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APPROPRIATE DRIP IRRIGATION TECHNOLOGIES PROMOTED BY IDE

A SOCIO-ECONOMIC ASSESSMENT

A REPORT
SUBMITTED TO IDE (INDIA)

BY

SJ PHANSALKAR

AMOL MANAGEMENT CONSULTANTS
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EXECUTIVE SUMMARY

From October 2001, IDE India started regular marketing of ADITI kits in Gujarat and Maharashtra. Including the earlier developmental phase, these products have been around for about five years by now. This study was intended to understand the impacts of these products on the users. This study is based on a survey of 107 ADITI kit users. Fifty-four of them were chosen from Gujarat, 30 from Maharashtra and 23 from MP. Of the 107, 37 were BK users, 18 were DK users, 29 were CS users and the balance were users of either micro-tube or pepsi type drip systems for growing pre-monsoon cotton. Most of the users were seen to be small or marginal holders from drought prone and dry regions in the country. Only 10 of the 107 farmers surveyed owned more than 10 acres of land. The systems do seem to appeal to the small holder for whom they are designed. Average land holding of a bucket kit user was 2.59 acres. Average land holding of a drum kit user was 3.6 acres. Average land holding of a customised system was 10.4 acres. Average landholding of pepsi and micro-tube system users was higher. However not all the ADITI kit owners can be described as poor in the Indian context, though almost all of them would be poor by the international definition of poverty. NGO are the sources of information and knowledge about the BK and DK. Further, they also seem to be the most important conduit for the hardware of these systems. CS and pepsi systems are bought mainly through market players with little NGO role. Information

seems to be flowing rapidly horizontally and IDE India has to now keep pace with the spread of the innovation by ensuring availability of materials. The role played by private marketers of drip systems (Jain, Premier) in creating awareness of the drip concept can not be underplayed and that awareness is helping CS sale. While the supply chain members selling the products receive prices in the range at which the products have been priced, the role of subsidies in case of BK and DK is not yet insignificant. CS and pepsi sales can be said to be quite without any overt subsidy. The pricing issue however will be commented below again. Ninety-seven of the 107 kits seen were in working condition. Most were seen by the surveyors themselves. This degree of reliability is amazing given the age distribution of the kits. Almost half the systems are of 2000 vintage. Barring pepsi and micro-tube based drip systems in MP, all other systems were used to grow vegetables or fruit. CS were more commonly used for fruit, BK almost exclusively for vegetables. Proportion of the extra produce obtained by using ADITI kits that was marketed rises rapidly from BK to pepsi drip. All BK users use quite a bit of the produce at home, all the pepsi drip users fully sell the produce. Income effect of the kits are salutary. Incremental income generated are in the range of Rs. 250-300 per BK, Rs. 700-1000 per DK, Rs. 3000-5000 per CS and Rs. 7000 per acre where pepsi drip is used. Cost benefit analysis shows that the BK has an IRR of 49%, DK of 39% and CS of 64% after considering opportunity cost of land and labour. There is clear evidence of their economic benefit. An important benefit of the BK is its very salutary impact on nutrition whereby every user family has improved its consumption of vegetables by over 30 kg per year. In case of DK this effect can perhaps be larger. One worrisome facet is that the current pricing of the products leaves little or no margin to make up the market development costs that are being currently met out by IDE India through donor funds. To what extent will this interfere with the eventual sustainability of the market is a moot question.

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1. INTRODUCTION

1.1 This report

This report is based on an exercise commissioned by the IDE (India) to study the socio-economic impacts which has been caused by the appropriate drip irrigation technologies (ADITI) promoted by them.

1.2 ADITI

ADITI covers innovatively designed micro-drip systems: the bucket drip kit meant for the kitchen garden, the drum drip irrigation kit meant for a small vegetable graden and customised low cost drip systems that use micro-tubes. ADITI also includes the interesting "pepsi drip" system that has sprouted as a fortuitous side effect of IDE's engagement in Madhya Pradesh. Eventually ADITI will also cover, micro-sprinklers. This study is focused on ADITI systems sold and installed in Maharashtra, Gujarat and Madhya Pradesh. Micro-sprinklers have not be promoted in any significant manner in this region and are excluded from our discussion.

1.3 Background

IDE started work on these "appropriate micro-irrigation technologies" or "AMIT" as they were then called four years ago. First two years were spent in product design, testing, field testing and demonstration with appropriate modifications to the product design as and when warranted by ground situation. Systematic efforts to take the technologies to scale and on a commercial basis began circa 1997 in South India and also in Maharashtra. During this period , IDE was and still is engaged in evolving three things simultaneously:

- The products themselves, (and appropriately modified versions therein)
- An optimal fit between the products and the crops possible for a region including at times technology for growing crops; and

- An approach for creating a market for these products in such a manner that members entering in the supply chain for these products would find it worthwhile continuing this business even if IDE withdrew from the process.

Further, while IDE strategically used available funding for consistently staying with this task of evolving these three things, each specific funding source required it to spend at least some time away from these three tasks. In view of this it is not surprising that the ADITI products have begun to be marketed on a large scale with clear "marketing – like" goals only in last year. But here too, the primary task is not mere marketing of ADITI products but evolving a BDS approach for promoting farm level enterprises of the poor that will lift the poor out of poverty. This subtle and important aspect of the background is essential for a proper appreciation of whatever IDE has achieved through ADITI. It should be obvious that it is early days yet to carry out a full-fledged impact assessment.

1.4 Work Done and the Team

This assessment is primarily based on detailed surveys of farmers who have purchased/used the ADITI systems. The survey was carried out using a structured format developed by us and tested during a field visit to Chikhaldara (Melghat area) where the kits were demonstrated in the year 2000. The survey was carried out by Sarvashri Sanjiv Phansalkar (contributing in Maharashtra and Madhya Pradesh), Sachin Mardikar (Maharashtra and Gujarat) and Vivek Kher (Gujarat and MP). The preliminary survey for developing the schedule and testing it was done in January-February 2002. Survey of users in Maharashtra was done in Feb. 2002. The survey of users in MP was done in June 2002. Finally, the survey in Gujarat was done in July 2002.

