agri-centre. This centre was promoted by a local entrepreneur who invested in a computer out of his own personal interest. IDE linked him with an agriculture content provider who provided access to a website, journals, periodic price information of various agriculture commodities, etc. Thereafter, farmers could pay a small membership fee to avail of some of these services. The entrepreneur also offered the service of bulking of the produce of small farmers to take to larger markets that offered a better price. IDE further worked with the entrepreneur to develop a sustainable business model. Looking at the success of this entrepreneur, other local youth started showing an interest in setting up such centres in other parts of the state.
- The concept of IT kiosks has begun to grow significantly in rural India. IDE, after the success of this agri-centre, initiated talks with business houses that are promoting IT kiosks. Some have shown an interest in providing information linkages to program supported manufacturers for supply of drip technologies through their kiosks while providing other market related information to the farmers from their centres.

10. WAY FORWARD

The experience with BDS market development in Maharashtra, has paved the way for further development of IDE's new program focus in India. The new program titled "Integrating Poor into Market Systems" or IPMAS will focus on working along the value chain allowing poor farmers to overcome water and other agriculture constraints and become market participants.

Regarding the USAID supported BDS program in Maharashtra, IDE has successfully completed the three year program of "Creating New Markets For The Poor With Micro Irrigation Technologies**".** With an outreach of 28,203 MSEs serviced directly by more than 700 BDS providers, the program has assisted in creating a more robust market for low cost drip irrigation technologies and quality inputs for these MSEs. It has added wealth of approximately $ 800 per MSE per annum who started in 2001 that has helped these MSEs pull themselves out of poverty.

The question for IDE at this stage is whether the time is right for IDE to completely pull out from the area. For example, IDE works through a network of manufacturers, distributors and dealers to take quality products at an affordable price to farmers. These products are continuously being refined and made more appropriate to small farmers. In the case of Maharashtra, IDE cut down the entry barrier costs by close to 50% to 70% and made it possible for small farmers to use drip systems. While the market for drip irrigation is well structured with supply chains in place and new players entering the market, the KB drip technology is still in its infancy. IDE provides the critical input of quality monitoring since the product is relatively new and the market cannot afford to take the risk of rejection/failure on account of quality problems. IDE has realized that such aspects of its current role need a more sustained intervention for which the market is willing to pay.

IDE believes that the market is now ready to pay for these services and IDE's role can be partially sustained by recovering cost for these services that IDE provides the private sector. IDE is working on a model that will make it possible for the private sector to pay for the services IDE provides, which will then lead to sustained delivery of these services by IDE over the next one to two years until the market is developed sufficiently to start demanding and providing quality products and services at the right price.

In addition, in the first three years, IDE has reached 28,203 smallholder farmers. While the majority of the farmershave been below the poverty line, they are essentially the less risk averse, entrepreneurial "early majority"[5] farmers. The more risk averse, "late majority" farmers (possibly also the poorest) still need to be integrated into high value markets.. The strategies required to engage with and create sufficient incentives for these MSEs to be participants is quite possibly different. IDE believes that there is still a pressing need for continued presence in the area if it is to facilitate these MSEs to become entrepreneurial farmers.

[5] Refer Geoffey More, "Crossing the Chasm"

ANNEXURE 1

SUPPLY CHAIN AND OTHER SERVICE PROVIDERS

A brief description of the various service providers who participated in the program is provided below.

Manufacturers - The AMIT kit consists of various plastic components, such as polyethylene/PVC pipes, emitters, fittings, valves, filter, stakes, packaging box, water containers etc. There were 15 manufacturers identified for various products/ components. Most of the manufacturers are manufacturing major components such as laterals and emitters.

Assemblers - Assembling AMIT kits is a simple process, which involves following major activities:

- Sourcing and procurement of different components of AMIT kits
- Cutting of pipes as per the required length
- Punching holes in the lateral pipe for fixing micro tubes
- Connecting the cut pieces with the help of connectors such as tee, elbow joiner
- Preparing coils of the cut pieces
- Packaging coils along with required fittings and accessories

There are different manufacturers, manufacturing different AMIT components. Therefore, sourcing components, procuring and assembling them into a user- friendly kit becomes a very important function in the supply chain. M/s Datta Irrigation was the only manufacturer, who was selling complete kits. The rest of the manufacturers are interested in selling their own components and not willing to get into the assembling business.

Dealer/Agent - In Maharashtra the supply of components is mainly dealt with by dealers and agents. In order to enhance availability of the products and associated services at the village level, IDE trained village youths in designing and assembling the kits at village level as per the needs of customers. Largely, supply chain of any drip product exists at the block or taluk level and in a few cases some dealers exist in large villages. But during the program, village youths have been identified and trained to cover a radius of 40 kms and sell drip irrigation systems, accessories and provide after sales service. The numbers of such youths are highest in Solapur. The Solapur experiment was a success and we have replicated this model in Jalna and Akola areas as well. These agents do not have a permanent shop like conventional dealers but largely depend on their mobility to establish relations with the farmers and increase their sales.

The dealers and agents have the following function to perform:

- Stocking AMIT kits and spare parts available for the farmers
- Promoting AMIT kits so that farmers are aware of the product
- Selling AMIT kits to the farmers directly or through fitters
- Giving know – how to the farmers
- Providing after sales service

Case Study: IDE staff met up with Mr. Subash Warsinghay, who works as a mobile dealer in Akot area of Akola. He was a driver by profession and earlier worked as a driver with a dealer of Jain Irrigation (a large drip irrigation manufacturing company based in Maharashtra). Subhas had a technical bent of mind and so quickly picked up the technical aspects and nuances of drip irrigation while serving as a driver. Subsequently he left his job as a driver and took up a job with Jain Irrigation Company.

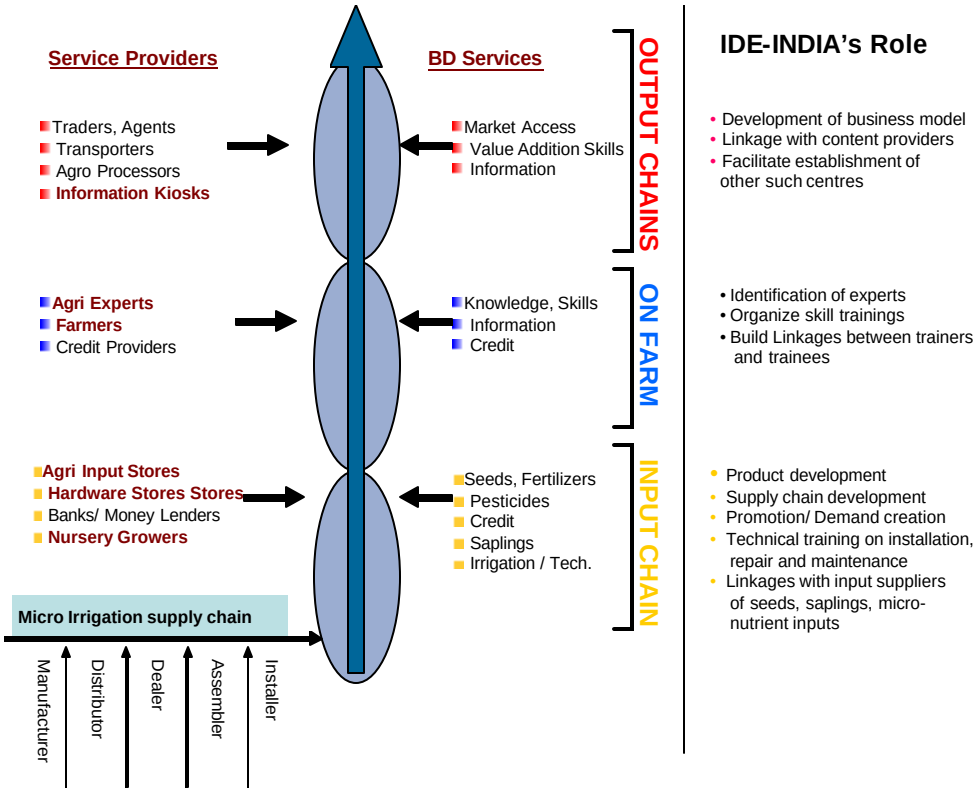
After IDE started its program in Maharashtra, he saw the immense scope and potential of KB drip. Due to the high cost of conventional drip systems and frequent changes in Government policy on subsidy he was not getting good orders as a Jain company sales person.

Mr. Subhas last year took up dealership of KB drip and started his work with a team of 2 field staff. With a good demand in the market, promotions, and his own relations in the market, his operations have greatly expanded and he now has a team of 5 staff.

Agri-input dealers - In addition to the AMIT supply chain, IDE also developed linkages of their MSE's with local level agri-input dealers for supply of quality inputs. Unlike developing assemblers for AMIT, these dealers are present at the village level. IDE has identified such dealers in the area and involved them in promotional activities and agronomy related trainings.

Nursery growers - Like Agri-input dealers, these nursery growers play an important role in supplying saplings. In the case of vegetable crops, a few prospective farmers and nursery growers have been trained to work as sapling suppliers. IDE has identified such nurseries in the program area and established linkages with the MSEs through farmers meetings and nursery related training.

IDE's Facilitation Role along the Value Chain



ANNEXURE 2

A BRIEF DESCRIPTION OF TOOLS USED FOR DEMAND CREATION

IDE used a number of promotion tools. These are classified as static and dynamic tools are briefly described below.

Static Tools

- Hand Bills
- Wall Paintings
- Dealer Signboards
- Caps and shirts
- Calendars and diaries
- Banner
- Big Umbrella
- Brochures
- Posters
- Display boards
- Ration card folder

Dynamic Tools

Video van show – A movie has been developed on AMIT with the help of popular artists from TV and film. Our office vehicle is being used to show the movie, which is equipped with projector, audio system, screen & generator. First, it moves to the villages in the afternoon and announces the name of the movie and place of show and then shows the film in evening. Villagers after finishing their tasks for the day get to enjoy this movie "Ek Pal" as it has been made as an entertainment film with an important message. The movie has been developed on a life of a youth who struggles due to scarcity of water and then migrates to the city to try and make a life for himself. It reflects the hardships faced by him in the city and how when he returns, disillusioned, he sees his wife growing vegetables using AMIT. It then shows how his family overcomes poverty with high value agriculture using AMIT. Most of this video shows are being organised by local dealers or agents. Typically after a show, several enquiries are generated.

- **Haat Demo –** A haat is weekly market where people from surrounding villages come to buy and sell their products, farm produce, etc. This is a good venue to carry out awareness campaigns and demonstrations. Such a demo is called a haat demo. A haat usually attracts a large number of people to the demo place and farmers are curious about this new technology. The local dealer in the haat is then at hand to convert some of the queries into sales.

- **Short campaign** -The Short campaign has been proved to be one of the best activity in demand creation. It is an audio campaign wherein a vehicle using a PA

system promotes the products and services. Since this activity can be expensive due to hiring of vehicle (four wheeler), audio set and battery, IDE has replaced the 4 wheeler with an auto rickshaw (three wheeler).

- **Farmer Meetings –** Farmer meetings are an effective personal communication medium for marketing and demand creation. They provide an opportunity to make numerous, diverse and continuous interactions with the potential customers in a customized, audience specific environment. The meeting provides immediate feedback. Meetings are organized through the help of local NGOs, dealers and agent. The main objective of the meetings is to inform, remind, motivate farmers to use AMIT and generate sales, to educate them on repair and maintenance and most important is to collect feedback.

- **Participation in Exhibitions and Mela –**There are exhibitions /trade fairs organized by local institutions on agriculture and related subjects. AMIT kits are displayed in these events with the help of local service providers.

- **Demo plot –** In a new area this activity is of great help in promoting AMIT. This involves identifying a progressive farmer, located near the road side who is willingt to use part of his land to experiment with the new technology. The progressive farmer must have good knowledge in agriculture to take care of the plants. The objectives is to establish a good demonstration site where other farmers can visit and see for themselves a display of new systems of farming.

- **Exposure Visit –** A group of farmers are exposed to a near by demo plot or a field where AMIT has been installed. This activity has proved one of the best of all activities as it yielded sure sales for the supply chain service providers. This is organized with the help of local dealers who prepare the list of potential customers in their area and invite them to participate in the visit.

- **Mass Media -**While IDE does not include mass media advertisements due to their prohibitive costs, some of the service providers have initiated such promotions on their own and given advertisements in local newspapers. Other low cost ways to use local mass media were explored advantageously by IDE staff.

  Newspaper: - The IDE staff has influenced reporters to visit their program areas, meet smallholder farmers and print their success stories. Media also interviewed service providers in the area but showed greater interest in publishing and highlighting MSE interviews. Most of the case studies have been published in local languages and in the agriculture section of the newspaper. This has proved to be an extremely effective and low cost way of using local media to create awareness. A list of some articles printed in local media is provided below.

Sl no	Date	News Paper	News highlighted
1	18/06/2002	Lokmat	Improvement in socio economic status due to profitability in horticulture farming
2	10/07/2002	Pudhari	Using AMIT in growing new variety of lemon
3	25/09/2004	Lokmat	KB drip best in Micro Irrigation
4	23/11/2002	Sakal	Saving water with low cost drip system
5	22/04/2003	Sakal	After sales service in AMIT
6	22/05/2003	Sakal	An attempt to communicate importance of drip by Video show
7	22/12/2003	Gaonkari	Training on crop water requirement by IDE
8	11/11/2003	Sakal	Vegetable crops possible with very less water
9	23/10/2003	Sakal	Rope & Washer pump
10	22/12/2003	Gaonkari	IDE facilitated training program on selection of saplings
11	16/12/2003	Sakal	Case study of a nursery grower (BDS Provider)
12	20/12/2003	Lokmat Times	Training program on water melon crop at Khorpudi village
13	13/1/2004	Gaonkari	Haat demonstration at Rajuri weekly market
14	9/3/2004	Sakal	Acceptance of KB drip by small farmer
15	20/1/2004	Sakal	Egg plant tree by grafting method
16	5/2/2004	Deshdoot	Rope & Washer pump operates with out electricity
17	21/2/2004	Punya Nagari	Low cost drip largely adopted by small farmers
18	29/1/2004	Deshdoot	KB drip is a blessing for small farmers
19	29/3/2004	Gaonkari	KB drip benefits farmers
20	9/4/2004	Sakal	Kitchen garden possible with 20 liter of water

TV Channels: ETV a national level channel has an agriculture program called "Annadata". It is a very popular program among farm families. IDE tried a similar approach with TV as it did with newspapers. The TV team visited the program area and interviewed MSEs. AS in the case of newspapers, these interviews were aired on their agriculture program. The TV channel has telecast eight episodes of program supported technologies and services in their "Annadata" program with out any cost to the program. IDE also received a request from from DD - 1 the premier TV channel

of Govt. of India to telecast IDE technologies in their environment related program called “Bhoomi”. It was a well done program with good coverage for the program.

