Income and Equity Effects of Income and Equity in water Use in Vidarbha

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Abstract: We find from the analysis of our primary survey that spatial and social inequities are strong in access to irrigation in Vidarbha. Access to irrigation is loaded against low castes, and particularly the SC/ST. We also discover that as expected, irrigation has salutary effect on income. The main effect is in the form of income stabilisation rather than income growth. The effect of increasing income is varied across districts in Vidarbha. Certainty of water delivery seems to be a major factor that governs the extent of income increase in irrigated farms. Other factors deal with choice of crops, particularly crops that substitute cotton. Cotton some how seems to act as a negative intervening variable. Exploring the relationship between cotton and irrigation, exploring the reasons for weak demand for irrigation and exploring why surface water correlates poorly with income are three possible research areas that need to be followed up.

I. Introduction and Research Questions

1.1 Agro-climatic background of Vidarbha

As per the 1991 Census Over 17 million people live in some 13300 villages and nearly 100 small and big towns in Vidarbha, covering a total of 94400 sq km at a population density of 184 persons per sq km. Thirty four percent of these people belong to the SC/ST. The average Sex Ratio is 957 women per thousand men and 17.4% of the population was reported to be under 6 years of age. Forty four percent of the population is classified as "main workers" and of these, 80% are workers on farm (including farmers and labourers.). Of the 92000 sq km of the geographical area, nearly 19000 sq km is classified under the category Forest Area. Net sown area extends over 46000 sq km or about 4.5 million Ha. Gross cropped area at 5.2 million indicates an average cropping intensity of 1.13. The bovine animal population is nearly 6 million at a density of 65 animals per square km. Of the 6 million bovines, 5.3 (88%) million are cattle, and of them cows account for 1.6 million (30%).

The soil type and rock formation varies as one moves from East to West in Vidarbha. In the Eastern districts Bhandara and Gadchiroli and to an extent parts of Nagpur and Chandrapur, lateritic soils cover gneisses, granite gneisses or schist underneath. There are pockets of deposits of alluvial soils around the river banks. Vainganga is the major river flowing through this region with Chulband and Wardha as its major tributaries. As one moves Westward, soil starts turning blackish. Trap soil (or alternately called Black cotton Soil-BCS) on top of basalt of the Deccan trap characterizes Western Vidarbha districts of Buldhana, Akola, Yavatmal and Amrawati. Sandstone formations occur in coal belt of Wardha and Kanhan valleys in Central Vidarbha regions covering parts of Nagpur and Chandrapur districts. Poorna, a tributary of Tapti is the major river of the Western Vidarbha. Painganga, a tributary of Vainganga forms the Southern Vidarbha.

As per the data as of 1997, of the 4.6 million gross cropped area, 600000 (13%)Ha is classified as irrigated area. Of the irrigated area, 360000 is classified as irrigated from surface sources and 240000 is irrigated from ground water sources. Of the 360000 Ha area irrigated from surface sources, 343000 Ha comes from the command of some 11900 minor irrigation schemes (at an average of 29 Ha per scheme). The total well density as assessed in Vidarbha is 4.3. There is a degree of imprecision in this data as the process of digging more wells has been on ever since. 281000 wells are classified as irrigation wells and 117000 as "other wells", though both types are used for both agricultural and non-agricultural purposes to a varying extent. Nearly 203000 pumps, over 95% of them electric pumps, are installed at an average of about one pump for every two wells. Naturally, some pumps are "mobile". Usual pump ratings are 3 or 5 HP. The phenomenon of deep tube wells fitted with submersible pumps is relatively uncommon for agricultural purpose in Vidarbha. It occurs mainly in more commercially developed areas as shall be presented below.

The area (in 000 Ha.) under various kharif crops is shown below:

Cop	Paddy	Tur	Cotton	Sorghum	BAJRA	Soy-bean	Other pulses	Total
Area	696	362	1722	948	24	455	356	4564

Paddy area, some 15% of all kharif area, is in the Eastern districts and tehsils lying to the East of Nagpur. A minor portion of the area also lies in the hilly terrain of the Satpuras in Dharni and Chikhaldara tehsils of Amrawati. The main crop in kharif is cotton, taken on over 38% of the area, followed by sorghum (20%), paddy (15%), soyabean (10%),tur (pigeon-pea, some 8%) and other pulses. About two lakhs hectares each are sown with wheat and gram and about 1.4 lakhs hectares is under horticulture, including of course mandarin oranges for which the reason is well known. Sugarcane is cultivated in 18000 Ha. Possibly because of the presence of heavy black cotton soil in much of Vidarbha or possibly because of insufficient incentives, mechanisation level is poor with only 9350 tractors registered for the whole of Vidarbha at an average of 1 tractor for every 500 Ha of net sown area.