Sampling was not done using SRS method. The attempt was to reach as many users as was possible within the given constraints. The law and order situation in Gujarat vitiated the study process in Gujarat. The data reported in Section 4-7 is based on the information gathered from this survey.

2. THE PRODUCTS

2.1 ADITI products covered in this study are the bucket kit (BK), the drum kit (DK), the customised drip system (CS) and the pepsi drip system (PP).

A Bucket Kit is designed to be a product that provides basically a familiarity to a potential user with the concept of drip irrigation. As such BK by itself is seen to have the potential of creating demand for larger ADITI products. Its own use value comprises of enabling a household in growing vegetables or some fruit in the kitchen garden, expected to be used mainly for home consumption. A standard BK includes a large plastic bucket with a tap attached to it to which drip laterals and micro-tubes are

attached. The user is expected to fill the bucket from his domestic water source each morning for the kitchen garden to be irrigated through the day. It can irrigate upto 20 sq mt area. Its cost varies by choice of materials between Rs. 225 to 300 with a modal value of Rs. 250/- per unit. BK can be used over several seasons.

A Drum kit is designed to enable a household to start a vegetable garden in 100 sq mt of land growing the vegetables for the market. In its proto-type, this comprises of a "drum" of capacity 200 liters feeding drip laterals to irrigate the vegetable garden. The "drum" can be a water-storage drum of the Sintex type, a used lub oil drum, a masonry structure or any other suitable arrangement. The user needs to fill about eight standard 25 buckets in the drum each morning for the garden to be irrigated during the day. The cost of a DK is around Rs. 800 without the drum and between Rs. 1200-1500 with the drum. DK can be used over several seasons.

Customised System is essentially a standard drip system comprising of the mains pipe, laterals and micro-tubes with or without water filter designed to suit the shape and the size of the plot. The mains, the laterals and the micro-tubes all lie above the ground, an important aspect in which this system defers from the more expensive conventional systems. CS have been designed for plot sizes of about an eighth of an acre (5500 sq feet or 500 sq meters) upwards. CS can be designed for a wide range of crops. Water is drawn from the source by means of a pump and fed into the mains for irrigation to occur. Various units of IDE have already designed and demonstrated the utility of CS for a wide range of crops such as mulberry, orchards of mango or orange, pomegranate, grape or banana plantations, drum-stick plantation etc. The cost of a CS varies by the choice of materials, spacing of the plants for which it is being installed, whether one will share one filter between two modules/plots or have a filter for each module etc. A typical CS may cost between Rs. 6000-8000 per acre, excluding the mains pipe. The CS has an expected life of upwards of five years.

Pepsi Drip now included in the ADITI products, this product emerged out of the efforts by cotton farmers in Kasrawad-Maheswar area in West Nimar district of MP. These farmers were exposed to the concept of the drip irrigation system by IDE and later experimented with thin plastic tubes. The name derives from the fact that an inexpensive ice candy popularly named "pepsi" in rural MP is packed and sold in the tubes of the same dimensions as were used by the farmers. The system comprises of a mains pipe laid above the ground nearly dividing the plot in two equal halves and the pepsi drip tubes arranged along the rows of the plants that need to be irrigated, connected with the mains at one end and closed at the other by tying a knot. Water is pumped out from the source and fed into the mains and from that in the pepsi tubes. A thorn of acacia or a needle is used to make holes in the tubes at the point closest to each plant and the drip system is ready for use. The tubes sell for Rs. 70 per kilogram. About nine kilograms of tubes are needed for fitting the "system" for one acre of cotton planted at 36" spacing with 42" spacing between rows. Quantity needed for other crops varies by the plant density. Mains pipe of this system has a longer life but the pepsi

tubes of this system are useable for one season. The cost of this system thus works out to about Rs. 1000 for the main pipe as a capital cost and Rs. 600-650 as recurring cost of the tubes. Some farmers also use a filter and that costs another Rs. 1000/-. The pepsi tubes are sold after three months and fetch up to Rs. 6-8 per kilogram.

Pepsi drip has been used almost exclusively for pre-monsoon sowing. Barring two farmers we met, all others have used the system for pre-monsoon sowing of cotton. One of the exceptional farmers did pre-monsoon sowing of chilies, the other of bitter gourd. Pre-monsoon sowing of cotton is done in the first week of May with ambient temperature ranging between a maximum of 47 degrees and the night minimum temperature of 26-27 degrees C. Access to live water source in peak summer indicates that the farmers would be better endowed than the rest of the farmers.

3. THE WORKING MODEL ADOPTED BY IDE (I)

Any marketing effort involves setting up working arrangements for flow of information, goods and money in such a manner that some how the whole system experiences an incentive for selling more goods and reaching out to more consumers. IDE believes in creating markets for products and technologies that hitherto did not exist while simultaneously holding the price of the product at a level that poor can afford.

IDE model for marketing ADITI products as adopted now may be summed up as below:

- Each farm household, the potential buyer of IDE ADITI products is an enterprise in itself. This enterprise comprises of combining available land and water resources in an optimal manner growing products that yield the best value for the enterprise.
- The farm enterprise is enmeshed in a network of market players that provide the enterprises information, goods and services and also buy the products of the farm enterprise.
- Sustainable marketing of new technology is possible only by creatively structuring marketing transactions and roles with associated structure of incentives that existing market systems finds attractive and not by by-passing or competing with the existing market.
- Technology is owned and meant for the benefit of the poor. Except for ensuring that the poor get a high quality products at lowest possible cost, IDE does not wish to gain pecuniary benefit for itself from the ownership of the technology or the brand.
- Specific model of marketing of ADITI products is that IDE field staff will work using diverse extension and communication methods towards creating demand for the technology. IDE staff shall train private sector service providers who will offer information and services to the farm enterprises at a cost to be borne by the farm enterprises. Flow of goods will be routed through supply chain members at commercial terms to be negotiated and settled by them. IDE field staff will ensure

that the service providers recommend goods of high quality but will not tie any one down to use of goods manufactured or marketed by any specific manufacturer or supply chain member. IDE staff will try and ensure that many manufacturers and supply chain members are willing to supply desirable goods so that no monopoly is created.