ANNEXURE 3

CASE STUDY 1

KB Drip – Shifting Identities and Enlarging Roles for Women
Case study of Chandrabhaga (village, Sunsgaon)

Fifty year old Chandrabhaga lives in Sunsgaon village (Block Jamner, District Jalgaon) Her family consists of her husband Daneshwer Gaikward, son and daughter in law and two grand children. The family is very poor and owns 1/2 hectare of land in which they grow cotton and vegetables. The small well in their land has water during the rainy season, but the level goes down very low during summers and so they have very little water available for irrigation. The family takes two cash crops in the season- in the period from August to January they grow vegetables in one acre of land and cotton in the rest 1.5 acres in the months June to March .

The family moved in this village about 10 years back and grew only rain fed cotton as they could not afford a well in their small land. While men worked in their own field, women of the house hold worked as wage laborers which was also very inconsistent as it varied between 2-6 months in a year depending on the employment opportunities that were generated with the availability of water. Inspite of the hard work, women suffered discrimination due to disparity in men and women wages. The women were paid almost half of what men got from the same work. The family could altogether earn a net income of Rs. 7-8 thousand per annum, bare enough for their survival.

Three years back the family took some loan and got a small well constructed in their farm. The well has water during the rainy season but the level goes down from November onwards and was therefore not enough for them to take another crop. Chandrabhaga working as a wage labourer had seen her employer using Drip system to irrigate his big farm. She soon realized the benefits of the system in terms of water and labour saving. The growth of the weeds was reduced and even during summers when the water level was low, he still managed to irrigate his horticulture farm by the use of drip system. She soon realized that if her family owned this system they could take up another crop or cultivate vegetables in their land. She realized that while the size of their land was enough to feed the family it was the water constraint that they suffered from.

Nurturing a dream of buying drip system she tried to find out the prices of the system. Her dreams came crashing down to a rude shock when she found that the system was much beyond their affordability and thus gave it up as a fanciful dream. Few days later Chandrabhaga along with her husband saw a video show arranged by IDE at the fellow farmer's house, which was about how a very poor farm family using drip technology have overcome their water constraints and increased their income. The movie highlighted that the systems were low cost and specifically designed for very poor farm families. Chandrabhaga convinced her husband to buy a system for their own farm. The customized system cost them about Rs.1000 for half acre of land and used easy drip as

laterals. They even attended a demonstration meeting conducted by IDE to understand the technology better.

Chandrabhaga's family now grows vegetables, with the water pumped from their well which lasts for half an hour irrigating one acre of land. The well is recharged the next day and regains its original level. In last two years the family has made an additional net income of Rs.7-8 thousand in addition to their income from cotton. The whole family works hard on the farm. Both men and women of the household start together from their home early at 7.30am taking with them Jowar roti and a dish prepared from the vegetables grown in their own land. With increased work opportunities on their own farms, Chandrabhaga and her daughter in law have stopped working as wage labourers and attend to their own farms patronizingly. They are happy with their newly acquired self-esteem as they refer to it as "apna kaam" - their own work. They have increased flexibility of working hours and no fear of losing their daily wages during illness. No longer do they have to face the harassment or the humiliation at the hands of the employer. The daughter in law goes back early home to attend to the children who come back from school.

Chandrabhaga feels that Drip system is very easy to operate and maintain and she can do it on her own. It considerably reduces the time and effort due to less weed growth. Chandrabhaga still spends a lot of time on the farm but likes it, as she says that she learns and experiences new things everyday. Earlier as a laborer the only work she knew was weeding and picking cotton. But now she has learnt to apply fertilizers, stacking of the tomato plants, and making sapling from seeds and their transplantation. She even exchanges information with women in her village about vegetable cultivation. About 35 households have now bought Drip system and are mainly cultivating vegetables.

With their increased incomes in the last two years the family has bought a TV, two goats and also hired a 2 acre land where they intend to grow vegetables and cotton. Chandrabhaga attributes this increased income to the vegetable cultivation done by them which was not possible without using drip system. The satisfaction of feeding her family with nutritious food was evident from her statement made very emphatically that the children have now started drinking goat milk and eat two vegetable meals in a day.

Chandrabhaga has now come to know of IDE's plan of introducing and helping farmers to grow high-value crops like tree-brinjal and turmeric. She wants to participate in growing these in her own farm as she feels that intercropping is a good agronomic practice and the best way to avoid risks like crashing of prices of a particular vegetable. She is well aware as she cited the example of her neighbor Ramesh P. Kulkarni whose papaya crop failed due to climate variation, and that of Atma Ram Rupchand Bhaumi who incurred losses due to crashing of drumstick prices. Her husband has seen the Vermiwash unit promoted by IDE in an exposure visit to a farm and was very impressed with the quality of cabbage produced by the farmer producing and using the Vermiwash. He is now keen on setting up one on his own farm as he feels that they have to spend a considerable amount on the "NP" fertilizer.

First sight impression of Chandrabhaga is that of typical rural women who tend to become invisible as they silently and humbly attend to household chores. Such is the impact of technology that it can transform the inner self of a woman to take on new challenges with increased vigour and strength to keep the cycle of motivation and achievement rolling.

CASE STUDY 2

Fostering Economic Independence for Fellow Farmers
Case study: Rajesh Patil (Entrepreneur farmer and opinion leader -village, Jalke)

Rajesh Patil is one of the progressive farmers of Jalke village and probably the most educated, as he has acquired a masters degree in Physics. He has almost 100 acres agricultural land in which he grows less labour intensive crops like banana, papaya, turmeric and cotton. For summer cotton he grows saplings of cotton from seeds and after a light shower in the month of June, transplants the saplings in the field. Rajesh uses drip system for complete irrigation of his farm. Since he has a big farm to irrigate, buying conventional drip systems would have required huge investments. So Rajesh has invested in buying KB Drip for a very large area, which is connected to an electric pump lifting the water from a deeply dug well. Rajesh is very happy with KB drip as he is now able to cultivate the entire farm, which he could not do earlier. He experienced better quality and quantity of bananas by using drip. He pointed out that if there was a proper system of rewinding KB drip system it would be very helpful in its storage.

Rajesh got associated with IDE when he bought KB drip. But his committed presence as opinion leader in IDE conducted farmer meetings, stems from his passion to work for fellow farmers who are less fortunate. He uses the farmer meetings as a platform to share his experience with KB drip. He talks about the technological aspects, and how even very poor farmers can suitably use it on their small plots to increase productivity. He gives various other agronomy inputs to them and answers their queries on seed varieties, germination, transplantation etc. Lately Rajesh has started motivating the farmers to produce organic fertilizers through vermicomposting to reduce their cost of inputs and also to improve the soil quality. Various exposure visits to his farm have been organized for farmer groups as a demonstration site for KB drip and Vermicomposting.

Three years back Rajesh attended a training program on producing organic manure organised by an organic farming group. He learnt that organic manure can replace use of commercial fertilizers completely. It conserves natural resources like soil and water and also the produce can command a much better price. Being an educated and a progressive farmer, he sought more information and started with a Vermi composting unit in his farm. Rajesh has now completely shifted to organic farming, using the vermiwash as a micronutrient, he delivers it through the drip system. He saves on about Rs 60-70 thousand which was spent earlier on the chemical fertilizers and pesticides. Rajesh has recently made about 20 cemented structures for vermicomposting, and a very efficient system of collecting vermiwash from them through a network of pipes.

Rajesh plans to form an organic farming group by motivating the smallholder farmers to produce organic fertilizers through Vermicomposting on their own farm. This will help them to enhance their incomes as it reduces the cost of inputs considerably and also the organic produce can get better returns through proper output linkage. The mandate of "Mandal"or the group will be to train farmers to produce organic manure and biological means of pest control. Two years back, Rajesh started cultivating turmeric which is not very common in the region and therefore commands a good price. Turmeric is grown in the months from June to February, and Rajesh uses drip during the last three months, when the rainy season is over. He plans to work specifically with small farmers to train them to grow turmeric as a high value crop and also provide them with turmeric seeds.

IDE looks at these progressive farmers like Rajesh as partners in facilitating the process of integration of the poor farmers with the market systems effectively as micro-entrepreneurs. ***Revered and looked upon by the local farmer community as icons in the field of agriculture, these farmers are well aware of the local farming needs of the poor farmers. They can suitably mobilize and guide the poor farmers to increase their productivity, so that they can rise above subsistence agriculture to small scale commercial farming.***

CASE STUDY 3

Redefining the Domains for Women
Ushabai Madhukar Patil – Village Karmad, Block Jamner

Ushabai and her husband Madhukar Patil have a small family of two children - a son and a daughter. They have a 2.5 acre land where they grow rain fed cotton and another ¾ acre land where they have started growing vegetables from the last two years after they bought the IDE Customized drip irrigation system. The family well on the land is shared amongst eight brothers and so the quantity of water available to them is very less. The family now grows a variety of vegetables and most of it is sold by them in nearby Jamner market through self retailing as they can get three times its value compared to its price from dealers.

Ushabai,s family has perfect role divisions. She reveals that all the member of her small family are very hardworking. Their underlying principle is to do as much on their own without paying to any middle agency. She and her husband go very early to the farm to attend to the crop and while Madhukar prepares the land by ploughing and harrowing, she sets up the drip system and does picking and harvesting. She feels that the system is very easily manageable and she can handle it independently. Their daughter who studies in the 9th standard does all the household chores in her mothers absence in addition to her studies. Ushabai shares that before they bought drip they were economically in distress primarily due to irrigation constraint. They could take only one crop in a year for cotton and earned only Rs 12 to 15 thousand per annum. With vegetable cultivation the family

made a net income of Rs. 25000 in the first year followed by Rs. 40,000 in the second year.

This surge in the family's income is a perfect example of their increasing interest and involvement in farming activities created due to increased opportunities. With access to water for irrigation made available through drip technology, Ushabai and her husband have showered their ¾ acre land with enormous green revolution inputs, care and family labour, while growing the low risk crops on rest of their 2 acre land. Since they manage their water slowly their plots retain the fertilizers applied on the roots. ***Spending considerable time in their field has made them "reflective farmers" who are experiencing and learning with every new crop they take. They are becoming aware and through better cropping intensity and growing of high value crops, they are making up for the land constraint that had not allowed them to rise above subsistence agriculture.*** After successfully overcoming the water constraint they now focus on other agro-inputs which can further increase the yield. They are constantly innovating and searching for new market opportunities like early plantation to get a better price, building linkages in the market, growing new vegetables and exploring the prices of nearby markets. Madhukar makes telephone calls to various market places to obtain information on vegetable prices.

Both Ushabai and Madhuker now have changed perceptions. Their concerns are directed towards yields, fluctuating vegetable prices, timely application of fertilizer etc. Since both have become equally skilled, they have flexibility in role division and Madhukar feels that even if he is away for a month his wife can carry on with the farm activities. At many instances he has acted on her advice and benefited. Once when the chilli seeds were destroyed due to intense heat she suggested to plant bottle guard, which in her opinion could stand the high temperature. They got a good crop and also a good price for it. With the new income, their son is studying computers, and the family has got a new borewell dug on theis farm.

Ushabai now identifies herself as a confidant and a well informed woman who many a times even takes the forefront roles like selling the vegetables in the market when her husband is away or preoccupied with other farm activities. These tiny empowering processes have prompted her to take up additional responsibilities of going to the post office or bank, which was earlier done by her husband only. Though the gossips of the neighbourhood did trouble her initially, she is now strident and confident that like her, other women will also cut across the deep rooted mindsets and come out of their restricted domains to take on new opportunities and roles. ***The satisfaction and pride of helping her family come out of the economic hardships is clearly reflected when Ushabai says that she is not deterred by the hard work she has to put in, in this new entrepreneurial effort of growing vegetables. She looks at drip system as a transformative technology that has brought a shift in her identity, a journey from a housewife with food insecurity to a skilled farm woman with enriched knowledgebase.***

CASE STUDY OF AGENT

Name of assembler: Md Saukot Ali Desmukh
Village: Malapuri
Taluka & District: Beed

Mr. Desmukh is a hardworking farmer, who works from morning to evening in his field to earn his bread and butter. He is in his early forties living with eight members of his family.

One day while reading the morning newspaper, his eye caught a small news reported in the paper about a small farmer using KB drip and how it had benefited him. Deshmukh was curious to learn more as he felt this could be a possible option for him too. After making initial contact with the dealer, he has bought 20 Kgs KB drip for his pomegranate crop. Using this low cost drip on his crop made him quickly realize the potential benefits and he soon started advocating the benefits to his fellow farmers in his village. Subsequently, many farmers visited his field to see for themselves and to take his advice on this system. While helping other farmers, he realized that this could be a new business avenue for him.

He has started his business with 50 kgs of KB drip only (typically one acre requires 15-20 kgs of KB drip). In his two and a half year's business, he became one of the most important persons in his small village. Last year he sold 1500 Kg of KB drip and other drip component at a value of Rs 200,000 ($ 4500). To further increase his business he gave an advertisement in the print media and conducted a number of local promotions and exposure visits for farmers.

Today he is an established businessman dealing with various agriculture products and a successful KB drip agent cum assembler.

CASE STUDY OF NURSERY GROWER

Name of the grower: Ms Sitabai Rambhau Mohite
Village: Ramurti
Taluka & District: Jalna
Area of Nursery: ½ acre
Name of plants: Mango, Custard apple, Lemon, Bamboo, Sweet lemon and etc.

Sitabai is in her late thirties living with her husband and three children in a rented house. She takes care of a nursery raised by her husband. One day her husband encouraged her to attend a training program facilitated by IDE on nursery raising.

She was greatly motivated after the training and knew that there was scope for her to do much more in her nursery. She availed a loan of Rs.5000 from the SHG and invested in her nursery. After two years, she has already paid back her SHG loan and now is able to

earn Rs. 25000 ($ 550) annually. Today, she is better known as "nurserybai" (the nursery lady) and lives happily with her family.