1.2 Research Issues

Access to irrigation is the source as well as the result of social inequality. Common observation reveals that in most places in the country, usually access to irrigation as well as fertile lands that respond very well to irrigation is biased in favour of high castes and more powerful segments of the rural society. The poor and the socially disadvantaged usually possess slopy uplands with inferior soil fertility and little access to water. And in turn irrigation tends to perpetuate this inequality. Further, the differential in household income and stability of that income as experienced by irrigated and unirrigated farm households is considered to be significant. This difference is all the sharper in regions considered to be drought prone where weather induced variations make the household incomes very risky. This paper attempts to answer the following questions:

- To what extent is the above true for Vidarbha?
- How do the income and equity effects of water use in agriculture vary across different districts of Vidarbha?
- What route does the income effect take?

II. Method of Study and Analysis

This paper is based on the research report titled "Status of Water Use in Agriculture in Vidarbha" submitted by the authors to IWMI in Sep. 2002. The method of research is thus embedded in the research reported there. The method of study entailed:

Analysis of secondary data obtained from the Primary Census Abstracts (PCA) as well as the District Statistical Handbooks (DSH) of the various districts. Based on the analysis of cropping patterns, 106 talukas of the 113 for which data was available were categorised in categories. The first class of talukas lying in the Eastern part of Vidarbha mainly grew paddy in Kharif season. The second class mainly grew cotton in kharif. The third category showed diversified cropping pattern. We selected ten villages from each category of talukas. The villages were selected using a non-purposive sampling method using the Village directory in the PCA as the sampling frame. Within each village, between ten and fifteen farmers were interviewed. These farmers were selected non-purposively. This survey was done during April-June 2002. Four investigators hired specifically for the purpose conducted the survey. These investigators were fluent in Marathi and came from farmers' families or at least had some exposure to agriculture. The survey was supervised by Shri Sachin Mardikar. It covered 27 villages in 10 districts and reached out to a total of 375 farmer households.

Village profiles were developed using data gathered through focused groups discussions. Individual farmers were then interviewed at length for the data pertaining to water use etc. The Schedules of Questions used are given in Appendix 1 and II.

The village level information sought and obtained pertained to village location, amenities, population, land use and water use for drinking as well as agriculture purpose.

Household information sought and obtained was about the demographic, socio-economic and occupational features and had in addition specific questions about sourcing and using water for agriculture. For a variety of reasons pertaining to quality of investigation and supervision, useful and useable information was obtained from 322 households and about 19 villages.

III. Data Analysis

3.1 Data Presentation:

The data given in Table Village1 sums up the information about the villages surveyed. Tables HH1 through HH7 sum up the most significant information obtained through this survey pertaining to the households. Information that is of definite interest but does not warrant presentation in a table format is discussed in the same section below the Tables.

(i) We divided the number of villages for which complete data was available in two groups: those that had irrigated area below the sample average and those which had above. The comparison of the villages on various attributes, shown in Table Village 1 below reveals that irrigated villages tend to be much larger in terms of population but smaller in terms of arable land, have their own gram panchayat, have more amenities, and tend to grow more paddy and much less cotton. It is to be noted that we are basically describing the situation and not imputing causality. This pattern perhaps emerges because the number of villages with irrigation is larger in the more thickly populated Eastern tract of Vidarbha.