A farm enterprise persuaded to install one of the ADITI systems will be served by a service provider called "assembler" located in a proximate locality. Assembler will design the details of the system and may on behalf of the farmer obtain or ask the farmer to obtain the necessary hardware from supply chain members in the area and assemble the products according to needed design. They will be responsible for ensuring that the system installed by them functions without problem. IDE field staff will monitor the quality of service.

In addition to the supply of ADITI products, the current IDE programme adopts the BDS model. This model also requires them to create service providers to participate in a system that provides ***information and materials and services*** to farm enterprises so that the later may improve yields, quality and market realisation of the products they grow.

4. WHO ARE THE USERS

4.1 Sample

The sample of farmers met during this survey is described below. Table 1 shows the distribution of users across the different types of kits. Since we did not follow SRS method, this distribution does not give the exact proportion of the different kits in actual use.

Table 1 : State wise Distribution of Sample

	Bucket	Drum	CS	Micro Tube	Pepsi	Total
Gujarat	37	13	4			54
Maharashtra		5	25			30
MP				13	10	23
Total	37	18	29	13	10	107

Table 1: Sample farmers using different kits

Bucket Kit Count	37
CS Count	29
Drum Count	18
Micro Tube Count	13
Pepsi Count	10
Grand Count	107

Note: Micro-tube type kit: The local parlance used by farmers who follow the "over the ground" laid laterals and micro-tubes combination instead of pepsi tubes. This is close to CS type, but not sold by IDE.

4.2 Landholding of users

Overall landholding pattern of users of different types of kits is shown below.

Table 3 : Landholding Pattern of Sample Population

Area (Acre)	No of Families
Less than 1(Incl. Landless)	25
Between 1 and 2.5	22
Between 2.51 and 5	16
Between 6 and 10	19
More than 10 Acres	27
	107

We note two points before drawing inferences from this table about which land-holding class prefers which kit.

- In the first place, till date, the effort has been more in the nature of persuading people to take to this innovation. Hence the quite a few innovative type farmers have taken the products.
- Secondly, much of the actual sales have occurred through intermediation of the NGO, who I turn would have chosen farmers on their own criteria.

However, Table 3 does indicate that so far IDE has been able to persuade farmers from all categories to try the new method of irrigation. The most "free market" like situation has existed in MP where the innovation ahs spread horizontally from farmer to farmer, with some intervention of the IDE-Maikal combine. In that State we find that most of the adopters are in 10 acre plus category. This has been commented upon while describing the pepsi drip system.

Table 4.1 : Land-holding wise distribution of users of different Kits in Sample Population

MP					
	Bucket	**Drum**	**Customized**	**Pepsi**	**Micro Tube**
Land Holding					
Less than 1 Acre	0	0	0	0	
Between 1-2.5 Acre				1	
2.51 - 5 Acre				1	
5.1 - 10 Acre				3	1
More than 10 Acre				5	12
Total	**0**	**0**	**0**	**10**	**13**

Table 4.2 : Land-holding wise distribution of users of different Kits in Sample Population

Gujarat					
Land Holding	**Bucket**	**Drum**	**Customized**	**Pepsi**	**Micro Tube**
Less than 1 Acre	15	1	3	0	
Between 1-2.5 Acre	12	6			
2.51 - 5 Acre	7	4			
5.1 - 10 Acre	3	2			
More than 10 Acre			1		
Total	37	13	4	0	0

Table 4.3 : Land-holding wise distribution of users of different Kits in Sample Population

Maharashtra					
	Bucket	**Drum**	**Customized**	**Pepsi**	**Micro Tube**
Land Holding					
Less than 1 Acre	0	4	1	0	
Between 1-2.5 Acre		1	2		
2.51 - 5 Acre			4		
5.1 - 10 Acre			10		
More than 10 Acre			8		
Total	0	5	25	0	0

Average land holding of a bucket kit user was 2.59 acres. Average land holding of a drum kit user was 3.6 acres. Average land holding of a customised system was 10.4 acres. Average landholding of pepsi and micro-tube system users was 18 and 32 acres respectively. All the areas in which these systems were introduced are drought prone, rain-fed agriculture areas and hence bulk of these land holdings are to largely unirrigated land. This reveals that on the whole, the kits were well targeted.

In terms of social groups, the following caste groups were represented in the sample:

Patel (39 HH, either pepsi, micro-tube, cs or drum) Tribal (32 mostly BK) Maratha (21 mostly cs) OBC (12 mostly DK), SC(3, mostly BK)

Asset ownership differed widely across different categories of respondents. BK users were largely poor tribal peasants who held minimum assets in fact very little beyond their cottage, as a pair of bullocks and implements. CS, pepsi and micro-tube system users owned own source of water and pumps. Several of the pepsi and micro-tube system users owned a tractor and multiple pairs of bullocks consistent with their land holdings.

Thus not all the existing users can be described as the poor. Non-poor are particularly more in micro-tube and pepsi drip irrigation kit users.

5 HOW DID THEY GET THE SYSTEMS

5.1 Awareness

Thirty of the 37 BK users reported that they learnt about the BK from one of the NGO partnering with IDE. (Rangpur Ashram, Manav Kalyan Trust, BAIF.) As noted, most of these were tribals. Others sources of information were IDE demonstration plots or Mahila Sammelan organised by IDE with one of the NGO. Of the 18 drum kit users, one learnt about it from a dealer, two others saw it in use at friends' place, three others learnt about it in an exposure trip while the rest learnt about the technology through one of the partner NGO. Two of the CS users reported having learnt about he CS type drip from friends or relatives. Four others learnt about it through IDE. The rest of them had heard about it and got to know the details through an NGO. Most of the micro-tube kit users came to know of the systems through an exposure visit to Maikal demonstration farm. Word of the mouth, suggestion by dealers, horizontal communication and seeing others use it worked as the source of information in case of pepsi drip.

In summary so far NGO have played a crucial role in spreading information and awareness about the ADITI products. Dealers' role in extension is not prominent as yet except for spontaneous spread of the pepsi system.