ANNEXURE 4

ENHANCING PARTICIPATION OF SMALL HOLDERS IN SEMI-ARID REGIONS OF THE COUNTRY IN HORTICULTURAL MARKETS

A REPORT PREPARED FOR THE IDE (INDIA)

BY

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AUGUST 2003

ENHANCING PARTICIPATION
OF SMALL HOLDERS IN SEMI-ARID REGIONS OF THE COUNTRY
IN HORTICULTURAL MARKETS

EXECUTIVE SUMMARY

IDE has been interested in enabling the small holders in drought prone areas of Central and Western India to achieve significant income enhancements by using its water control and delivery technology. The obvious bottleneck in this regard is the ability of the small holders to use their scarce land and water resources for producing goods that will fetch them significant incomes. Engaging in horticulture is one major mechanism for doing this. However, incomplete integration in input and output markets and weak bargaining power hinder the process. Hence, IDE was keen on exploring ways of enhancing empowered market participation of small holders in the horticultural markets in these regions.

This report is based on a research undertaken by a team of four persons led by the author. This research covered horticultural production centers and markets in the semi-arid tracts of Rajasthan, Gujarat, Maharashtra, Karnataka and MP. It also looked at the marketing interventions made by other players and has tried to draw lessons from them.

This report identifies the important facets of a commodity that need to be managed for successful and empowered market access by the small holders. These facets include diversification and heterogeneity, quality preserving logistics, identity preservation, traceability, price discovery, transactions velocity, non-value adding transactions costs etc. It elaborates the ways in which these facets determine the desirable strategies for better market access.

The research conducted confirms what is generally known about the horticultural production and marketing. The sector is plagued by the fundamental and ubiquitous problem of fragmentation. Fragmentation occurs primarily due to hugely dispersed production of horticultural production. While there are well marked clusters of fruit production, vegetable production is much more dispersed. Fragmentation is also high on account of incomplete integration of different markets. The marketing channel is well understood and covers the stages of primary market, transit market and terminal markets connected to each other through a long chain of intermediaries. Either closed or an open bid auction through a market *adati* is the dominant method of marketing in vogue. Small holders face a highly risky and expensive process of price discovery. Market intelligence is difficult to come by. This complicates simple strategies of producing off-season vegetables or even growing produce with the market in mind, making it difficult to implement for small holders. The choice in crops, varieties and agronomic practices are largely governed by traditional knowledge modified by motivated advice by the input suppliers.

The report suggests that IDE needs to develop a two-track strategy. The first track is applicable to clusters of professional horticulturists who have adopted IDE products for their value in controlled delivery of water. They need less attention on the input and agronomy side than on the market side. It is suggested that small associations of small holders together with enterprising small holders at village level be supported to learn about the markets, market intelligence and necessary innovations and / or changes in their practices. Further, they are assisted in obtaining necessary services through service providers in the classical BDS approach. The second track is about poor, remote and often tribal producers who are perhaps more rewarding clients. These people need to be persuaded and trained to become good producers of horticulture. Demonstrations in their own situations, exposure visits, assistance in obtaining the appropriate inputs in appropriate packaging sizes etc. is what they need and IDE may consider doing the needful. The clusters also need assistance in better market access, but this comes into prominence once the production is streamlined.

ENHANCING PARTICIPATION
OF SMALL HOLDERS IN SEMI-ARID REGIONS OF THE COUNTRY
IN HORTICULTURAL MARKETS

I Introduction:

This report is prepared for IDE India to assist them in designing interventions that will help their clients, also enable small holders to improve their incomes by using micro-irrigation technology to grow horticultural crops. This report is prepared on the basis of the efforts of a team comprising of members Ajay Desai, Sanjay Ghatanekar, RJ Phansalkar and Pradumna Deshpande and led by SJ Phansalkar.

1.1 This report attempts to address the study aims and objectives laid down in the Terms of Reference for this assignment. These are reproduced in the box below.

Box 1 Terms of Reference

This study will focus on semi-arid tropical regions in India, particularly in the states of Gujarat, Maharashtra, Andhra Pradesh and Karnataka. The further narrowing of geographical focus will be done in consonance with IDE's current marketing plans and in consultation with regional offices of IDE. It will cover the following aspects:

a. Identifying major local transit and terminal/regional markets for fruit and horticultural products, characterize them in terms of size (quantity of different products of relevance to small holders of IDE), number of operators, current market practices, trends etc. Characterizing the hierarchy of and linkages between different markets (starting with village markets, local weekly markets, local transit market, local consumption market and regional terminal markets.)
b. Current harvesting, post-harvest and marketing practices of small holders in the geographic areas recommended by IDE and through observations and discussions with farmer groups, understanding the constraints with regard to marketing faced by small holders.
c. Determining factors that inhibit smooth and rewarding market access for small holders, determining effective methods by which individual (or in a group) small holders can take fast decisions about accessing one or the other markets etc..
d. Assessing the level of knowledge, skill, technology currently available with target group for IDE with the best producers in a comparable area and determining ways of bridging the gap, including using agriculture input dealers as information channels.
e. Assessing the skill, technology and attitude gap that needs to be bridged for small holders who are currently non-producers of horticultural products to take up these crops and profit there from.

1.2 Work Done: This report is based on the following works:

a. Surveys of small holder horticulture producers and/all MI kit users. These surveys covered farmers in Maharashtra, Gujarat, MP and Karnataka.
b. Analysis of secondary data obtained from various sources, including in particular the National Horticulture Board.
c. Visits to chosen horticultural markets and discussions with market actors
d. Study of certain interventions of NGO and others.

1.3 Structure of the report: We first present the conceptual issues involved in improving beneficial integration of small holders in the market system as well as the issues involved in improving the effectiveness of the extension systems that enable them to take to more profitable crops. We believe that a sound understanding of these issues needs to inform choices on design of interventions for improving small holder incomes by improving their access to markets on one hand and the productivity of their land, labour and water resources on the other. In section III, we summarize the findings of the surveys conducted by us in the four states. The inferences from these surveys are presented in such a manner as to facilitate the task of relating the existing reality with the conceptual analysis. In the same section, we also present a few small case studies of farmer behaviour that throws up important lessons on how small holders can improve their incomes. We also present the macro-picture on the horticulture markets in the country. In Section IV, we summarize the important lessons and issues from our field work. In the last sections, we suggest a strategy based on our work and observations from other interventions.

II **Conceptual Framework**

2.1 The obviously essential condition for benefiting from the market is the possession of assets required to produce goods and services that are demanded. Small holders do have at least small patches of land on which to grow horticultural crops. They have an advantage of having family labour which can be applied to the diverse tasks in the production process. IDE does provide them technology for efficient water delivery to the crops if and where they have access to water. The essential condition is thus met for all small holders with access to a base level of water.

Effective participation in the market requires

- Access to information: The small holder must know what product is required when and where. It is perhaps even better if s/he were to know the information about arrivals during specified time slots of a year so s/he can decide that her produce is harvested just after or just before periods of peak harvest. That will enable her to gain better realization. A finer point is about the sub-type or variety of a vegetable required or preferred in a market. For instance katargam papdi (a special small and sweetish variety of French beans) is extremely popular around Sankranti in Gujarat. All manners of leafy vegetables are required around the festival of *mahalaksmi* in September in Vidarbha. The yellow genda flowers are in huge demand on Dussehra and Diwali all over India. Similarly, specific

varieties are in high demand in thin time windows about which the producers need to know ahead so as to plan planting and nurturing it to make it ready for harvest. In short term, prior information on arrivals as well as prices prevailing in proximate mandis may save the producer from incurring prohibitive sunk costs that force him to sell at a loss in unfavourable circumstances.

- Access to logistics of packing, transport, intermediate and final storage etc. For instance shortage of Railway wagons can cause banana realizations to plummet in South Gujarat and Khandesh. Truckers strike causes doom for mandarin orange growers of Nagpur. The dependence of potato growers on cold storage owners is proverbially known in North India.
- Access to working capital is important at almost all stages of cultivation, but their importance at the time of marketing is crucial. Producers are tempted to sell their produce for a price discounted by as much as 30% for spot payment and at these points in time access to working capital would increase their incomes.
- Assurances are needed to enable the small holders to take necessary risks. Mere information is not enough. She needs to know the agents and market players and also needs to have assurances about their behaviour or some institutional assurance on contract enforcement.

Yet it must be recognized that markets are large, cruel and behave in their own uncontrollable manner. Virtually no amount of prior information, access to logistics, working capital and assurances can ensure profitable deals for a producer all the time. For a market player, the total loss function (a sum of actual and opportunity loss) is proverbially non-zero. Each player must face a combination of a systemic risk and an idiosyncratic risk. The former is common to all the market players: small and big. Sources of such risks can be Acts of God, strikes, riots, sudden shifts in market tastes caused by outbreak of diseases, rumour induced shifts in market preferences etc. Idiosyncratic risks are unique to each producer and depend on the quality of her produce, timing of her harvest, her own logistics arrangement, her contract with a market agent and so on. Above access and assurances can reduce the idiosyncratic risks to a minimum and allow her to make intelligent guess on the systemic market risk.

2.2 The access and assurances listed above are of course factors that improve effectiveness of market access for all types of producers of agricultural commodities. The diverse attributes of the product/market about which symmetric and reliable information can help build more evolved and mature markets and hence help efficient and transparent market for producers are given below.

- **Diversity in Product Type**: Wheat as a commodity is just one grain. There may be types of wheat, but the difference between them is not as much as between say bottle gourd and egg fruit. This diversity is the highest in vegetables, then perhaps in fish then in fruit etc. Each vegetable has different attributes in terms of keeping quality, resistance to thermal shock, tolerance to differing moisture and temperature regime etc. Different visual, organoleptic or chemical attributes may be used for assessing the quality for different vegetables. Thus the greater the diversity, the greater the complexity in

managing quality, packaging, transport, storage etc. Ceteris paribus, the greater the diversity of a produce type, the shallower is the market for each species in the group. Market for sweet peas is perhaps much smaller than market for lentils.

- **Heterogeneity** Some products are homogeneous and diversity in them is not valued. For instance, for a french fries manufacturer, diversity may be a pain. On the other hand, in several ordinary vegetable products, diversity is huge with sharply defined preferences for each type. In eggplant, small shiny black ones may be preferred for making *bharela baingan* (stuffed eggplant), long and tapering ones may be demanded for a similar purpose in hotels, medium size fruit may be required by low and medium grade restaurants for making the ordinary curry and bumper fruit may be wanted for making *bharta* (mashed eggplant). Small tomatoes may be fine for manufacturers of sauces and makers of sambhar or rasam but for salad purposes, one needs nice, shiny large fruits.

- **Identity Preservation**: Given the heterogeneity of produce, it may be important to undertake the post harvest and marketing of the produce in such a manner that the identity of the produce is preserved. Who would want to pay for spinach mixed inexorably with some other leafy vegetable should such loss of identity at all happen because of foolish handling? Surely I would want to pay more for *katargam papdi* if no other type of french beans were mixed in it. At times, this could be a finer issue. Demand may be for commodity with the same phyto-chemical property and not mere physical properties. This happens for instance in medicinal herbs. The question is to what extent is the marketing system able to preserve the identity and whether the market is willing to pay for this.

- **Traceability:** This refers to the difficult yet probable possibility of tracing a final consumer lot of a product to the farm on which it was grown. This kind of a traceability is of crucial importance in marketing of organic produce**.** Surely the credibility of an organic marketer would rise tremendously if he guaranteed traceability and could produce evidence of his logistical tracking system**.**

- **Price Discovery**: This, of course, is the most important element from the point of view of the producers. For a produce that is assessed by producers on its visual and physical attributes, by the processors on its chemical or phyto-chemical attributes and by the buyers on its organoleptic attributes, it is well nigh impossible to devise mechanisms that will make the process of price discovery objective and fair to all. In horticultural produce, the possibility of a bench mark price is perhaps bleak. Yet, it is important to recognize that the price discovery process must be reasonably objective and transparent. It must be objective in the sense of its independence from the specific personality of the seller or the buyer. Transparent in the sense that fair or otherwise, it is

known to both the parties that a specific attribute is being awarded or discounted. For example, illustratively, both farmers and buyers must know it up front that tomato must be oblate spheroids with the longer axis not longer than 4 cm and that penalties will accrue for both over and undersized fruit. Whether a tomato of this size necessarily produces good ketchup in the factory or gives nice fresh salad to the buyer is beside the point. Optimally, price discovery must occur without too much pain, for instance, not after the producers have brought the produce to the market after trudging twenty miles in freezing cold. The price discovery must be an open process, the closed hand deals are inferior in this regard compared to open auctions however fixed they may be.

- **Fragmentation**: The number of producers in a unit area involved in producing the commodity or the product per unit defines the extent of concentration. Fragmentation results when the concentration is very low. For instance, every one in Patiala grows wheat in winter and hence the fragmentation in wheat markets there is extremely low. On the other hand, to get say, ten tones of sweet peas in East Nimar district (one of the pea producing districts), one may have to transact with fifty producers. The production is thus very fragmented. Fragmentation can also be understood as an obverse of the extent of integration of different markets. These two concepts are logically dependent on each other (except in very special cases such as opium). If producers are scattered over a wide area and if each one of them produces only a small volume of a produce, then the chances are that the concerned markets would be fragmented as well. This is because integration of markets needs coordination and that in turn needs investment either in infrastructure or in social capital or both. And with widely scattered miniscule production volumes, no one finds this investment worth making.

- **Transaction Velocity**: This is the number of times a product is physically handled (loaded, bagged, unloaded, opened, loaded again etc.) between the producer and the end user before the product loses its current form and identity. When a farmer harvests his vegetables from his farm and gives it to his wife for making dinner, the velocity is the minimum. Some times, this velocity may be as large as ten. Each handling means handling labour, possible contamination, handling losses, wastages and delays.

- **Non-Value adding Transactions Costs:** In general, the important functions performed by market intermediaries include pooling, assembly, sorting, quality assurance, risk buffering, weighment, price discovery, negotiation and payment routing. These functions need to be performed if the commodity is to reach from the producer to the ultimate user while the two remain unknown to each other. Market intermediaries add time and space value to a produce for which they charge service fees as institutionalized in the market. Such fees are involved every time the commodity is transacted. When the transactions velocity is high, the gross transactions costs are also very high. But unless the

intermediaries are in a position to add values other than mere time and space values, or perform other functions as noted above, the cumulative transaction costs may be essentially non-value adding. This would happen all the more if there is no real need for the buyer and the seller to remain unknown to each other. As one can guess, highly fragmented markets for diversified, heterogeneous and perishable commodities are likely to have very high non-value adding transactions costs.