Table Village-1-

Relevant Attributes about Villages studied

SN	Attribute	Villages with lower level of irrigation (n=9)	Villages with higher level of irrigation (n=10)	Remarks
1	Average distance from Tehsil	15.4 kms	13.2 kms	
2	#villages with credit co-op or bank branch	1	5	
3	# villages with Panchayat drinking water scheme	7	10	
4	#villages with own gram panchayat	5	6	
5	Average number of HH	132	286	
6	Average village population	665	1290	
7	Average SC/ST pop in %	26	32	
8	Average arable area (acres)	931	520	
11	**Average irrigated area as % of arable area**	**2%**	**63%**	
12	Average animal population	413	200	
13	Average % of buffaloes in the above	21	22	
14	# villages on river/streams	4	6	
16	% arable land under cotton	53	14	
17	%arable land under paddy	11	95	

(ii) The household sample in the survey covered 321 Households of whom 127 did not have access to any irrigation at all. One hundred and eighty six of them were cotton growers. As can be seen, almost hundred percent farmers in Akola, Amrawati, Wardha and Buldhana districts are cotton growers. The same is true of Washim and Yeotmal (not shown here.) Cotton dependence of the Western and Central Vidarbha is clearly demonstrated. See Table HH1.

Table HH1

Sample Characterization

SN	District	Number surveyed	Without access to water	Cotton growers
1	Akola	42	29	42
2	Amrawati	48	8	45
3	Buldhana	15	7	15
4	Bhandara	20	9	0
5	Chandrapur	48	22	26
6	Gondia	15	1	0
7	Gadchiroli	23	0	0
8	Nagpur	53	25	2
9	Wardha	57	26	57
	Total	321	127	186

(iii) We divided the farmers into three categories based on their caste. We included the dominant tilling and workmen castes such as kunbi, teli, kalar etc in High caste. SC/ST etc were included in "Low" caste. This division is provisional and based on our judgment. The total sample of 314 for whom caste information was available had 175

(55%) persons from "High" caste, 51 (16%) belonged to "Medium" castes and 88 (29%) belonged to Low castes. Access to irrigation does seem to be biased against low castes, with 21% of them having access. The bias in access to irrigation is loaded particularly heavily against low castes in the cotton tract. See Table HH2.

Table HH2

Access to Irrigation across Caste groupings

SN	District	Farmers with no irrigation				Farmers with Irrigation			
		Total	High	Med	Low	Total	High	Med	Low
1	Akola	25	13	3	9	15	3	10	2
2	Amrawati	39	27	3	9	9	8	1	-
3	Buldhana	8	7	-	1	7	4	-	3
4	Bhandara	11	5	-	6	10	5	-	5
5	Chandrapur	24	5	7	12	23	13	2	8
6	Gondia	15	7	2	6	2	1	-	1
7	Gadchiroli	23	9	1	13	-	-	-	-
8	Nagpur	23	18	4	1	27	16	6	5
9	Wardha	28	18	4	6	25	16	8	1
	Total	196	109	24	63	118	66	27	25

(iv) We tried to understand how much land of farmers claiming access to irrigation was in fact irrigated and how did this vary across size of the irrigated farms. It appears that the smaller irrigated farms are more completely serviced by the irrigation facility at the command of the farmers. Proportion of irrigated area in total landholding falls almost uniformly, to reach a level of 52% for irrigated farmers with more than 20 acres land. This appears to be a result of the fact that bulk of the irrigation is based on open dug wells.

Table HH3 :

Extent of Irrigation by landholding classes for Irrigated farmers-All districts

SN	Landholding	Mean Proportion of irrigated Area in total landholding	Number of irrigated farmers
1	0-2.5 acres	98%	36
2	2.5-5 acres	87%	67
3	5-7.5	85%	23
4	7.5-10 acres	70%	37
5	10- 20 acres	70%	30
6	Above 20 acres	52%	7

(v) We have tried to assess the extent to which different sources of irrigation are used in Vidarbha. Wells (89, or 46%) form the most important source of irrigation. The second place (28%) is taken by flow sources such as river, nullah and canals. The third place is taken by "multiple sources". Tanks and ponds are used only in the Eastern tract. Finally, there seem to be very few tube or bore wells, (2.5%) and mostly in the orange belt of the region.

Agricultural income per capita is expectedly high for irrigated farmers in most Districts except Gondia. We need to find the reasons about Gondia. The per acre income in irrigated farms is higher by 30-100% and the higher income effect is seen in Amrawati and Chandrapur districts. See Table HH4.