5.2 How did they acquire the materials?

All the BK users obtained their kits through the partner NGO promoting the product. Eighteen of the twenty nine CS users got the materials from representatives of the manufacturers directly. Three of them bought the materials from the supply chain members in this trade. The remaining obtained the materials though one of the NGO. This also includes one demonstration plot. Two of the eighteen drum kit users got the materials directly from a shop or a dealer. NGO routed and delivered the materials to the remaining. All the micro-tube or pepsi drip users obtained the materials directly from supply chain members.

Table 5.1 : State wise Sourcing Pattern

		Source					
State		**Direct Manufacturer**	**Dealer**	**Government Sources**	**IDE**	**NGO**	**Relatives**
GJ	**Bucket**					37	
	CS		4				
	Drum		1			12	
MP	**Micro Tube**		12	1			

	Pepsi		10				
MS	**CS**	17				7	1
	Drum	1			1	3	
Total	**107**	**18**	**27**	**1**	**1**	**59**	**1**

In summary, role of NGO seems to be very strong in distribution as well for BK and DK. The remaining systems are largely distributed via the private market.

5.3 How much did they pay and was there any subsidy involved?

Sixteen of the BK users reported the price of the BK Rs. 330 each for the kit, two said it was Rs. 300, three said Rs. 275 and six said Rs. 250 each for the kit. Lower price or no price was stated by the remaining persons, some of whom included those who ran a demonstration. Thus, most NGO sales have been booked at cost. In most of the former cases, the assembler of the kit was able to charge a margin. The users paid much less: only five of the users paid full cost; about twenty five paid fifty percent of the cost and the remaining paid nothing. This category includes those who installed it as a demonstration kit. Eight of the drum kit owners reported the price of Rs. 1200 for the kit. Three reported higher price. Others either stated a lower price or did not tell a price at all. Two of the drum kit users were given these systems free, five of them paid half the price and the rest paid full price. CS users quoted total expenses that varied a lot by type of application and the area. Six users of the CS got these systems free as subsidy or as a demonstration kit by the NGO. Remaining paid between 60% and 100% of the total cost of the installation of the system. The gross amounts involved were much larger, starting at Rs. 6000 and going as high as a lakh depending upon the area. Two of the micro-tube system users had received some subsidy. Remaining of them and all of the pepsi system users paid full cost.

In summary, the role of subsidy either by the participating NGO or by State or some body seems to be not insignificant yet.

6. ARE THE SYSTEMS WORKING?

6.1 Current condition as reported

Three of the CS users reported that the laterals were broken and the system was not in use. Five drum kit users reported that the systems were not in use mentioning various problems, mostly connected with the condition of the laterals. Remaining 97 users reported that the systems were in use and in working condition. A majority of these systems were seen by the surveyors themselves when they visited. It is amazing that even the "low value" kit like BK was stated to be in working condition by almost all the users.

6.2 When were they installed?

Table 6.1 shows the distribution of the various installations with the respondents in this survey. As can be seen from it, seven systems are five or more years old. Another twenty five are more than three years old. The remaining are relatively new. Given this age distribution the performance as reported in Section 5.1 seems truly remarkable.

Table 6.1

Year of Installation of Systems with Respondents

Year	Kit Type	No of Installations
1996	**Drum**	1
1997	**CS**	4
1997	**Drum**	2
		7
1998	**CS**	9
1998	**Customized**	1
1998	**Micro Tube**	4
	All	14
1999	**Bucket**	1
1999	**CS**	5
1999	**Drum**	3
1999	**Micro Tube**	2
	All	11
2000	**Bucket**	13
2000	**CS**	2
2000	**Drum**	3
2000	**Micro Tube**	2
	All	20
2001	**Bucket**	17
2001	**CS**	6
2001	**Drum**	1
2001	**Micro Tube**	3
2001	**Pepsi**	6
	All	33
2002	**Bucket**	8
2002	**CS**	2
2002	**Drum**	6
2002	**Micro Tube**	2
2002	**Pepsi**	4
	All	20
	Grand	**107**

7. WHAT ARE THE USERS USING THE SYSTEMS FOR?

7.1 Crop Choice

Almost all the BK users reported that they grew summer vegetables with the BK. Similar answer was given by the DK users. There was a greater variation in the use by DK.

While BK use was almost patterned by the NGO recommendation, DK was less so. Egg plant and okra and papaya were the common plants reported to be grown using BK. Papaya was reported by tribals in Melghat when demonstration was tried there in 1999. Gujarat BK users have grown the other two products. CS users used the product for pomegranate, drumsticks, tomato and other horticultural products. Micro-tube and pepsi tube system users had installed these almost exclusively for pre-monsoon cotton cultivation.

7.2 Subsistence or Market

Most of the BK users used the little produce they got from their 20 sq meters at home. Produce quantities reported/expected were upwards of thirty kilograms over the whole life of the plants. This estimation was imprecise because the lady of the house took the vegetables over a period of time and not at one go. While estimation of the quantity was not precise even for the DK case, the users agreed that they used the produce for selling. CS users sold the produce producing handsome earnings for the family. This is revealed in the case stories later. Micro-tube and pepsi tube users were of course growing the cotton for the market.

8. INCOME EFFECT OF THE ADITI PRODUCTS

8.1. Income Effect of Bucket kits

Bucket kits are viewed as fun by most users, primarily because the land area it irrigates is considered to be so small as to be irrelevant for any serious income generation. Yet the income effects are amazing. Often these effects are not recognised in the minds of the users because the produce is used for self-consumption and that too over an extended period of time. Of the thirty seven tribal users surveyed, as many as twenty five reported having changed their diet habits to include vegetables even in peak summer in their meals. Three of them could not grow any thing as the water shortage was very severe indeed. The vegetable plot of one farmer was affected by termites. Few poor and tribal families have become sophisticated enough to impute and calculate and impute money value to what they get basically from their backyard! But in our sample seven families reported incomes or savings in Rupee terms. The figures reported ranged between Rs. 250 to Rs. 3000. This last figure was reported by Roopaben of village in Sabarkantha district.