Gross inefficiencies of the market can result from poor communication infrastructure and high fragmentation. Traditionally, monopolistic power of the market traders owing to institutional factors such as indebtedness of small producers, interlocking of markets and familial link between market players is associated with gross inefficiencies. It has been observed that high incidence of market cess and taxes can cause a great deal of distortion in the market as much of the commodity gets transacted outside the formal market with very little institutional checks on contract enforcement. This too causes inefficiencies.

Thus credible information on the above factors backed by willingness to act according to the information, if available to the small producers will make market interactions beneficial for the small holders. Specifically, this information will have to be available on:

- Locating markets
- Identification of market players
- Current market institutions
- Availability of safeguards from monopolistic power
- Ways of managing transactions costs: search, monitoring and enforcement
- Price discovery
- Trends in demand pattern

In addition to the above information, actual services may need to be provided regarding

- Sorting, Pooling, packaging, storage, transport logistics
- Choice of market for a given lot at a given point in time,
- Quality assurance and
- Payment recovery

2.3 **Generating information on trends, market wise and season-wise demand pattern**

In general, the subject of how to ensure small holders get the right type of technology, agronomic practices and materials for putting these in practice is better studied and understood. There are problems due to fragmentation and geographic scatter that makes the provision of related services expensive. Demand of small holders is often below the antennae of existing market players who are used to dealing with large producers.

We list the factors that will make technology interface beneficial for small holders:

- Content management of the field of taking technology from the scientist to the farm, using whichever medium is critical. Scientists are prone to speak and write in *researchese* that is little understood by farmers, particularly small holders. Scientists are also prone to making assumptions about resources and skills that may not be realistic for small holders. Converting the essential message from the scientist, retrofitting it in the context of the small holder and then ensuring that it is disseminated at manageable costs is a challenge.
- Content management is about existing knowledge. Some knowledge will have to be generated all the time. This is the overall field of R&D of an appropriate type, including adaptation trials.
- Localizing a technology or an agronomic practice involves specific adaptation of a standard practice to the specific resource conditions of a farmer. For instance, a practice may be known for light domath soils while a farmer has a sloppy and blackish soil. He then, would naturally want to know how to modify the standard practice.

- **Value Engineering**: IDE is, of course, very well at it and knows what this means. We need to generalize this concept to the process of replacing components, materials and processes with others that serve the same purpose but at lower costs. This is really necessary for enabling the small holders use the technology for increasing their incomes.
- **Problem Solving**: With the best laid and executed R&D, adaptation trials and localizing, problems are bound to arise during the crop cycle. Thus there is a need for practical problem solving for the small holders in a manner consistent with their resource conditions.
- **Product Choice**: This links up with the assistance in marketing. In the relatively wide range of choice, the small holder needs to be assisted in choosing a product and its specific variety/sub-type so as to maximize the likelihood of her fetching the best price.
- **Technology Choice**: When alternate choice of technique is available, as it usually would be, the small holder needs considered suggestions about what is best for her. This includes, for instance, advice about choice of time at which the crop should be sown.
- **Sourcing and Supplying Materials**: Since the demand of small holders for materials such as seeds, manures and fertilizers is in very small lots, they are often below the antennae of the usual supply chain of the concerned commodity. Hence, assistance in terms of choosing good quality materials and repacking them in lots of sizes that make sense to the small holders would be a welcome service and one that will reduce the hassles of the small holders.

- Handholding and training of the small holders may become relevant particularly when new crops are chosen, new technologies including new irrigation technology is chosen or new ways of post-harvest processing or marketing are chosen for and by them.

2.4 **Defining the problem of creating market based systems for enhancing small holder participation**

The discussion above indicates the diverse services that are needed by small holders and the problems that are faced. We do not think that there are enough service providers who are providing some of these services and there certainly are no providers who provide all the services. Either there are no service providers in the market who are providing these services or such service providers who are so doing charge fees that small holders cannot afford. One can hypothesize many reasons for the absence of service providers for the services indicated in sections 2.2 and 2.3. Some of these reasons could be:

- Services for some of the areas essentially create public goods. R&D, adaptation trials, localization of technology, content management for extension are some such services. Since they create public good, no single private producer is willing to pay for the services. In any case, the costs involved in creating necessary infrastructure and human resources for this purpose is expensive and some of it in the nature of capital costs. Thus, we find that Universities and State Departments of Agriculture are the only "service providers" of this type.

- From my earlier research in BDS, I had found that small enterprises are unwilling to provide for "strategic" services that can contribute to the general improvement in their performance. Rather, they are willing to pay for "transaction" oriented services that can be seen to result immediately in some concrete gain to the enterprise. A similar tendency is to be expected in small holders. A small holder is likely to be willing to pay a portion of extra realization to a service provider rather than upfront fee for information which could but may not result in any concrete incremental profit. In other words, information qua information is not considered at all valuable unless it is backed by a machinery that can show its money value there and then. This is perhaps a strong hypothesis and one that can become a powerful guide to action.

- Geographical scatter and fragmentation of production makes any compact business of providing services very cost ineffective. We can hypothesize that if compact clusters of producers of the same products were to emerge, service providers would also come up to cater to them. (From personal observations, I can say that this is true; even in remote Lohardaga in Jharkhand, there are service providers for agronomy, materials and related services since there is a vibrant vegetable cluster in that region.) Some mechanism of "aggregating" the latent demand for services needs to be discovered.
- Since neither of the limited services (meeting say only one or two of these functions) for a range of crops nor the whole range of services for just the

horticultural crops, seem to have economic potential that justifies existence of service providers dedicated to horticulture, instead what we have is a class of service providers and market players who seem to undertake a wide array of activity for an undifferentiated client group that includes but is not limited to small holder horticulturists.

Thus the problem may be formulated thus:

We need to create a new class of market actors who will be willing to focus on small holder horticulturists and provide services to them. We would like to see this happening in a phased manner such that both the horticulturists and the service providers find incentives in the new economic exchange that are profitable enough to spur an increasing range of services on both the technology/input side as well as on the market access side. Eventually, we would like these new market actors to be fully sustainable based on the service charges they can levy on the producers.

III **The Reality as it Exists Now: Learning from the Field**

3.1 **Maharashtra, Gujarat, MP and Karnataka**

We conducted field visits in these four states. The regions visited within these states are listed below:

SN	**State**	**District/Regions visited**
1	Gujarat	Bharuch, Himmatnagar, Godhra, Panchmahal, Surat
2	Karnataka	Belgaum, Dharvad, Hubli, Raichur
3	Maharashtra	Pune, Ahmednagar, Nasik, Jalgaon
4	MP	East and West Nimar, Narsinghpur, Chindwara

IDE does not work in all these regions. Some of them are not "target" regions. We did not specifically restrict our fieldwork to small holders. We wished first to:

- Familiarize ourselves with the current state of the agronomic knowledge and skill available in a region with good farmers
- See how they market their produce, learn about techniques of cultivation etc.
- And then try to find out where the small holders compared to them so as to know how gap can be filled up.

We also tried to learn about social and institutional infrastructure as it prevailed now. In each of these districts/areas, we interviewed between ten and fifteen farmers. These interviews were conducted using a structured sheet. Because we did not want specific and numeric information but wanted an uninhibited discussion, we deliberately avoided using standard formats. We have interviewed about 300-350 farmers all told. The data generated pertains to the current agronomic practices, current source of information,

current post harvest and marketing operations and related factors. We have also prepared some short cases based on our discussions with farmers.

We annex full field reports as annexes 1 through 3 as given below.

Annex 1: Report on field work in Nasik-Dhule Jaalgoan belt
Annex 2: Report on MP
Annex 3: Report on Karnataka

The spreadsheets S1 and S2 contain summary tables as gleaned from these reports.

3.2 Short cases

Case 1

First time lucky and hence needy for inputs!

In the village called 'Athaisa' about 18 Kms away from Gadarwada town in Narsinghpur district, Govindprasad Srivas has his 6 acre farm. There are approximately 370 voters in Athaisa. The village is about 7 kms away from southern bank of Narmada and about the same distance north side from another river 'Shakkar'. Govindprasad is about 26 and has a brother who is 23. His father and two brothers have been farming for many years but had never grown vegetables until a year before. 'Srivas' is a barber community in this part of MP. Unlike the 'Kusawah' community, they have no knowledge of farming. Also, none of them are educated beyond the 8th Standard. However, they have good relations with almost everybody in the village. The family has learned farming the hard way after gathering information from those who do farming. They have largely been growing wheat and gram.

There is one well in Govindprasad's farm. It has abundant water through out the year. So, Govindprasad doesn't have any worry about water. Erratic power supply and power cuts is however his big concern as of many of his counterparts in the rest of MP state. A year ago, Govindprasad decided to grow vegetables. After some initial arguments, his father encouraged him and advised him to learn the practical things before going the big way. His father himself took part in experimentation actively. Govindprasad had closely observed potato farming and so he bought the seeds and prepared the soil in about ½ acre plot of land. They grew wheat and gram as usual in the rest of the land. He sowed the seeds maintaining proper distance, added fertilizer and used the recommended pesticides. He took every possible care as this was the first experience. In the process, he was required to be on the farm every day till power supply becomes available to switch on his 5 Hp motor for watering the wheat and his new first time potato crop.

Simultaneously, he borrowed money and bought seeds of many other crops like brinjal, tomato, ginger, okra and garlic. He sowed them in small plots of 10 feet by 10 feet. These

plots were to be their 'practical experiment' to gain experience on vegetables.

Understandably, he has many queries. Not all the information about vegetables is shared with them by the people in his village. He also knows that they cannot become experts overnight. Govindprasad observed that the Bhindi (okra) size is too small and though tomato crop has come out well he wonders why tomatoes are getting infected. His garlic experiment has been a great success but he did not know about it till it was told to him by another farmer who had experience in garlic.

Govindprasad is extremely happy to get a bumper crop of potato in half an acre land. Already, he has started harvesting and so far has got about 18 bags (each bag with approximately 80 kg.) of good quality potatoes and he expects to get at least 5 more bags from the remaining land .When he sold his yield, he got a good price of Rs 130 per bag. (Rs. 65 for 40 kg called one mound.) This yield in just half acre land in 3 months period has boosted his confidence and now he is planning to plant potato crop in 2 acre land. As such, he has really enjoyed his first success.

One does not know how fast Govindprasad will become a regular vegetable grower. But the important point is that his many doubts about vegetables remain unresolved. He needs a lot of information and guidance. And unfortunately, there is no one to give him the information without bias, arrogance or hidden agenda.

In conclusion, if many such Govindprasads get the information they need, sooner or later they can start growing vegetables regularly !

Is there any profit in vegetable business?

We were attracted by the beautiful flowers of marigold and *Shevanti* (chrysanthemum) on the Pune, Nasik road in Naraingao in the farm of Pandurang Nana Fulsunder, who has 4 acres land holding, in total. Pandurang, who is 'Mali' informed us that he used to grow flowers on a large scale until 3 years before. However, now he does it on a very limited scale as it is his hobby. We were told that the flower market is captured by many new varieties of flowers these days and the technology involved in growing them is quite costly. Pandurang now keeps himself more occupied in vegetable growing which he has been doing for many years. Pandurang used to work in one private goat institute (Bakari Palan Kendra) and has retired about ten years ago. He has his relatives in the same town and his brother-in-law is 'Hundekari'. 'Hundekari' is the person who collects farmers' produce and sends it to the market where vegetable merchants buy them through 'Adat', another middleman. Pandurang and his wife along with his son and daughter-in-law work in their farm from morning to evening and keep themselves busy in some activity or the other related to vegetable growing. There were at least 14 different varieties of vegetables available in the farm and many other things were planned. Various vegetables like leafy vegetables, *mula* (radish), methi, *palak* (spinach), *Dhaniapatta* (Coriander); fruit vegetables like tomato and Brinjal; creepers like lima bean cruciferous like, cauliflower and underground vegetables – roots, like potato, carrot, *ratali* (sugar- beet) and onions were in different stages starting from sowing to harvesting. In addition to this, some leafs were also grown for animal feeding.

Pandurang was telling time and again that growing vegetables has become marginally profitable, as these days, one is required to spray a lot of insecticides. Also, labour involved in harvesting is expensive. He mentioned that a woman who works for 7 to 8 hours in the field for harvesting carrots could at the most collect 40 to 45 Kg of carrots. Her wages are Rs 60 to 70 plus two meals while the selling price of 40 Kg carrot is never more than Rs.75 to 80. This makes it extremely difficult to make profit when one adds to the transport and commission charges. Precisely for this reason, they grow such vegetables on the smaller scale where family members themselves do the harvesting and labour cost is saved in a way.

If the vegetables are grown on smaller scale, their price goes up but this in no way helps the farmers. The end customers in Pune or Mumbai buy the vegetables at Rs.20 per kg while the farmer hardly gets Rs. 2 per kg. When we talked to 'Hundekari' and 'Adats' and the vendors who sell vegetables, everyone told that there is no profit at all. Their reasons were that vegetables get quickly rotten, demand fluctuations are too high, and at times, the recovery from the vegetable merchants is not possible etc.

One wonders if no one gets any profit then how the vegetable business goes on.

Can farmers themselves become a fountainhead of information?

Sitaram Dagadu Nimbalkar of Aanndwadi, Naraingao has a 5 acre land. He lives on his farm with his wife two sons and their wives. The whole family works on their farm in which many varieties of vegetables and fruits are grown. Naraingaon is on the Pune, Nasik road and there are many small and medium size dams in the area. As a result, water table has risen and sufficient water is available through out the year.

Sitaram was busy in packing and loading his 20 quintiles of potato produce when we reached him. His wife offered us tea which was prepared on their 'Gobar gas plant'. His elder son was busy in preparing land and joined us after he tied his bullocks, thereafter we visited all the plots in his farm.