Table HH4 :

Source of Irrigation for Irrigated Farmers

SN	District	Source as reported by Farmers with Access To irrigation					Average Agricultural Income Rupees Per Acre	
		Wells	Tube/bore wells	Canal/river/nullah	Tanks	Multiple	Irrigated	Dryland
1	Akola	-	-	-	-	13	6999	5315
2	Amrawati	33	-	8	-	-	6966	4160
3	Buldhana	4	-	4			6147	4033
4	Bhandara	6	-		3	2	5329	3820
5	Chandrapur	4	-	11	3	8	8639	4151
6	Gondia	5	-	3	6		6890	8562
7	Gadchiroli	11	-	-	-	12	5803	NIS
8	Nagpur	3	5	21	-	3, incl in Canal	7389	5469
9	Wardha	23	-	8	-	-	7305	4067
	Total	89	5	55	12	38		

(vi) As expected, credit off-take per acre is higher in irrigated farms in irrigated farms. The difference is 25%. The credit off-take is 40-50% of agricultural income per acre for irrigated farms and a whooping 70-80% for dry farms. This would perhaps be caused by credit intensity of cotton. The distribution of credit across seasons seems to be the same for both the categories.

Table HH5 :

Credit Absorption

SN	Item	Farmers with Access to Irrigation n = 194	Rain-fed Farmers N = 127
1	Average land holding (acres)	7.62	6.37
2	Average credit absorption per acre of land (Rupees)	3960	3293
3	Proportion of credit need for summer and kharif months (April-Sep)	67%	67%
4	Proportion of credit need during winter/rabi months (Oct-March)	33%	33%

(vii) Interestingly, land-man ratio for irrigated farms is higher than for dry farms for all districts except Akola. Clearly, it is the better off farmers who have taken to irrigation. Spatial scatter of farms does not seem to be high in Vidarbha. See Table HH6

Table HH 6 :

Land pressure and scatter

SN	District	Rain fed Farmers		Irrigated Farmers	
		Average Land-man ratio (acres per person)	Average # plots	Average Land-man ratio (acres per person)	Average #plots
1	Akola	1.88	1.48	0.83	1.21
2	Amrawati	1.19	1.12	2.21	1.70
3	Buldhana	0.86	1.14	1.73	1.49
4	Bhandara	0.51	1.55	1.39	2.2
5	Chandrapur	1.17	1	0.78	1.42
6	Gondia	0.2	1	0.77	1.5
7	Gadchiroli	Not in sample	Not in sample	0.76	1.39
8	Nagpur	1.39	1.25	1.62	1.33
9	Wardha	1.54	1.15	2.07	1.31

(viii) Total per capita income is higher for irrigated farmers in all districts except Akola. Here this seems to have happened because of much higher land-man ratio for dry land farmers in the sample. At times, the effect on per cap income is dramatic. Agricultural income contributes a higher percentage to total income of irrigated farms than of dry farms. Irrigation does not seem to offer much stabilising effect to irrigated farms if one looks at the income variation figures. Finally, as expected, wage income is a much higher component of total income of dry farms than of irrigated farms.

Table HH7 :

Irrigation and Household Income

SN	District	Rain-fed Farmers				Farmers with Access To irrigation			
		Percap income (Rs/yr)	Contr. Of ag income in total income	Variat -ion in Incom e in %	Contrib ution of wage in income	Percap income (Rs/yr)	Contr. Of ag income in total income	Variat -ion in Incom e in %	Contri bution of wage in income
1	Akola	12671	79	26	6	6798	69	56	10
2	Amrawati	5890	61	13	22	17368	78	54	2.8
3	Buldhana	9915	64	32	11	13194	73	42	5
4	Bhandara	3756	54	30	11	8656	83	16	4
5	Chandrapur	6626	68	16	16	8285	89	22	13
6	Gondia	4250	35	10	neg	6046	81	27	neg
7	Gadchiroli	Nis	nis	Nis	Nis	6623	60	21	25
8	Nagpur	10477	67	19	12	12693	81	15	5
9	Wardha	10653	72	24	7	20434	82	18	1

Nis: not seen in the sample

3.4 Qualitative Data

(ix) Water Markets: Water markets do no seem to have come up significantly in Vidarbha. The only people who have responded that they obtain water for irrigation from other sources and on payment are those who take water from public sources such as canals or co-operative lift irrigation societies. Farmer to farmer water transactions seem to be infrequent. While they are not entirely unheard of, no instance of such transactions has been reported in the sample in the survey. Two types of water market transactions that have been reported in our other formal or informal discussion with farmers. The first type is charging money for a whole "irrigation" for a crop, that is for supplying water that would normally be done for giving one round of flow irrigation, (about 1 inch of water). This seems to be charged at around Rs. 300 per irrigation, and depending upon the distance of the farm to which water is carried and the pump size, would take up to 5 hours. The second type of transaction, usually implicit agreements and often between members of the same extended family is about share of crop, usually going up to a third of the crop. The uncertain accessibility and availability of water in the dug wells seems to be the main cause for weak water markets.