Box 1
Income Effect of Bucket Kits

a. Chikhaldara, Melghat Taluka, Maharashtra
During the demonstration phase of BK, tribal families some fifteen kilometres from Chikhaldara were given a BK by the NGO partnering with IDE. These kits were given in 1999. The tribal families were given in addition, papaya seeds. Users would fill the buckets from the nearby hand pumps. Tribal families reported production up to 60 kilograms from the papaya trees irrigated with the BK. The value of these papaya fruit would be in the range of Rs. 600 in Nagpur market Rs. 360 in Chikhaldara. Most of the families however consumed the fruit at home or shared the fruit with the neighbours. An lady user who wished to expand the use had shared the fruit in the first year but had started selling from the second year. She remarked that this was like her pension in her old age!

b. Chhota Udaipur, Gujarat
Tribal Madabhai of village Khakria reported that he had installed the system in 2001. He grew diverse vegetables such as guar, okra and gourds. He largely used the vegetables at home. He estimates the savings at about Rs. 250 in one summer season.

c. Sabarkantha, Gujarat
Roopaben, a tribal lady of village Dhambolia in Sabarkantha district has barely one bigh land. She used the bucket kit for growing vegetables. She has innovated by making the bucket kit "mobile". She picks up the kit and keeps it another plot. She planted vegetables in two plots each of 15 feet by 13 feet size. So she alternates the kit between two plots. She has planted three saplings near each of the micro-tube outlet. In addition, she had kept papaya tree earlier. She grew vegetables all year round. She grew and sold Guar, chillies, egg-plant and okra as well as a few papaya fruit. She estimates the total of the sales of vegetables and consumption at home, at Rs. 3000/- from 38 sq mt of land, or about Rs. 81 per sq mt! Of course to attribute all this to BK is to hog all the credit for the entrepreneurship of a smart tribal woman.

8.2 Income Effects of CS

For twenty five CS users who reported that the orchards established with CS have started yielding, the incomes reported to have accrued on them totaled Rs. 621000, averaging nearly Rs. 25000. Most of them had installed the CS on one acre or thereabout. There was one outlier who claimed the income gain to run into Rs. 800,000 from 14 acres of land where he used CS to grow tomato. The income earned from the orchards where the CS was installed ranged from Rs. 20000 to Rs. 30000 on a per acre basis. This is very significant indeed considering that the average per acre income in drought prone areas ranges between Rs. 3000 and 5000. Considering that the investment in CS ranges

between Rs. 6000 to Rs. 10,000, this is a very significant return on capital invested indeed.

8.3 Income Effect of Drum Kits

Estimates of gross income earned by use of DK varied between Rs. 600 to Rs. 2000.

Of the thirteen working DK seen, most were used for producing some horticultural produce or the other. There is some degree of fuzziness about the income effect as reported by users.

Box 2
Income Effect of Drum Kits

Drum kit seems to fall between two stools. It is not just "fun" irrigation as bucket kit is taken to be. The amount involved and the area one needs to work on makes it a serious business. And yet, its yields are not so large as to make a person miss her wages from the market. The second important issue about a DK is that in the case of quite a few users, they have planted fruit trees that will yield only after the third or the fourth year and since we interviewed them in the second year, they had no income to report. How do we value income expectation?

Among the people who told us concrete figures about the income from using kits, modal figure was Rs. 100 per week for about ten weeks in a year. An incremental cost of Rs. 25 per week was associated with this income. (labour for moving vegetables, transport etc.) The net income was reported at Rs. 75 per week for 10 weeks, or Rs. 750 per season.

While people agree on this as a fair estimate, they disagree on whether it is "adequate". Many people had given it up because they found it too tedious for the income. The biggest problem was reported in filling the drum. "In a water short place like this village, it is difficult to get eight buckets of water every day from a hand pump. Some one does start objecting to it, said one user." Another problem with the income effect is that this income gets compared with what would the woman managing the garden have earned if she had gone on wage work. " I get paid Rs. 30 per day plus one meal. Even if I get work only for three days, then I earn better income from wage work than tending to this garden using the DK" said another user. She of course forgot to mention that on wage work, she may have a chance of insensitive treatment or even harassment!

But suitably targeted, this DK is wonderful aid in supplementing family income. After all, return on capital employed is substantial: Rs. 750 net on an investment of Rs. 800. The right targeting is the area where getting 8 buckets of water is not a problem and where wage opportunities are not very promising.

8.4 Income Effect of Pepsi Drip

The incremental income earned by using micro-tube or pepsi drip systems is estimated at upwards of Rs. 7000 per acre. The income effect is to be calculated carefully without attributing too much to the pepsi drip. The following steps in Box 3 explain the logic.

Box 3
Income Effect of Pepsi Drip

Three factors contribute to make pepsi drip an attractive proposition.

In the first place, with a pepsi drip system in place, one can grow pre-monsoon cotton when one could not, or at least multiply the area under pre-monsoon cotton three-four fold. This happens because of the way water levels in the dug wells behave. It is impossible to run a pump in these wells for four to six hours at a go that would suffice for a flood irrigation method for one acre, but one can run the pumps for an hour every morning! And in an hour, one may be able to irrigate two acres of pre-monsoon cotton.

So the first effect is of increasing the area. We take a modest fifty percent rise in area under cotton though farmers have reported trebling it with pepsi drip.

The second effect is in terms of better germination of seeds with pepsi drip than with flood system. Farmers reported savings of about a third of the seeds. With seed prices reaching Rs. 900 a kilogram this is not hence a small gain. The non-quantitative benefit is in the form of uniform growth of plants with pepsi drip.

Finally there is the sharp reduction in weeding labour. With pepsi drip irrigation, there simply is no need to hire labour for weeding: the moisture is enough simply for the growth of the cotton sapling, summer kills every thing else. With flood irrigation, a lot of weeds grow and hence have to be removed. When this labour saving is adjusted for the labour rquired to arrange pepsi tubes, some net effect is available.