Sitaram told us proudly that he has 38 years of experience in farming, mainly vegetable growing. The Nimbalkar family members are very hard working and have distributed various activities among themselves. The two sons look after the activities on the farm such as land preparation, sowing, spraying insecticides etc and their wives do the harvesting related work. The decisions related to crop rotation, plot size and location of the plot in the farm are taken mainly by Sitaram and in the process other members have acquired a lot of knowledge and experience. The mother-in-law regularly goes to the daily market for direct selling of the vegetables. Sitaram himself arranges for the transport and maintains the records of major sales. He has become a 'Hundekari' (a person between *adat* and the farmer in the marketing link) and manages to send the vegetables to Pune, Nasik or Mumbai market from his farm as well as from the surrounding farms. In this process, he earns some commission. There are two types of crops taken by the family as for as its volume is concerned. Some vegetables are grown on small scale so that fresh vegetables are always available to the mother-in-law for direct sale. At the end of the day, she brings Rs 150 to 250 after selling the vegetables in Naraingaov market. Some vegetables are grown on a slightly larger scale with Sitaram handling this output.

There are many plots of different sizes small, medium and large. In the smaller or medium size plots leafy vegetables like radish (Mula), methi, palak (spinach), & dhaniapatta (coriander) & onion leaves are grown.Vegetables like brinjal, tomato, potatoes, cabbage, califlower, onions were grown on the medium size plots of 6 to 12 '*Gunthe*' (acres is 20 Gunthe). There were also 2 large plots of one acre and one and half acre where wheat and new variety of 'Maka '(Baby corn) were grown. Sitaram informed us that 'Baby corn' has lot of demand in Mumbai market, as this is in current fashion among the upper classes of the society these days for taking low calorie, highly nutritious and tasty food.

On the boundaries of some plots, we observed a variety of trees like drumstick (moringa), and early fruit bearing crops like papaya, lemon, banana etc. In some places, the plots were divided by creepers and vines like lima bean, yard bean, ghevada etc. Sitaram also had trees of erandel, coconuts and two trees each of mangoes and katahal. All these trees

were planted as part of hobby and great interest in the work. This has added variety and commercial value in daily vegetable sale in addition to providing nutritious fresh food to the family.

Looking at the farm of Sitaram, one started wondering about how interesting farming could be and what a great potential mother earth has! If only we have more Sitarams among the vegetable growers, then farming will be much more lively!

In Chachadgav village of Dindori Tehsil in Nasik District, we met one farmer called Fakirrao Nathu Pelmahale, who has two and half acres of land holding. This village is about 25 kms from Nasik. The standing crop of Cauliflower(Gobi)on two plots of half acre each impressed us. Upon enquiring, we learned that Gobi from this farm is exported after selling it in Washi market of Mumbai. Fakirrao, who was in his late forties or early fifties gave us the details of agronomic practices followed by him starting from land preparation to harvesting. He informed us that he grows Gobi on some plot or the other through out the year and takes three crops of Gobi. From April to October, he grows local variety of gobi, October to December is the regular season while December to March is off season when he gets 50 to 60 percent more money. The way he described the details for us, he seemed to have become a 'Gobi' master! Observing his yield, we noticed that every flower was quite big in size. Fakirrao informed us that when the flower is small, he ties the leaves to prevent exposure of flower to sunlight. This not only keeps the flower white but it also becomes less prone to insects as it gets protected from the morning dew and remains fresh. To get a good size of flower, he waters the crop after every 8 days and frequently adds small quantity of urea every 10 to 12 days. He told us that the taste of such a large size flower is still maintained and the secret of this is in land preparation. While preparing the land, he digs a pit for every plant and fill it with organic fertilizer ('gobar') mixed with some insecticides. One doesn't know whether small farmers who have achieved expertise are awarded in our country or not but we felt like saluting this illiterate expert !

The Extant Service Providers

Sanjay Patil is B.Tech. in Agriculture and after serving in 'Jain Irrigation', he has started his own business of supplying agriculture related materials to the farrmers. We met him in his shop 'Jai Tulja Bhavani Traders' at Shedurni in Jamner Tehsil of Jalgao District. He supplies seeds, fertilizers, pesticides, and electric motors. Off late, he has been supplying easy drip system related hardware. He meets at least 15 to 20 farmers daily and knows some of them by their names. He informed us that the staff from Taluka Agriculture officer is supposed to look after 3 or 4 villages but he goes in the villages only when there is some scheme of the Government. These officers are respected not for their knowledge or technical skills . They are welcomed because they can give some benefit. Sanjay said that indebtness is today the biggest problem of about 90 percent of small farmers. Most of them therefore buy the things from him on credit and are ready to pay even up to 3 percent interest per month. He thinks that farmers should form groups and each group must work to solve a particular issue. The biggest disadvantage of the farmers is they are not united. At the end of the day, the situation is that every village is divided on any issue and people are maintaining the status quo to avoid tension. Sanjay strongly believes that information centres at Taluka levels are urgently required. They should be the first priority of any one who wants to initiate a change. When we enquired whether he will be interested in starting such a centre, he became defensive and said that he was not sure. Sanjay has got advantage of his education, as he knows the subject thoroughly. He therefore can give good service to his customers. He now hopes that many vegetable growers will start using easy drip system and will take extra crop. He is trying his best to help the farmers while doing his business. We certainly need more persons like Sanjay near the villages.

We will discuss the current situation on the various important issues identified in the conceptual framework using these reports and case studies. This is done below.

3.3 ***Assessing current situation: The effectiveness of market participation by small holders***

- Locating Markets: Small holders have somewhat limited knowledge about the markets. While an occasional small holder may have heard of or visited a distant and more paying market for his produce, it is safe to assume that their marketing operations are limited to proximate markets. At times, they may be limited to only proximate market operators and some times, even within that the market operators who have extended them credit or with whom they have long standing business relations. Small holders seldom, if ever try to locate markets for their goods, rather though often they desperately seek buyers in the proximate markets for what they produce and have already harvested. The extent to which extant markets and market operators provide them useful information on markets for

goods they produce or could produce is not high at all. In fact, most of these market operators themselves are small and pressed for their own survival. Considering that the extant market operators have long, organic and often mutually supporting relationship with the small holders, ***it may be better to work with and through them so as to enable small holders of a whole cluster to access better paying markets.***

- **Identification of Market Players**: As stated above, small holders seldom bother to identify distant or even new market players for their produce. Unless small holders pool their produce, none of them have sufficient volumes that would justify efforts and expenses on searching and negotiating with new actors. Usually, they operate through their existing set of market players (*adatis*). At best, what may happen is one of the producers themselves buys them out and on his now expanded business account, search and negotiate with new and perhaps distant buyers. **Thus it may be better to encourage evolution of within-the-village market intermediaries who can search and negotiate with distant buyers on behalf of the rest of the small holders.** While there may be little difference in the degree of transparency and effective price realization by the small holders, it is almost certain that non-price services (information on trends, varieties, timings, seasonality, product form etc.) would be of a higher order if the intermediary actually seeks new buyers. It is suggested that a profit seeking individual is likely to be the best within village intermediary rather than elaborate arrangement of pooling or cooperativisation.
- **Current Market Institutions**: These are well known and well understood institutions of *adatis*. An informal Committee of these *adatis* supervise the functioning and sort out common issues related to the markets and a formal Government Agricultural Produce Market Yard Committee. *An Adati* is a commission agent. He usually acts as the broker between sellers and potentially a number of buyers. Different mandis have different auction norms, but in most places, the open auction system is adopted. Buyers can open packs and inspect quality of the materials brought by the sellers. Following such an inspection, there is the auction for a whole "lot", by which is meant the entire quantity brought by a seller on a day. Sizes of lots vary across sellers and across *adatis*. The *adati* takes his "fixed" commission that seems to move between 6 and 8% of the sales price across the country for fresh horticultural produce. *Adati* also charges additional schedule of charges to cover loading, unloading, inspection, documentation etc. A variable market fee is payable on the documented lots to the market yard. *Adati* guarantees the payment. Frequency of payments and the payment period varies. Regular producers of goods want a running account that is settled at the end of a season. They may buy commodities for their needs and ask the broker to settle the bill. In some markets and for most small holders, payments are quicker and there is a discount of one or two percent for cash sales.
- **Availability of Safeguards from Monopolistic Power**: In a majority of situations, there is no foolproof safeguard against the monopoly power of market players. However, monopoly power seems to arise out of communication and transportation bottlenecks. As these reduce, the monopolies are replaced by oligopolies of market operators. This makes precious little difference to the

producers. Again, given the fact that producers want a long standing arrangement with the market operators to avoid repeated search and negotiation costs, they depend on one among the several oligopolistic players. Finally, producers in general tend to buffer the uncontrollable loss to them due to oligopolistic behaviour of the intermediaries by unpredictably diluting product quality. The whole market system thus performs at a low level as the prices start reflecting the drop in quality. The only sure way of curbing the monopolistic or oligopolistic power of market operators is true to create greater and more effective competition. Alternately, oligopolistic power of market operators can be met by a countervailing power of producers' combine. We would prefer promotion of greater competition in the markets. Small holders through their informal association or through a village level intermediary must explore and establish working contacts with market intermediaries in several markets so that their dependence on one set of intermediaries reduces. This should be done wherever possible and feasible.

- **Ways of managing transactions costs (search, monitoring and enforcement):** In a majority of cases, producers incur upfront costs of this kind only once, when they start their account with an "*adati.*" The *adati* then manages the transactions subsequently for the costs listed above. The trouble with this system is that the producer can only realize the prices prevailing in the specific mandi in which they have made such a tie up. As will be discussed later, the various markets are anything but fully integrated. (A quick look is invited at Graphs 1 through 6 annexed hereto. The movements of prices clearly indicate lack of complete market integration.) Thus, in tying up with a market *adati* in one mandi, the producer in effect loses the possibility of gaining from participation in other markets. That is how the point about evolving greater competition and maintaining contacts in several mandis becomes important.
- **Price Discovery**: Price discovery is the most troubling and troublesome part of the extant marketing system for the horticultural produce in the country. Several aspects about the way price discovery occurs are to be noted. **In the first place,** price discovery occurs only after the producer has incurred a sunk cost in bringing the produce to the market. Considering that this cost could conceivably be 10-15% of his/her price realization (involving as it does at least one stage of sorting, two stages of handling and usually two stages of transportation), it is a very expensive system. **Secondly**, whether in an open auction or in a closed hands deal, the producer seems to play no role whatsoever in price discovery. There is just no negotiation about the price as sales happen in most horticultural markets in which producers participate in the country. Negotiations and haggling are quite common on and after the produce reaches a terminal mandi. **Thirdly,** the process is not transparent at all. It is not clear from the process what aspect of the produce is being rewarded or punished. What is worse, it is also not very clear from the process that the agreed figure was, in fact, the full price shown to the seller by the *adati* and not a façade for a conspirational understanding between the buyers and the *adati.*
- **Trends in Demand Pattern**: Here too, one hits a problem in India. Horticultural consumption is largely driven by supply. Thus buying behaviour of consumers

reflect what is currently available for the price they can afford rather than what they wish. For instance, consumption of banana reflects this pattern substantially. Banana is available practically through the year in most Indian markets. But other fruits are available only during its season. May-August, one sees a lot of mango, August spells the beginning of the apple season, abundant pear and the stone fruit; September to November is dominated by apple again, December usually by guava while January to March is the grape and mandarin orange season. Are these fruits seen in the markets because they are demanded or because they are supplied? Decidedly the latter. What is more, every time, banana has competition from other fruit, its price dips while when there is no other fruit, banana attracts a decent price. In case of vegetables, one notices that carrot and peas are seen in each house in the winter but very few houses in August. Again, this is caused by supply and not a demand pattern. In other words, the current market system is not designed to reflect demands very well. For getting signals on demand, small holders may have to supplement the feedback from the market with their general observation or special studies.

Service Availability

- **Sorting, pooling, packaging, storage, transport logistics**: By and large, these services are now readily available in "established horticultural clusters". Their availability in case of very small and sporadic producers is a problem still. This is bound to be so since the suppliers will find it rewarding only if the demand occurs in clusters so that they can economize in their operations and take advantage of scale.
- **Choice of market for a given lot at a given point in time**: Such a choice may perhaps naturally exist for established producers living in very well connected locales. A lemon producer in Anand can decide whether to send the produce to Vadodara or to Ahmedabad depending upon which bus comes to the stop first. Established producers in locales less well connected will have to make special efforts in evolving their equations and relationship with *adatis* in several markets. This, they may be able to do even if they are not as well connected to their brothers in Anand, particularly if their individual or collective produce can fill a medium sized vehicle. The small holder producer in well connected locales too has no problem about choosing markets. But the small producer in a remote market has no meaningful choice about the market. His produce is well below the optimum load for a vehicle, he has no contacts in other mandis and the value of produce is not large enough for him to take the trouble on his account to develop market information and linkage.
- **Quality Assurance**: There is a major issue here too. Most Indian horticultural produce is sold for use as a fresh food ingredient, not as an industrial raw material. The tolerance range in which the diverse quality attributes (shape, size, colour, taste, degree of ripening, age since harvesting, thickness of skin, pulp-skin ratio, quantity of seed in the fruit etc.) can remain and yet be accepted by buyers for fresh food requirement is quite broad. Seldom are these aspects subjected to

objective tests. In some inexplicable manner, the actual attributes of a specific lot on such parameters get translated into its price discovery.

- **Payment Recovery**: Most producers including small holders do not mention this as a major problem. A major reason for this perhaps has to do with the fact that they keep a running account with their *adati* and make an arrangement by which they buy stuff they need from the same market or the same city without making any payment. The *adati* makes these payments on their behalf, usually for some kind of a service fee. But basically, payment recovery problem is eliminated.

IV Key issues and problems

4.1 **Who is the target**?

IDE's IPMAS programme attempts to impact two distinct classes of farmers.

- The first is the class of small holders who are engaged in horticultural production even as of now but face difficulties in accessing water. These farmers are reasonably well versed in the agronomy of horticulture and have at least the basic psychological make up for internalizing better techniques of land, water and crops for maximizing production. They are also reasonably market savvy. IDE's basic contribution comes in the form of a water saving device and also in broadening the scope and range of agronomic inputs to them.

- The second class is of the poor and the marginalized rural producers, often in tribal areas who are not horticulturists at the moment. Some of them follow field crop-migration cycle, while some of them may be engaged in taking two field crops etc. Still some others may be taking to horticulture as an additional activity in their homestead land, without really changing their existing crop or economic activities. For these farmers, horticulture is an add-on. The point is that the farmers in this category do not know how to engage in intensive, well managed horticultural garden activity as a way of earning their livelihood.