(x) Water application: Flow irrigation is the predominant method of water application in Vidarbha. Drip or other type if application methods are few and far between. This is revealed by the survey. Virtually no one in the sample uses other methods. Water is carried up to the farms by means of pipes but distribution within farms is

Income effects would in general be neutralized by some of the following factors:

- Farmers are growing crops that are not responsive to irrigation at all or do not permit cultivation of a second crop,
- Thee are significant uncertainties in actual delivery of water to the farms.

In the cross-sectional analysis at taluka level, we find that income effects of surface irrigation are negative in Vidarbha. (Phansalkar, op cit, page 8) This means perhaps that the later two factors mentioned above overshadow the former salutary effects to occur. The same analysis also reveals that there is a strong positive link between ground water irrigation and per capita income. At the micro level analysis as done in Tables above, we find that in seven of the nine Districts we studies, irrigation is associated with higher per cap income. This has not been seen in the households surveyed in Akola perhaps because they were classified as irrigate households as their lands were in command of some minor irrigation schemes but it did not deliver water. But in every district, the income stabilisation effect can be seen. (see Table HH7)

4.3 What route does the income effect take?

We have discussed the possible routes for income effect to come into play. As is known, cotton is the dominant crop of Vidarbha. It appears to us that the income effect seems to be subdued partly because of this fact. Since cotton is cultivated during June-January and since temperatures rise beyond forty degrees from early March on in some parts of the region, second crop after cotton is not grown at all. Hence the income effect can occur only through two routes: farmers substitute cotton with some other crops or farmers grow cotton with irrigation so as to increase income. This later possibility exists and in our survey we did find farmers growing cotton with one or two supportive irrigation post October, but the associated rise in income is uncertain since pest is the main aletory variable for cotton. Further one may note that absence of crop diversification and inclusion of significantly high income yielding crops in their portfolio is perhaps why the water markets in Vidarbha are at such a subdued level.

V. Inferences and Issues for Further Probing

We find from the analysis of our primary survey that spatial and social inequities are strong in access to irrigation in Vidarbha. Access to irrigation is loaded against low castes, and particularly the SC/ST. We also discover that as expected, irrigation has salutary effect on income. The main effect is in the form of income stabilisation rather than income growth. The effect of increasing income is varied across districts in Vidarbha. Certainty of water delivery seems to be a major factor that governs the extent of income increase in irrigated farms. Other factors deal with choice of crops, particularly crops that substitute cotton. Cotton some how seems to act as a negative intervening variable.

We believe that the nexus of cotton and irrigation needs to be fully explored. If irrigation opens up a window of opportunity for poor farmers to expand their incomes but if cotton crop discourages them from taking to irrigation or taking full advantage of irrigation, then the situation needs to be studied to identify steps that would encourage people to improve their lot by using water. This is all the more important in a region where ground water is so singularly underutilized.

Another issue that needs to be looked at is whether and if why the demand for irrigation is weak. Our initial discussion brings out uncertainty in accessing ground water, cost of accessing ground water and cost of extracting it as three discouraging factors. It is to be noted that these factors operate equally if not more strongly in regions that have nearly completely exhausted their water resources. Why is Vidarbha then showing poor development of ground water?

Finally, we would suggest that it is important to investigate whether the negative or weak relationship between surface irrigation holds out in all the canal commands and to understand the reasons for that to happen.