With average cotton yields of 8 Q per acre and an average price of cotton at Rs. 1500 per quintal, incremental production is worth Rs. 6000, saving in seeds is worth Rs. 300 and saving in labour worth Rs. 800, coming to a total of Rs. 7000 per acre. Farmers have reported that the first picking of cotton comes when air humidity is high and this tends to make the cotton picked heavier. The weight gain is reported to be about 20% and they do not perceive any significant price adjustment done by the traders. "This is one unmentionable benefit", said one farmer.

8.5 How do they get extra income?

Surveyors were told that in a majority of the cases of CS users, no plantation would have been possible in the absence of ADITI products. The producer was unable to raise enough money to buy a "regular" drip system from Jain or Pioneer and simply did not have enough water to flood irrigate the plantation. So he could do the plantation simply because a system in his reach was available.

In case of the micro-tube and pepsi systems, this comment was heard even more strongly. In the first week of May when pre-monsson cotton is sown, ambient temperature in day time is above 45 degrees C in the Maheswar area. At this temperature, it would take four or five hours of pumping from their water source to irrigate a cotton plot at the time of sowing. The source simply does not have so much water. On the other hand, the pepsi system reduces the pumping requirement to less than half an hour per acre and this may be repeated perhaps every day for enough moisture to remain available for the seed. Since most dug wells do have water that lasts for half an hour pumping and then regain this level after half a day or so, this kind of irrigation is feasible.

Thus the main income effect is by way of enabling production where none was possible without the ADITI product.

8.6 Cost benefit Analysis

Cost benefit analysis of the ADITI kits can be attempted based on the data available with us through the survey. It does involve some issues that need to be first settled. These are discussed first and them schematic cost-benefit analysis is given.

A] Valuing crops that have not started yielding yet

Horticultural trees (mango, sapota, cashew) have been planted by many current users. These are being irrigated using DK or small CS. They will start yielding income three or four years down the line. When they yield incomes, the farmers may or may not be using the same or even similar ADITI kits. In fact the need for supplementary irrigation may vanish in certain coastal climate once the trees establish themselves. Whether and what proportion of the income stream that accrues from such trees should be attributed to the ADITI kits currently installed is an issue. We argue, based on the observation of the ground situation as well as discussion with the concerned users that
The plantations would not have been established at all without the ADITI kits since the farmer does not have source to use conventional irrigation method. In fact in some instances, he buys water that is transported through tankers and these are delivered via the ADITI kits. Thus a lion's share of the income from the plantation of the fruit can be attributed to the kits. However, as a conservative approach, we recommend that we attribute only a third of the income stream to the kit, the balance to take care of the share of the land and of labour.

B] Imputing opportunity cost of land on which ADITI kits are used to grow crops

We generally find that BK are installed in the backyard of the rural poor, DK is used in wada or kitchen gardens and CS are installed in regular farms. The land area in which horticultural produce grows now with the help of the ADITI kits was most often previously not used for any economic purpose. Yet to attach zero opportunity cost to its use is perhaps not fair. We suggest we attach an opportunity cost equivalent of the usual rain-fed crops grown in the area for that plot of land. Thus, for Gujarat, this would be the gross value of pearl millet (about Rs. 5000 per acre, or Rs.1.1 per square meter. In MP, it would be Rs. 7000 per care due to cotton or Rs. 1.6 per square meter. In Maharashtra, it would be about Rs. 1.1 per square meter as in the case of Gujarat.

C] Valuing home-consumption: Much of the production from BK is used for home consumption

The most incontrovertible method of valuing it would be at realizable market price of the vegetables. This often would be a guest mate if the household has sold nothing at all. They would be buying vegetables if they had not grown at home, but these prices would be consumer prices and not producer prices. We recommend that we will use a uniform Rs. 6 per kilogram as the price for valuing home grown vegetables.

D] Valuing labour

The ADITI kits make production of vegetable crops possible in summer by optimum use of the scarce water resources. But much of the production can occur only because the householder tends to the plants, picks the produce, markets it etc. It is argued by some persons that it is necessary to net the value of labour inputs before arriving at the contribution of the kit. One way to look at this is to say that the ADITI kits essentially enhance the value of the labour. Another is to impute certain value to labour, at a given wage rate and estimated time spent on the work. In doing so, a legitimate question is to ask how should one assess the fact that working at one's own farm is definitely far more secure and comfortable, particularly for women, than working as wage workers on some unknown farms. While working on one's own farm, distance-to-work involved is smaller, timings can be more convenient and fear of exploitation, harassment etc. is no longer applicable. Considering all these issues, it is suggested that we impute value to owner's labour at half the market wage rate.

E] Life span of the ADITI kits

Life span is of critical importance in case of CS and BK. In some of the DK cases where the kit is used for nurturing the orchard till the trees establish themselves, so long as the life of the kit is two years, it may suffice. In the case of pepsi drip, life span is known to

be short and the cost benefit analysis is a single period exercise with no need to discount future income streams.

F] Discount Factor

We discount future income streams at 12%.

The schematic Cost-Benefit Analysis is given in Table CB1 below.

Table CB1

Kit	BK	DK	CS	Pepsi
Unit land size	20 sq mt	100 sq mt	0.5 acres (2046 sq mt)	1 acre (4092 sq mts)
Life span considered	3 years	3 years	3 years	3 months
Time period of analysis	3 years	10 years (for tree crops)	7 years	1 year
Typical crop	Mixed vegetables	Fruit trees	Pomegranate	Cotton
Gross value per unit and from which year	Rs. 25 per sq mt from the first year	Rs 50 per sq mt from the fourth year	Rs. 15 per sq mt, from year three	Rs. 2.93 per sq mt
Value net of bought in items incl hired labour	Rs. 350	Rs. 3000 from the fourth year on	Rs. 15000	Rs. 8000
Value of labour	Rs. 150	Rs. 1000 per year	Rs. 5000 per year	Rs. 1000
Opportunity cost of land	Rs.32	160 per year	Rs. 3500 per year	Rs. 4100 per year
Net income stream	Rs. 118 per year	Rs. 1800 per year from year 4	Rs. 6500 per year from the third year	Rs. 2900 each year
Capital investment	250	1200	3500	Rs. 900
NPV	80	5800	16500	Net profit attributable to pepsi drip is Rs. 2000 per acre.
IRR	49%	39%	64%	

Note: The above Table should be treated as one with illustrative rather than definitive indication. It assumes certainty of pricing, yields and marketability of the produce.