I believe that the IPMAS approach for these two classes of farmers needs to be different. For the first category, one needs to focus on aspects of post-harvest stages and market linkage. Including crops in their portfolio based on market intelligence is an important aspect of this change, but the rest of them are about post harvest stages. More careful sorting, better packing, pooled transport, evolving a joint production-cum-marketing plan for better realization, establishing links with as many market players as possible, allowing emergence of a market intermediary within the village, perhaps long term contracting with or even contract farming for a regular buyer are some of the things that may improve their realization and incomes.

For the second category, the issues are more basic. At one level, the participating NGO often believes that "even if they do not earn much money from this, they will eat the vegetables and this will improve their pathetic nutrition". This is of course indisputable. Such logic also goes further to argue that so long as the plot of land planted with vegetables produces more income than what they already get from it (which often is very little), the tribals are happy. While this be so, neither mere nutrition supplementation nor small increment to incomes enthuses people to continue and invest efforts in the new activity. Naturally, one sees them reverting to the old ways allowing the MI kit to go waste. These farmers need to be trained in systematic, professional, market oriented horticulture. Hence they need to be given training in methods, shown demonstrations and given exposure to proper horticulture. A large number of such tribal farmers firmly believe that their fate is only to migrate and do unskilled labour. Many of them actually say that "Such systematic horticulture is beyond our abilities, only the kurmis (malis, vaghris, kushwahas---) can do it!" Such a mental block and diffidence has to be overcome and a spirit of "you also can do" has to be instilled in them.

I believe that the two tasks suggested for the two classes of farmers need to be handled differently. While there may be commonalties in the strategies one formulates for this purpose, one needs efforts at two levels. Since it is almost certain that these two classes of farmers live in separate geographic clusters, there is no inherent difficulty in the process.

4.2 **Getting over fragmentation**

The objective in our context of the desire to reach out to small holders and to integrate them in the markets is essentially to induce aggregation so as to achieve some concrete economic advantages. These come in the form of savings in transportation costs, ability to bear transactions costs of dealing with new actors or new mandis, making it worthwhile for diverse service providers to cater to the group of producers etc. We need to focus on this objective alone and not get carried away by romantic ideologies. I recommend that it may be better either to encourage individual initiative in the village or to encourage the small holders to come together in informal clubs on as needed basis. The former will be spurred by a desire to self-improve as well as a kind of extension motive, though it will be sustained by individual economic incentive. A classic case of an individual finding it profitable to initiate group action since his own benefit exceeds the costs of making the group action come about is also likely to occur. We find that this approach of an informal association has worked wonderfully well for the Ismaili farmers of Mohodha. Individual incentive seems to work in villages of intensive horticulturists in Western Maharashtra where the studies were conducted. It is perhaps better to initiate discussion about these ideas (informal clubs or one individual taking initiative and being compensated by others based on services rendered) during the course of interaction with small holders and then allowing the producers to decide what suits them most.

There are alternate ways of inducing aggregation. Aggregation is needed at three stages. The first is the aggregation of the produce per se and this is needed mostly for achieving some logistical cost saving or efficiency. If we are clear that we are looking at

horticulturists or wannabe horticulturists who will be mainly supplying small lots of produce for fresh consumption, aggregation for this purpose has the relevance only for primary transport and transit storage. But aggregation may be needed in terms of land area cultivated under horticulture. This may be needed for land treatment, application of some agronomic package and supervision thereof or for those who wish to contract farm. Finally aggregation is also desirable in terms of number of small holders involved in the process. This is needed for ease of extension, demonstration of a new technology package or needed by an external service provider so that he realizes the economic potential for his services.

4.3 **Getting over ideological biases**:

Ideas of sharing and equity come naturally to the development world. We often believe that the best way to enhance market standing and bargaining power is to form associations and co-operatives. We believe this leads to pooling of produce and hence larger quantity and helps to bargain with the intermediaries in the market. We also argue that a degree of risk mitigation occurs automatically with the pooling process and we can actually give refined methods for deciding prices to be paid to individual farmers that combine the risk pooling concepts. We must recognize however that in insisting on such a format, we may actually be introducing new complications in the village economy and polity. There are several advantages to farmers working in a co-operative format, but there are several disadvantages as well. (Some of the disadvantages are: perception that the co-operatives creates positions of salience and importance attracts the wrong type to it, co-operatives when registered have to face bad regulations, co-operatives have artificial "democratic" governance norms that may not be very conducive to orderly conduct of a hard nosed business, co-operative history reveals the difficulty in avoiding member opportunism and "co-op as the buyer of the last resort" behaviour; the additional and amplified risk of member loss if the co-operative employees or Secretary run away with the cash etc.)

4.4 **Technology package we can offer to the small-holders**

It is to be noted that the "professional, intensive horticulturist" household seeks no advice from us in this field, but would appreciate facilitating supplies of kits within its pocket and perhaps some informational inputs. The discussion below is for households that are not intensive horticulturists at the moment.

Choice between fruit and vegetables, mix

Horticulture includes both fruit and vegetables. BAIF's DHRUVA project has powerfully demonstrated how fruit plantations can lift poor and marginalized tribal households out of poverty trap. Admittedly, the agro-climatic conditions enabled the organization to popularize high value fruit crop such as mango and cashew. Experiments with mango are also going in Eastern area under the aegis of PRADAN (Purulia team). NM Sadgur's experiment with gooseberry and AKRSP(I)'s experiment with sapota have worked

wonderfully well so far as production is concerned but the market realizations do not seem to be adequate for obtaining significant poverty impacts and also portend fairly sizeable risk. Fruit plantation necessarily involves a gestation period during which the poor small holder needs to invest time, water and perhaps some capital. This therefore obviously needs more consistent follow up and motivation on the part of the promoting NGO and IDE.

Vegetable cultivation starts yielding immediately but the task is far more labour intensive than other crops the household grows. The household compares the income it would have obtained if the household had simply sold its labour or migrated for work with the income from vegetable. This comparison is seldom very encouraging if the household is an indifferent cultivator and on top of it allows it to be a whole time occupation of all workers.

It is perhaps best to recommend a mix: fruit plantation with inter-cultivation of vegetables till the fruit tree's canopy permits. Also it is better to recommend a graduated level of intensity of cultivation. The households needs to develop and hone its skills and develop its confidence before it fully commits its most precious and reliable asset, namely its labour, to the task of vegetable cultivation. Thus to start with, one may recommend use only of the homestead land at a level of cultivation that can be handled even by persons who would stay back when the working adults migrate. As the household evolves confidence, the area can be increased.

Type of crop: For a complete novice, it may be better to recommend very simple and every day vegetables to begin with. As the producer gets into the mode of careful, alert and efficient production, other crops can be introduced. The value addition comes from introducing crops that are not currently grown by the producers and have a good market that can be tapped. Such crops do not need to be exotic. They may be highly seasonal (like katargam papdi in Surat) or they may be demanded round the year (beat root for instance) but not produced in sufficient quantities. These can be identified only after a careful understanding of the local market and proximate transit market.

Timing of the crop: Off-season vegetables of the popular type fetch very good returns. Caulifower fetches far better price in August than in December. Green peas will sell like hot cakes in October. The production conditions need to be managed carefully and the small holders need to be trained in producing off-season varieties. To begin with, it may be better to start with "just before" or "just after" peak season vegetables. Thus if the normal cauliflower season is from November second half to February, a small holder may aim to produce it in such a manner that it is harvested in the second half of October or after the last week of February. In this manner, the variation in production conditions to be managed may not be radical.

Agronomy and packages

At times the promoting NGO are seen to give "kits" of seeds of different types of vegetables (such as brinjal and bhendi in Gujarat) and ask the new entrant small holder to

plant it. Beyond that, often there is no agronomic support provided. Both the parties sort of agree that nothing "much is involved" and hence not much special effort is needed. But for a tribal small holder who has never tended to vegetables, a lot of change in behaviour is called for. It is possible that IDE decides to sub-contract the agronomy task to some one or evolves a market based system etc, but to say that nothing much is needed is perhaps not quite correct. Again, packages have to be evolved for different plot sizes as well as different seasons. This is necessary since the MI kit sales keep occurring through the year. Hence the package of seeds and inputs necessary for the current season is important rather than the one that will be used a year hence etc.

Inputs: In general, most growing regions have well serviced input markets. But these are well serviced from the marketer's point of view. I find that the current supplier of inputs are the "krishi seva Kendra" or the agro-service centers. These people tend to push the inputs that fetch them margins rather than the inputs that are best for the farmers. It is possible that IDE may try to use the Agrobusiness Clinics concept introduced in the 2003 budget by the FM to initiate a new generation input cum extension supplier. But

Danger of prescription and danger of free giving: When small holder tribal farmers not initiated in vegetables cultivation are told by their "paternalistic" NGO to sow some seeds and to adopt certain practices, they do so unquestioningly. In one instance I saw farmers having sown okra in early winter without wondering at all about germination, plant health, yield or without enquiring about whether any change in agronomy is called for. When I saw the more or less withered plant stand and asked them why they had sown the seeds, one of the small holders simply pointed a finger at the NGO and said "he knew okra is not sown in November, but did so only because the package was free and the NGO told him to do it." Perhaps such uncritical acceptance of agronomic advice is rarer-I hope it is, but this reminds us that we ought to be very careful while giving any package free and while giving any advice through a well respected paternalistic NGO.

V. Suggested Strategy

Before concrete measures are suggested for adoption by IDE, some relevant but general points are made. These are taken based on advice from some experts in agricultural produce marketing.

5.1 **Work with not against the market**

It is very tempting, particularly for change agents, to brand the existing market as exploitative, unresponsive and anti-poor and to try and devise mechanisms that work parallel to if not outside the market. To me this seems more ideological than logical. With complete recognition of all the shortcomings and defects of a market as an agent for producing welfarists results, I humbly recommend that it is better to examine alternatives on cost, subsidy and sustainability accounts. It is best to work with the market. Not only would it obviate the need for discovering and establishing logistic, information and cashflow mechanisms anew, working with the market will also automatically induce a

hard nosed approach in the CBO, in small holders and groups. Above all it will reinforce the market oriented approach of the staff of IDE. This method will mean that existing market will only face perhaps one or two new entrants, some thing the market is used to all the time. But it will not face a threat of being ignored or by-passed and hence will not unintentionally lead to consolidation of the anti-change lobby. The way to work with the market is to identify one or two market actors who can be use for the small holders and alter the cost-returns calculus for them so that they consider working for the small holders.

5.2 **Co-opt existing market actors but not the leading actors**

Leading market actors are usually not very amenable to change. They are completely lost in their own world of market superiority. They have precious little time or patience for small holders. It is possible that they may not find it even worth while talking to IDE staff. On the other hand small market actors are working at the fringe end of the market. They are looking for ways to enhance their standing, increase their market share and expand their reach. At the same time, they have the expertise needed to operate in the market, know the nuances of its functioning and are savvy. Hence it is better to co-opt them. IDE has rightly done this earlier in many instances. The same sound strategy will work again.

5.3 **Outline of suggested Strategy**

a. IDE is engaged in popularizing and marketing micro-irrigation kits in a broad geographic area. IDE may consider classifying the areas/cluster it works in into two classes. The first is the class of clusters of established intensive horticulturists who are adopting MI kits for their advantage in controlled water delivery and water savings. We call this Class A. The second (Class B) is the class of clusters where horticulture is being promoted along side MI kits essentially for its promise of poverty impacts. The operational strategy, while following the same basic approach of **BDS with a cluster focus,** for enhancing market participation of small holders in these two classes will be different for the two classes in specific content. The approach is elaborated below.

Class A clusters:

- These clusters are of well versed horticulturists. For them, the art of horticulture is not new, nor are they novices to input and market situations. They come to IDE essentially because the MI kits help them obtain a cheap solution for the water control and delivery problem. For these clusters, if IDE were planning to engage on the input side, IDE needs to first become sure that it has evolved an agronomic package of significant value to them. Chances are that, some of the horticulturists are more suited as resource persons rather than potential recipients of extension support. In such clusters, IDE needs to identify small clubs of small holders who are willing to experiment with new techniques etc and encourage them by providing them support

of logistic type. But with these clusters, the work will be essentially on the marketing side.

- It is best to start with one or two "high potential" vibrant clusters in which the approach may be tried out and perfected.

- To begin with, IDE may consider focusing on identifying enterprising small holders who have already shown some initiative in regard to better marketing arrangements for themselves and / or on behalf of a group of small holders.

- Along side this, or in addition to this, small informal groups or clubs of small holders may be encouraged anchored by these enterprising small holders.

- IDE may encourage these clubs and enterprising small holders to visit markets other than those in which they have been active with the specific objective of learning about marketing information, price data, better practices in packaging, transportation, storage and possibilities of establishing marketing linkages. Such encouragement may be in the form of supporting a part of the travel cost, providing introductions to key players where possible, organizing talks by existing players, processors etc.

- Such clubs may be encouraged to meet periodically. At these meets, IDE may invite a range of service providers (agri-clnic professionals, market operators, packing material marketers, input dealers etc.), bankers, and diverse consultants for talking and exchanging idea. This may be done by supporting the travel costs of these service providers.

- As demand for some of these services emerges from the small-holders' clubs, the enterprising core members may be encouraged to discuss with the service providers to come to a view about the kind of "service package" they need. IDE may subsequently help the service providers in evolving a suitable service package and a suitable pricing mechanism so that services are valued based on results and payment made accordingly. Other than travel costs, other payment may be linked from the very start to some measure of the volume of business done. (number of users, area covered, quantity traded, volume of materials sold etc.). In the first round, IDE may actually cover a part of the costs to encourage the service providers to come forward as well as for the producers to experiment with the services. IDE's experience in the CPHP will be much help in deciding the steps here.

- The aim should always be to disengage from this involvement in a year or two and allowing the informal clubs and the enterprising small holders to deal directly with the service providers.

- As things appear to be settling down, these enterprising small holders should be used as agents of change in other clusters.

Class B clusters

- These clusters are of those small holders to him horticulture is being introduced along with MI kits for its promise of poverty impacts. These clusters are likely to be relatively backward, remote tribal pockets with small holders having relatively less exposure to markets and experience of growing the crops. It is important to ensure that the small holders learn the art of good horticulture, get over their fear and inhibitions as well as start on the way to integrating with the markets. For the purpose of developing confidence in the community as well as the promoting NGO, it is better to concentrate on particularly difficult clusters and show that things can happen "even there."