9. OTHER EFFECTS OF ADITI KITS

9.1 Employment Effects

ADITI kits BK and DK are meant primarily for small holders who will use their own productive labour by harnessing innovative water application technology for increasing their own incomes. As such, employment effect of BK and DK are only in terms of providing additional, though possibly part time employment to family members at home. There are two important aspects to this: in the first place, the additional employment opportunity is offered at the very homestead of a family, saving on travel and privations of working away from home. This is significant for women who can work without fear of harassment or humiliation and work without having to leave the young children at the care of their siblings. The second aspect is that this employment opportunity is such that the work can be done to suit the overall daily schedule of the family. Irrigation of the planted vegetables does not have to depend on availability of power or diesel etc. Nor does it have to wait for the turn of the plot under a typical warabandi system. Water can be filled in the bucket/drum when it suits the family and irrigation can proceed without any further intervention.

Employment effect of the CS are favourable. Installation of the CS enables the farmer to use what was an unirrigated plot under a rain-fed crop to grow an irrigated horticultural crop with much higher labour absorption. Not all of this extra labour absorption need or can come from the family of the owner of the plot.

9.2 Gender Effects

The gender effects of introduction of irrigation in general tend to be mixed. On one hand, irrigation brings in more income and women tend to benefit from it along with the menfolk. The strongest effect of extra income is withdrawal of women of the household from wage labour market. For reasons of social status or whatever, an irrigated farmer discourages his wife, and more so his daughters and daughters in law from working as hired wage hands on others' farms. This of course means that these women escape the drudgery of working away from homes and also are spared the indignities and humiliation that hired women labourers are prone to suffer from contractors or employers. On the other hand, irrigation tends to increase the overall labour requirement of the farm and some of this labour, and for small holders, almost all of it comes from family hands including women. This effect is seen to be the highest when farm households grow labour intensive crops such as vegetables. Thus overall work load of women tends to increase with irrigation.

In case of ADITI kits, there certainly an increase in work load of the women, particularly those who did not participate in hired labour market. But in case of BK and DK, it is associated with greater participation and control on income by the women as well. In fact, what seems to happen is that the men folk view the BK or DK kits and crops grown

with their assistance as a benign addition to their overall cropping activity and tend to look at women who engage in them patronizingly. This allows the women control on the activity as well as on the income there from. It can not be denied that the impact of pepsi drip and CS is in the shape of increased labour participation from women. To what extent it is matched by an increased control of women on resultant incomes is not clear.

9.3 Nutrition Effect

Since all the ADITI kits are used mainly for cultivation of fruit and vegetables, and since it can be presumed that at least some of the produce is consumed at home when none earlier was, effect of ADITI kits on nutrition is positive. The best nutrition effect is of BK. All the thirty seven users of BK reported increased consumption of vegetables grown with the help of the BK. The quantities wee estimated variously between 30 and 60 kilograms. The degree of imprecision in the quantity comes because people pluck the vegetables when they needed. This effect would appear to be promising. Naturally, the effect in terms of increased absorption of vitamins or minerals through vegetables would depend on the choice in regard to product mix. The effect is so clear that one may wish to influence the implementers of MCH programmes to include the BK as a part of their schemes for growing iron rich vegetables and fruit in the kitchen garden of the poor households.

10. HOW EFFECTIVE IS THE IDE MODEL FOR MARKETING OF ADITI KITS?

10.1 IDE (India) started full-fledged marketing of ADITI products about one year ago with a staff strength of five in Maharashtra, none in MP and four in Gujarat. By now over 7000 ADITI kits (including all types) have been sold and installed. See Table Mkt1 below for details. These results indicate a high degree of effectiveness of marketing. Yet several issues remain to be answered. These are discussed below:

Table Mkt1

Sales of Various ADITI Products

	For the period October 2001 to September 2002		
Type of kit	**Gujrat**	**Maharashtra**	**Total**
Bucket Kit	1896	217	2113

Drum Kit	325	120	445
Micro Sprinkler	38	12	50
Customised Kit	256	3786	4042
Pepsi	0	550	550
Total	**2515**	**4685**	**7200**

10.2 Whose kit is it any way?

IDE India promotes ADITI kits with the explicit objective of taking the water conserving and controlling technologies to small-holders for them to raise their incomes. IDE India itself has no commercial interest in the volume of sales. That is why IDE promotes private service providers who design the necessary system, procure necessary components for them and install them at the buyer's farm. IDE India also attempts to ensure that adequate quantities of components are available and for that a functioning supply chain is in place. Finally IDE India regulates prices and monitors quality of the kits finally delivered to the farmers. The buyer is expected to meet full cost of the kit so delivered to him and the service providers are expected to find adequate incentive in the transaction.

In most ordinary circumstances, the marketer himself seeks commercial incentives by staking a claim to the residual profit. He may "outsource" manufacture as one sees in drug industry. Distribution function is routinely outsourced in most industries. There is a small trend of outsourcing movement of stocks of components down the supply chain as well (this is the new system of third party logistics popular for instance in automobile line). Each service provider for the outsourced services is rewarded based on volumes and other related parameters. Yet, despite such outsourcing, the residual claim rests with the central marketer.

In the case of ADITI kits, no one seems to stake a claim to the residual profits. IDE India would like the manufacturers or the supply chain members to assume full responsibility for the products once it has demonstrated that the market exists for this category of products. Each of the supply chain members believes it is working for IDE. The costs of IDE India staff (six each in Gujarat and Maharashtra) and the inevitable and substantial costs of promotion and marketing are currently being met by IDE India out of donor funds. At a rough guess these expenses may not be smaller than Rs. 25 lakhs for the two regions together, or some Rs. 350 per kit sold on an average. If and when some one other than IDE India assumes full responsibility for the marketing of these products, this expenditure will have to be recovered from the price of the product. It is not surprising that under the existing pricing conditions, no one really comes forward to assume full responsibility for marketing. The only instance where entirely private initiative is

working is the sale of pepsi drip in MP. There it is spreading through horizontal communication from farmer to farmer and not through a formal marketing effort.