- The most crucial thing in this regard is to demonstrate that the MI kits as well as the vegetable cultivation works, produces saleable things and enhances incomes. Hence it is important to encourage the promoting NGO to take up demonstration farms in each cluster. These demonstrations should be in plots of chosen small holders and be managed by the small holders themselves. There should be close supervision from an "expert" in intensively producing the range of vegetables being demonstrated. Cost of the small holder putting up the demonstration (measured by the value of the alternate crop he would have grown otherwise) must be born by IDE and he should be allowed to keep the profit from the demonstration farm as well.

- The second step should be to form informal associations of the small holders in these clusters and take them for the purpose of exposure to these demonstration farms in their clusters as well as to the distant vegetable growers.

- As in case of Class A clusters, these groups should be encouraged to meet periodically. IDE should support the travel cost of a range of service providers in the agronomy and input field to these clusters for informal interactions with the associations. While University departments outreach centers are useful, perhps input dealers and enterprising and youthful agriculture graduates willing to start "agro-business clinics" will perhaps be more responsive and useful in providing more complete range of services.

- These service providers should be encouraged to evolve "miniature" kits/packs and services to be of use to the small holders and cost of development of such packs, cost of developing extension materials etc. should be supported by IDE.

When a cluster seems to become mature in production, IDE may think of encouraging one of them to take initiative in learning about markets some what further than their closest market towns. Such persons should be supported in their travel etc. They will go and establish links with market operators elsewhere, learn about the market practices, packaging needed, the peak and trough of various products, type of varieties etc. They should be encouraged to become service providers to the small holders in these matters. IDE may consider supporting such enterprising small holders set up their business as a

market intermediary by providing them initial assistance, help in obtaining bank loans, guidance in arranging transport etc.

Complete Report With Annexes Is Available On IDE(India) Website

ANNEXURE 5

AN ASSESSMENT OF THE KB DRIP SYSTEM EFFECTS ON FARMER'S INCOME

By Marco Vitanza

March.2004

1.Introduction

The use of drip irrigation systems in agriculture is beneficial for several reasons such as reducing water requirements, preserving soil fertility and enhancing yield. However, drip irrigation is typically very expensive and can be inappropriate for small plots of land. The International Development Enterprises India (IDE) has developed and promoted a drip irrigation system that is affordable and suitable for small plots of land, with the aim of making drip irrigation technology available also for poor farmers, thus enhancing their income. This system is denominated the KB drip system.

The objective of this study is to analyze the benefits obtained by the farmers who have acquired the drip irrigation system developed by IDE. Interviews of users constitute the basis for the study. In particular, the needs to quantify the income benefits arising from installation of drip irrigation has been assessed, together with those aspects of the drip systems that make greater impact on such benefits. Other benefits that are not directly income-related were also analyzed. Furthermore, an attempt has been made to examine if there are differences in users' benefits, and if so, who gets more benefits and who gets less or no benefits from the drip irrigation system. This has been sorted by which crops the farmers are growing and other variables that may affect users' benefits. Indications about why some farmers are reluctant or not in condition to acquire the system have also been inferred.

Section 3 gives a presentation of drip irrigation in general and of the system developed by IDE in particular. This includes technical details and prices as well as users' overview in Maharashtra, India and - to a lower degree of detail - in other parts of the world. It also gives a brief description of how IDE promotes this technology. Section 4 describes where and when interviews were carried out, how they were conducted and what questions were asked. It also describes the climatic conditions the farmers faced in the year before this study was conducted. Section 5 gives an explanation of all the different benefits of the drip system and how these affect the farmers' income. Non-income benefits are also briefly discussed. Section 6 addresses restrictions and weaknesses of IDE's drip irrigation system. Section 7 makes comments on other findings that emerged from this analysis. This includes farmers' perception of the drip system, reasons for which some farmers are reluctant to buy it, how the income increase is spent and few remarks about the dissemination of drip technology. Section 8 discusses the problems with quantifying the change in income due to drip irrigation, suggesting caution on definite quantification at this stage. Nevertheless, an attempt to quantify income benefits and sort these by crop type and other factors is made in Section 9. Finally Section 10 gives recommendations on possible further studies on this subject.

2. Executive summary

This study is to investigate the income benefits for farmers in Maharashtra after the installation of KB drip system. Interviews of 36 farmers conducted in the time period between the 25th of January and the 24th of February 2004 constitute the basis for this analysis.

The main reasons for increase in income generated by the drip systems and the IDE facilitation approach are:

- Possibility to broaden the crop varieties and to extend the cultivation period enables farmers to grow more water-intensive high-income crops. This appears to be the greatest contributors to income increase.
- Possibility for farmers to grow a broader variety of crops and thereby interact more with market prices.
- Increased capability for larger- and better quality yields.
- Other benefits as reduced pest attacks, less labor requirement, increased collaboration among farmers and enhanced self-confidence also contribute directly or indirectly to higher income.

The most remarkable increase in income is found when farmers who didn't have enough water to grow horticulture or summer vegetables, were enabled to do so by adopting the drip system. In such case, farmers are found to completely change crop types and cultivation periods and thereby radically increase their income.

Farmers with initial low income, gains highest relative increase in income when installing the drip system, while farmers with initially high income, gain more in absolute terms.

Quantification of the increase in income because of KB drip is premature at this point in time, mostly because farmers have used the system for a relatively short period.

3. Drip irrigation and KB drip

Drip irrigation is a way of irrigating the land with tubes that lead the water directly from wells or other water sources to the plantations. A key component for such system is the tubes, which need to be simple to install, robust to maintain and most of all cheap. Compared with the more common practice of surface irrigation, this system gives several benefits. Drip irrigation uses water more efficiently in that it avoids the losses due to evaporation, which can be considerable in the region where this evaluation was made. The water quantity requirement therefore declines dramatically, often down to one fourth of the quantity required for surface irrigation. Farming yields are greater and of better quality, since the soil acquires and preserves a better farming quality. These and other advantages of drips are discussed more thoroughly in section 5 of the report.

The problem with conventional drip systems is that in general they are expensive to install- and that the cost is born by the farmers who use it. The conventional drip systems can also be complicated to use and not suited for smaller patches of land. Therefore drip

irrigation has been an inaccessible technology for poor farmers. IDE has addressed these drawbacks by developing drip irrigation systems that are less expensive and appropriate for small patches of land. Simplifying the system and using less expensive material are the key differences from other systems.

IDE is continuously developing drip irrigation systems with better quality and lower price. The last system developed is called KB Drip, which is sold in two models, i.e. with 125 microns and 250 microns wall thickness of the tubes. The 125 microns model has the lowest cost and has an estimated lifetime of 2-4 years whereas the thicker and therefore more expensive 250 microns has an estimated lifetime of 4-6 years. The 125 microns model is appropriate for vegetables, while the 250 microns model is appropriate for other horticultural crops because of their long life. Some farmers use 125 microns for short-term horticulture crops like banana and papaya. The prices depend on spacing between crops, distance from the water source and model used, but ranges typically from 2500 to 4000 rupees per acre (55 to 90 US Dollars, 1 acre is 4000 square meters).

The products developed by IDE are branded as KB (Krishak Bandhu) products. IDE is not producing or selling KB products, but has found private actors to fill these roles. However IDE is doing a substantial part of the marketing, by interacting directly with farmers or groups of farmers. IDE also does a considerable effort on following up with activities such as farmer training programs on appropriate use of drip systems. In this way IDE's employees keep a close relation with many of the users and can advise regarding other aspects of farming as well as management of water.

IDE started its program on drip irrigation in Maharashtra in October 2001. By March 2003, 7,392 farmers were using KB drip systems in Maharashtra. In the same area, the number of users by January 2004 had increased to 14,365 farmers.

4. How the study was carried out

The study was done in the state of Maharashtra in central India. The following districts were visited: Solapur, Latur, Akola, Amaravati Buldana, Jalna, Beed, Aurangabad and Osmanabad (In Osmanabad there were no interviews, but important information was collected). In most of the districts, interviews of farmers from different blocks and villages were carried out. Jalna is an exception, were most interviews were made in the same village, Sindikalegaon. Interviews were made from the 25th of January to the 24th of February 2004.

The study includes interviews with standardized questions of 36 farmers who had been using the KB drip systems (described in Appendix1). Discussions with several other farmers also helped to gather a clearer picture of the benefits and weaknesses of drip irrigation.

Interviews were conducted with field managers or field staff as translators. The questions asked in the interviews aimed to gain knowledge about the changes brought-in by drip

irrigation, such as changes in farmers' income. The questions addressed the following points:

- Crop(s) before drip system installed and yield/income from this.
- Crop(s) now irrigated by drip and yield/income or expected yield/income from this
- Changes in crop type before and after the installation of drip. Differences in yield, quality, water requirement and other differences
- The area irrigated by drip, plans for expansion or reasons not to
- Type and price of drip system
- Family's size, total land owned, different sources of income and financial situation
- Situation of water availability and depth of well
- Other benefits or disadvantages with KB drip system

The choice of which farmers to interview was mostly taken by field staff, field managers or KB dealers, trying to include an as representative as possible range of crops and farmers' economical condition. Although one could raise questions as to how representative the selection of farmers using KB drip had been, the farmers interviewed represented a broad range of users in terms of crop type, income and location. Out of the 36 farmers interviewed 23 were using the drip system on vegetables, 18 on horticulture and 5 on cash crops or cereals (the total of the 3 categories exceeds 36 because some farmers were using the drip system on both vegetables and horticulture).

Other aspects need to be taken into account in drawing conclusions from this study. Amongst others one should consider that the monsoon gave very little rainfall in Maharashtra the year before this study was done (see appendix of rainfall in selected areas). This has lead to some peculiar results. Comparing a farmer's income with drip in 2004 with his income without drip earlier years, there might be no increase in income at all. The reality is rather that the farmer was speared from likely considerable losses. In this sense, the study outcome is conservative in term of assessing the drip system benefits. The difficulty of quantifying prevented losses is discussed in section 8.

5. The benefits of drip irrigation

When asked for the main reason for buying the drip system, farmers answered that they had shortage of water. Without drip systems, they would have to leave fields blank or grow low-income crops as cereals or cotton. Many of the farmers who were interviewed had completely changed cropping pattern after installing the drip system, gaining in this manner a remarkable income increase. Larger yields- and better quality crops irrigated by drip compared with surface irrigation help increasing the income. However, the possibility created by a more efficient irrigation to broaden the crop varieties and to extend the cultivation period appears to be the greatest contributors to income increase. This means that relative to income before installation of drip, those who had enough water to grow water-intensive crops all around the year by surface irrigation earlier benefit mostly of higher yields and better quality, while those with scarce water, benefit both from broadened crop varieties and extended cultivation period and area as well as higher yield and better quality. Other benefits are also discussed below.

5.1 Less water requirements

Drip systems give the farmer new possibilities of production in virtue of the fact that crops require less water with drip irrigation than surface irrigation. The farmer may now grow more water-intensive vegetables and horticulture that give higher income. This is indisputably the main reason for increase in income. Furthermore farmers may be able to cultivate vegetables in summer period too. By cultivating vegetables in this period, farmers will get a high value for their produce, as market prices for the period are high.

Drip irrigation was also essential for farmers growing horticulture, because many of their trees would dry out if it weren't for the reduced water requirements that drip irrigation reassures. This would be disastrous for a farmer growing for instance sweet lime, which gives its first yield after 5 years or so. Preventing this to occur is therefore a major benefit of the KB drip. Furthermore, the KB drip reassures to some extent that trees will not dry out in case of drought, and thereby gives farmers confidence to grow horticulture which gives good returns in income.

KB drip gives increased opportunities for the farmer both in horticulture and vegetable growing because of less water requirements. In particular it was noted that farmers changed from growing cereals, sugarcane (mostly in Latur and Solapur) and cotton (mostly Akola, Amravati, Buldana and Jalna) to grow horticulture and vegetables, including summer vegetables.

5.2 Opportunities and markets

With more opportunities of crops, farmers have a broader possibility to interact with markets and respond to market prices. Many farmers interviewed seemed to use this possibility. Evidently this leads to higher income. Some were almost not selling any of their produce before they installed KB drip, but grew cereals almost merely for own consumption. These farmers would typically sell their labor force for at other farms or such with very low wages. When installing KB drip these farmers faced new perspectives of opportunities in agriculture. Typically, the greatest impacts on income are in cases like this, where farmers are brought in touch with the markets because of KB drip. Linkages to markets are facilitated by IDE.

5.3 Higher yields and better quality

This study can reconfirm what has been more scientifically proved, that crops that are drip irrigated give higher yields and better quality than those that are surface irrigated. This was found by interviewing farmers that grew the same before as after installing drip system, or farmers who simultaneously grew the same crops with drip irrigation and with surface irrigation. Some farmers interviewed had none or only marginal increases in yield/quality with drip, while others had substantial increases in yields, reaching up to 50 or 60 % higher yield in some cases (appendix1: farmer number 10, 14, 22, 34). More typically the increase in yields for any crop type with drip- compared to surface

irrigation, would reach from 10 to 30 %. Increase in yield depends on the crop type. The resulting increase in income is slightly higher than the increase in yield as some expenses are fixed and does not vary with production quantity.

The reason for the increase in yield and quality proves to be that drip irrigation preserves a better combination of soil/air/water, while surface irrigation makes the soil set, letting less air into the soil.

5.4 Less labor requirement

Surface irrigation requires much labor. Some farmers would need to hire this labor, other farmers would do it themselves while yet others would partially do it themselves and partially hire labor. This means either less expense on hired labor, or freeing their own labor force for other purposes. The expense on labor for surface irrigation for would typically be around 1000 rupees (22 USD) per month on a 4 acres plot if completely hired.

5.5 Reduced risk of pests

There is a less chance of pest attacks when irrigating by drip compared with surface irrigation. This leads to lower risk of loosing yield because of drip and in some cases to lower requirement of pesticides. This last point was only found in a few cases, saving some 250 rupees (5.5 USD) per acre each year.

5.6 Enhanced self-confidence

Farmers who had changed from surface irrigation to KB drip, were seen to have enhanced self-confidence regarding their agriculture. The reason for this seems to be that as the farmers face new opportunities, they were also eager to know more about these opportunities. They might investigate the markets, getting information about exact water requirements, appropriate use of pesticides and fertilizers and so on. IDE is helping to provide these sorts of information through training programs and direct interaction with farmers.