Hence the questions whose kit is it any way and who shall "run with the ball" once IDE India has demonstrated the existence of market for the kits.

10.3 Promoting a technique or specific kits?

It appears instructive that once farmers learnt the basic principle of drip irrigation, their own imagination and creativity enabled them to contrive of the pepsi drip method. Thus it appears more important to promote the basic technique of drip irrigation rather than promoting specific kits. The existing kits can be used as illustrative products. That can bring down the costs substantially from the dizzy levels at which conventional drip systems are sold. This would basically mean that the staff needs to provide information as well as psychological space for use of alternate designs, alternate components and alternate concepts to farmers.

It appears to me that with increasing difficulty in state finances, the era of subsidy on drip systems is fast disappearing and competitors would have to develop products that are much cheaper. Simultaneously, increasing water shortages are going to make the relevance of drip more and more salient. In fact it may be important for IDE India to work with one or two entities that currently appear to be competitors. I feel that it is vital to include a component of on-farm water harvesting in the promotion campaign. It is important to combine on farm water harvesting with use of such harvested water through drip techniques for growing crops in all drought prone or even other monsoon dependent rain-fed regions.

The teams may thinking about these issues in a manner consistent with the commitments on reaching out to a target number under the donor agreements.

10.4 Role of NGO: How effective are they as channels of marketing?

IDE India effectively partnered with NGO when the ADITI products were being developed and tried out in the field. In the process it developed good working relationship with dozens of NGO in the states. It was thus natural for the initial marketing efforts now to start with NGO. It is clear that only a few NGO have now been taken as channel partners, but it is also apparent that at least in Gujarat, significant sales have occurred through the intermediation of NGOs. The question is how effective is the choice of NGO as a partner in the marketing efforts.

Paragraph 10.2 brings out clearly the fact that there is an element of subsidy (or an un-recovered market development cost) even with current pricing. NGO have a way of some how assuring the eventual buyers that they are getting a good deal. In fact the word "beneficiary" is a typical NGO coinage and IDE India is trying hard to move from

it to customers. NGO partners may pay full cost to the channel partner on IDE India's insistence. Yet while bulking the demand and making all payments together, NGO may use some of their "scheme" monies for purchase of the kits. Most BK sales in Gujarat seem to have occurred with some subsidy from the participating NGO. The subsidy sales cause a problem in the sense that any one who learns about them wishes to buy only on subsidy, and what is much worse is willing to wait till he gets on subsidy, even though he might lose possible extra income in the waiting period. The second danger of NGOs as major marketing partners or intermediaries is that they may tend to show distribution as the same as installation. This kind of a phenomenon was noticed when I traveled in Kutch last year. The third problem often is that NGO monies themselves come from donors and many donors are soft targets for "flavour of the month" kind of items. Hence if a new promising gadget catches the fancy of the donor, then all the NGO attention is likely to be shifted to the new item and there would be a big hole in marketing efforts and volumes for IDE India.

11. SUMMARY AND CONCLUSIONS

a. This study is based on a survey of 107 ADITI kit users. Fifty four of them were chosen from Gujarat, 30 from Maharashtra and 23 from MP. Of the 107, 37 were BK users, 18 were DK users, 29 were CS users and the balance were users of either micro-tube or pepsi type drip systems for growing pre-monsoon cotton.

b. Most of the users were seen to be small or marginal holders from drought prone and dry regions in the country. Only 10 of the 107 farmers surveyed owned more than 10 acres of land. The systems do seem to appeal to the small holder for whom they are designed. Average land holding of a bucket kit user was 2.59 acres. Average land holding of a drum kit user was 3.6 acres. Average land holding of a customised system was 10.4 acres. Average landholding of pepsi and micro-tube system users was higher.

c. However not all the ADITI kit owners can be described as poor in the Indian context, though almost all of them would be poor by the international definition of poverty.

d. NGO are the sources of information and knowledge about the BK and DK. Further, they also seem to be the most important conduit for the hardware of these systems. CS and pepsi systems are bought mainly through market players with little NGO role. Information seems to be flowing rapidly horizontally and IDE India has to now keep pace with the spread of the innovation by ensuring availability of materials. The role played by private marketers of drip systems (Jain, Premier) in creating awareness of the drip concept can not be underplayed and that awareness is helping CS sale.

e. While the supply chain members selling the products receive prices in the range at which the products have been priced, the role of subsidies in case of BK and DK is not yet insignificant. CS and pepsi sales can be said to be quite without any overt subsidy. The pricing issue however will be commented below again.

f. Ninety seven of the 107 kits seen were in working condition. Most were seen by the surveyors themselves.

g. This degree of reliability is amazing given the age distribution of the kits. Almost half the systems are of 2000 vintage.

h. Barring pepsi and micro-tube based drip systems in MP, all other systems were used to grow vegetables or fruit. CS were more commonly used for fruit, BK almost exclusively for vegetables.

i. Proportion of the extra produce obtained by using ADITI kits that was marketed rises rapidly from BK to pepsi drip. All BK users use quite a bit of the produce at home, all the pepsi drip users fully sell the produce.

j. Income effect of the kits are salutary. Incremental income generated are in the range of Rs. 250-300 per BK, Rs. 700-1000 per DK, Rs. 3000-5000 per CS and Rs. 7000 per acre where pepsi drip is used.

k. Cost benefit analysis shows that the BK has an IRR of 49%, DK of 39% and CS of 64% after considering opportunity cost of land and labour. There is clear evidence of their economic benefit.

l. An important benefit of the BK is its very salutary impact on nutrition whereby every user family has improved its consumption of vegetables by over 30 kg per year. In case of DK this effect can perhaps be larger.

m. Current pricing of the products leaves little or no margin to make up the market development costs that are being currently met out by IDE India through donor funds. To what extent will this interfere with the eventual sustainability of the market is a moot question.