Take for instance farmer number 3 in the appendix, which was growing cereals and leaving most of his land blank from February to June before installing drip. After installing drip, this farmer is growing banana and various vegetables, also in summer period. This farmer was clearly more active in his choice of crops types and cultivation methods than earlier. He was also more active in getting information cultivation practices. Obviously this is very beneficial for the farmer, also in terms of income.

Another interesting case was seen in a village called Pimpelgaon Kothwala in Washi talluka in northern Osmanabad. About 15 farmers had installed KB drip and most of them were almost only growing watermelon. What was interesting about these farmers was that they went together for hiring trucks to send their produce to Solapur. They were also collaborating about getting information on pesticides and cultivation practices. They have

formed a sort of informal agricultural cooperative. This translates into increase in income as well as giving social benefits. IDE is encouraging these sorts of interactions between farmers.

5.7 Better nutrition

In some cases members of a household did not get varied nutrition before installing KB drip. With drip irrigation these farmers could consume some of their new products, and thus have a more varied nutrition.

6. The problem of severe drought

As mentioned, this study was done in January and February of year 2004, and the monsoon gave very little rainfall in year 2003. The drip system uses water more efficiently than surface irrigation, but if there is no water at all, there is no water to use more efficiently. In some cases, especially noted in Jalna district, farmers would have to leave some or all plots blank from March or April and to the monsoon because of water shortage, even when irrigating by drip. They would still gain major benefits compared to surface irrigation, but the increase in income would be less remarkable than for those who are able to grow crops in summer because of KB drip.

Another outfall of this was seen in Sangola in Solapur. In a village called Tippihelli, rainfall in 2003 was no more than 40mm. In this village several farmers were growing pomegranate irrigated by KB drip. With such a low rainfall the farmers didn't have enough water in their wells to irrigating the pomegranate trees sufficiently. As a consequence the pomegranate trees will not give yield in year 2004, and in the worst case, young trees will completely dry out. Of course, the situation would not be better without drip system, but this is a case where the farmers are not gaining on the KB drip, and may loose some of the investments. For this particular village, critically low rainfall is said to come only once or twice in a decade. In a long-term perspective there is therefore no doubt that KB drip has an enormous positive impact on income, put to evidence by farmer number 8 in the appendix, who had his first major pomegranate yield one year before this study. For this farmer, the change from growing cereals and selling labor force to growing pomegranate was immense in terms of income, changing yearly income from 20'000 rupees to 140'000 rupees.

It is therefore seen that the highest potential gains in income are for farmers who do not have enough water to surface irrigate a certain crop through the whole summer, but does have enough water to drip irrigate this crop during the whole summer. The data in this report strongly reflects this.

7. Other findings

7.1 Farmers believe small animals will bite the tubes

Some farmers interviewed thought that small animals would bite the irrigation tubes and ruin it. This was especially given as a reason not to use KB drip on sugarcane plantations, as they are inaccessible so it would be difficult to repair leaking holes. Growing sugarcane in rows, thus making the crop more accessible, could solve this. However, out of 36 farmers interviewed, including several farmers using KB drip on sugarcane, there was found only one case were animals had bit the tubes. This was on a pomegranate plot in Aurangabad. This farmer solved the problem by elevating the tubes from the ground. This farmer was using an older version of IDE developed drip systems. It is thought that the problem is less severe with the newer version, KB Drip, as it flattens when it's not irrigating and is of softer material, while rodents prefer harder material.

7.2 Further expansions of KB drip for farmers

Most farmers interviewed had started with using KB drip on a small patch of land, and as they saw the positive results, they expanded their use of it. Some farmers interviewed were in the process of experimenting with the system on a smaller patch of land. This means it might take some time from a farmer starts to use KB drip to his potential is saturated. The main reasons farmers had to not further expand their use of KB drip were either that they had no more land or no more water. Only one case was found were farmer didn't have enough money to buy anymore of the drip system because he had a 100'000 rupees loan to repay at 5% interests per month and was unable to raise money for drip irrigation system for all of his land. However, he was using KB drip on a small patch which surely helped him to pay back the loan.

7.3 Spin-offs and re-investments

Most of the farmers interviewed were asked on what they were planning to spend their increase in income caused by changing to drip irrigation. Common answers were house building and repayment of loan. Often, increase in income would go to expenses on social functions and festivals (i.e. dowries) or unprofitable investments such as gold. Very few farmers were thinking about re-investing the increase in income in land or agricultural machinery, but plans of re-investing in deepening the well was more common. Many of the poorest farmers would use the increase in income for consumption, and by this raise the quality of life.

Whether the increase in income leads to gainful re-investments or not, it undeniably raises the quality of life of the farmers' families. Furthermore it helps farmers out of debt traps if that is the case.

7.3 Diversification of crop types

There are predictable seasonal fluctuations in market prices as well as unpredictable non-seasonal fluctuations in market prices for vegetables and horticulture. Because of this, diversification of crop types spread risk of getting low price for produces. It is assumed that most farmers are strongly risk aversive. Circulation and diversification of crops on a patch of land also keeps the soil more fertile. However, in this survey there were found very few farmers that are diversifying crops. This might be because many of the farmers interviewed are new to growing horticulture and vegetables and do not have much knowledge about farming practices in different types of crops. Farmers may, because they are new to growing horticulture and vegetables, also not be aware of the risk involved in growing only one crop type. IDE is now conducting training programs aiming at making farmers diversify crops and spreading risk.

8. Problems with quantifying KB drip's impact on income

Quantifying the impact on income of the farmers that are using KB drip is very problematic because of four main reasons.

First, many farmers interviewed were still experimenting with the KB drip on a part of their land when interviewed. Often, they would have plans of expanding their use or they would await results on that small patch, and in case of positive result, they would expand. Therefore, for many farmers the potential use of KB drip was not saturated, meaning that further changes in income could come as farmer increases the share of land irrigated by KB drip. This could partially be solved by comparing the farmer's gains on a small plot with the farmer's plans of expansion of KB drip. This would though be based on the assumptions that with a fixed amount of water, the quantity of land irrigated by KB drip gives constant returns to scale in terms of net income. Another problem in this regard is that as farmers start growing new crop types because of KB drip, they would need some time to gain experience on this type of crop, reducing the initial advantages.

Second, the impact on income to be analyzed should be the difference in income of a farmer who is using KB drip compared to what would be the same farmer's income without KB drip, everything else the same. As data for this report was gathered in a drought year, the impact on income of KB drip was often found to be in prevented losses. The problem occurs to be that it is very hard to say how much worse the situation would be in this particular year if the farmer still were using surface irrigation. To get an idea about this, the farmers were often asked what they think would be the case without KB drip, but to quantify the actual difference would remain ambiguous assumptions.

Third, as there are great differences in how long the farmers interviewed had been irrigating with KB drip, not all of them had yet had their first yield after switching to drip. Therefore, several estimates of farmers' incomes after installing drip are based on what the farmer was expecting to get in future. Often, these expectations were found to be somewhat implausible. Especially in some types of horticulture, where trees have a lifespan of several years with yields naturally changing with the age of the tree, it was difficult for the farmer to predict the future yields and therefore future income. Farmers

did also sometimes not have precise accounts on their yields, income and expenditures, or they were reluctant to reveal this in the interview.

Fourth, the increase in income is dependent on the price the farmer gets for his produce. The market prices fluctuate, not only seasonally, but also non-seasonally. Since market prices are object to such irregularities, the increase in income would need to be seen on a long perspective together with a throughout analysis of the market prices which this study does not include.

Therefore, any quantification of the increase in income because of KB drip will at this point of time be very approximate. It is thought that calculating the arithmetic average of increase in income for the farmers interviewed will give misleading results. Rather, it is tried to find typical increases in income. This gives room for more subjective interpretations of the data, but it is found necessary to do this in order to correct for the four above-mentioned problems.

9. Quantifying the increase in income

As discussed in Section 8, it is problematic to quantify the income benefits from the drip system. However, an effort has been done to get indications about this. It is suggested that these indications in this section should be regarded as preliminary and not be object for use in other contexts. The study outcome is conservative in term of assessing the drip system benefits because prevented losses because of drought are not fully taken into consideration and are most probably underestimated.

The income benefits vary with water availability, crop type and other factors.

9.1. Water availability

The most important factor in determining the increase in income because of the drip system is water availability. This was also mentioned in Section 6. Farmers with abundant water would already grow water-intensive, high-income crops and irrigate their land in the summer period before installing the drip system. These farmers would mostly raise their income because of larger yields and better quality, typically gaining a 10 to 50 % higher net income. These farmers would typically have a reasonably good income also before installing the drip.

Farmers with a very scarce amount of water might not be able to irrigate their land in the driest period of the year even if they have installed the drip system. This means that they will not get the benefits of growing summer vegetables or horticulture, but they would still be able to grow more water-intensive and high-income crops with the water they have, giving increases in net income not succeeding 50%.

Farmers in between these categories are the ones that undeniably gain most of the drip system. Farmers who had insufficient water to surface irrigate horticulture or summer

vegetables, but is able to irrigate these crops by drip, face totally different economical conditions. Farmers in this category would typically get 75% to 125% higher net income with the drip system, although farmers gaining less than 20'000 rupees per year on an area larger than 2 acres could get even higher relative increase in net income.

9.2. Crop types

The net income differs substantially for different crop types. Some crop types need to be specifically addressed.

For vegetables, the prices differ drastically as for the seasons. Prices of most vegetables are likely to be more or less three times higher in summer and early monsoon period compared with the post-monsoon period. Therefore, farmers that are able to grow summer vegetables would typically get 30'000 rupees (665 USD) in net income (including the cost of KB drip) for an acre of vegetables (say tomato or eggplant), only for the summer harvest. This would mean an even higher income per year for this one acre, as other crops could be cultivated the rest of the year. To put this into context, 30'000 rupees is more than what the whole household of many farmers interviewed had in annual income before installing the drip system.

Generally the net income for horticulture is slightly higher per area than for vegetables, but it also requires some higher investments and longer time before the first yield comes. There are also to some extent larger variations in the net income compared with vegetables. Many farmers would intercrop vegetables or cereals between the fruit trees, and therefore get income while the trees were growing, but not always did this give significant income to the farmer. Considering that the sweet lime tree lives more or less 15 years and gives variable yields from the fifth year and on, the average net income per acre-year through the lifespan of the trees is at least 50'000 rupees (1110 USD). This is, if the trees are given appropriate water, fertilizers and pesticides. For the pomegranate, the income varied substantially with different varieties reaching from 20'000 to 55'000 rupees in net income per acre-year. For banana the variations were even larger, probably because of differences in price and price expectation by the farmers. The range goes from 15'000 rupees per acre-year to the unreasonably high expectations of over 100'000 rupees per acre-year in net income. It is reasonable to expect from 30'000 to 40'000 rupees per acre-year in net income on banana.

IDE does not promote drip on sugarcane, cotton or cereals. However, some farmers started adopting the system on these crops with following results.

Farmers who were irrigating sugarcane with KB drip had very different experiences regarding yield. One farmer interviewed (number 32 in the appendix) experienced no change in yield because of drip, while another farmer (number 10 in the appendix) experienced a 60% increase in yield with drip irrigation compared with surface irrigation. Sugarcane prices fell some time before the study was done and many farmers growing sugarcane had great use of the drip system to find alternatives to growing sugarcane. As mentioned in Section 7, some farmers are reluctant to apply drip systems on sugarcane

crops because they think small animals will bite holes in the tubes. With the low sugar price, farmers using drip on sugarcane crops would make more or less 20'000 rupees (445 USD) on one acre per year.

For cotton, the drip system gives possibilities to start cultivation one to two months before the monsoon. This pre-monsoon cotton is more resistant and gives higher yield. In this study one farmer who had cropped pre-monsoon cotton, said yield was 50% higher. However, cotton does not give as high returns as vegetables and horticulture. Even with the drip irrigation, cotton would hardly ever give more than 15'000 rupees (335 USD) in net income per acre in one year, and usually it would be less than this.

One farmer interviewed (number 4 in the appendix) was irrigating a maize crop with drip. Without the drip system, this maize crop would certainly dry out. Maize does not require much water and does not give high income, but for this farmer this crop was very important as it both served for own consumption and for fodder for his buffalo. This buffalo would in turn produce milk worth 90 rupees (2 dollars) per day. In this case, the drip system prevented losses worth more or less 30'000 on yearly basis by irrigating a cereal as maize.

9.3 Other factors

There are other factors that systematically change the drip system's impact on farmers' income. Progressive farmers certainly know how to make the most out of the drip system. However, these farmers also knows how make good income without the drip system. Therefore, in absolute measures, the progressive farmers benefits more from the drip system than conservative farmers, although relative to income before installing the drip, the conservative farmers experienced larger increases. Whether a farmer is progressive or not is to some extent correlated with his education. In this study, precise data regarding farmers' education has not been gathered. Let aside education and the definition of "progressive farmer", it is seen from the data gathered that farmers with initially low income gets a higher relative increase in income than farmers that initially had higher income. On the other hand, farmers with initially higher income, benefits from a larger absolute increase in income compared with the ones with initially lower income.

Farmers gain possibilities to grow a broader variety of crops with the drip system. But if the farmer has poor access to markets and poor information about market prices, he might not fully be able to take advantage of the new possibilities he has. Precise data on farmers' access to markets and information about markets was not gathered in this report, although a certain correlation with the impact on income of the drip was noted.

10. Recommendations for further studies

Further studies should respond to the problems discussed in Section 8. First, data should be collected from farmers who have used the system for a longer period in order to get data based on actual income rather than expectations. It is suggested that farmers interviewed should have used KB drip for at least one year on vegetable plots or one-year horticultural crops. If farmer is growing other horticultural crops, data should be collected some years after the trees give their first yield. Taking the example of sweet lime, which normally gives the first yield after five years, data should be collected after approximately eight years to get a clear picture of the effect on income from this production. More precisely, this should be counted as years after the farmer has expanded the use of KB drip to his total potential or desire.

It is furthermore also suggested that data should be collected over several years to correct the effect of irregular rainfall, market prices, pest attacks and other stochastic variables.

An analysis of trends in both market prices as well as rainfall, over the past years, would help in understanding how income benefits are correlated with these two variables and thereby work out the long-term income benefits by KB drip system.

As discussed in sub-section 9.3, it is felt that the income benefits gained from KB drip are somewhat correlated with progressiveness or education of the farmer. Access to –, and information about markets also seem to play an important role. This could be further investigated in order to address these differences in IDE's further work.