Appendix I : Village Level Information

Village Name			
Tehsil/Taluka/CD Block			
District			
Village Infrastructure			
Distance from Tehsil (Kms.)		Communications-Post Office/STD (Y/N)	
Distance from Dist. HQ (Kms.)		Railway/Bus Station (Y/N)	
Internal Village Roads (Type and Kms.)		PHC (Y/N)	
Drainage System for HHs		Police Station (Y/N)	
Drinking Water Source (DW/BW/PWS)	DW- BW- PWS-	Gram Panchayat (Y/N)	
Bank		School (Y/N)	
Cooperatives – Agri.		Samaj Mandir/Community Place (Y/N)	
Cooperatives – Credit			
APMC			
Village Market Day			

No. of Households				
Total Population	Total	Male	Female	
Caste wise population breakup	SC	ST		
Other major castes and # Households				
Total Village Land (Hectares)				
Of which	Common Land	Irrigated	Unirrigated	
	Cult. Waste	Forest Land		
Total Farm Land (Irr. + Unirr. + Cult. Waste)				
Total "E" Class Land				
No. of Hand pumps				
No. of Wells within village				
No. of Wells on village farms				
No. of pumps	Elec. Motor		Oil Engine	
No. of cattle	Cows	Bullocks	Buffalo's	SheGoat
Water Resources				
No. of Streams flowing through the village				
Months till which water flows in them				

Distance of Stream (at entry) from its origin (Specify Stream Type, F-First Order, S-Second Order, M-Matured)				
Minor Irrigation Structures in the village. Y.N, Please specify type (PT-Percolation Tank, MT-Malguzari Tank, VT-Village Tank)				
Type of water harvesting structure				
If yes, please specify type and numbers	CEPO	KT Bund	Earthen bund	Cement plug
Difference in Elevation	Maximum			
	Minimum			

List of Seasonal Crops by order of acreage								
Kharif			Rabi			Summer		
Crop	Acreage	%	Crop	Acreage	%	Crop	Acreage	%

Perennial Crops taken in the Village	Acreage	%
1.		
2.		
3.		
4.		
5.		

Draw a rough sketch of the village showing broadly the ridge, the catchment and water harvest zones and the land ownership by communities.

Appendix II : Household Survey

Name of the Head of the Household							
Name of the person interviewed (relationship)							
No. of members in the HH		0-6	7-14	15-25	26-40	40-60	Above 60
Males							
Females							
Total							
Caste (ask only if it is not obvious from the name)							
BPL Card Holder (Y/N)							
Land holding of the family (Acres)-							
Land acquisition through		Year acquired	Area (Acre)	Soil Type	Irrigated /Non Irrigated	Source	
Inheritance							
Purchased							
Govt. Scheme							
Encroachment							
Leased							
Others- Batai							
Contd.							
		Slope	Main Crop	Crop Yield (00 Kg/Acre)			
Inheritance							
Purchase							
Govt. Scheme							
Encroachment							
Leased							
Others- Batai							

Ask only For the best plot:							
Crop	Acerage	Seed Rate (Qty/Acre)	Seed Source	Pesticides	Fert. Type (O/C)		
Level of use of inputs (No. of times)							
Tillage	Farm Yard Manure	Irrigation	Weeding	Fertilizer	Pesticides		

Credit Needs Assessment				
	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar
Purpose (Seed-1, Fert.-2, Pesticide-3, Labour-4, Medical-5, Personal-6, Education-7, Social Obligations-8,				
Source(Money Lender-1, Bank-2, Society-3, Neighbor-4, Supplier-5, SHG-6				
Amount				
Collateral (None-1, Gold etc.-2, Land-3, Utensils etc.-4, 3rd Party Guarantee-5,				
Interest Rate				
Agreed Repayment by				

Water resource Availability	own or not	Source	Distance traveled	Availability Months	Mechanism for drawing water
Drinking					
Agriculture					

This section has to be filled only if the respondent mentions more than one source for above

	Distance traveled	Availability Months	Water Table position in (Ft.)				Mechanism for drawing water
			Jun	Sep	Dec	Mar	
Drinking							
Source 1 -							
Source 2 -							
Source 3 -							
Agriculture							
Source 1 -							
Source 2 -							
Source 3 -							

Mechanism for drawing water for Drinking Purpose (HP-Hand Pump, EP-Electric Pump, DP-Diesel Pump, O-Others pls. mention)

Water Management in Farm					
Main Crops taken	1.	2.	3.	4.	5.
Area under cultivation					
No. of plots					
Size of largest plot					
Channels up to the farm (Lined/Unlined)					
How is water distributed					
Size of Sub plot					
Area Irrigated – Own					
No. of Irrigation's given					
No. of Hrs. per irrigation					
Method of Irrigation (F-Flood, D-Drip, S-Sprinkler, O-Others, specify)					
Rationale for choosing or not choosing a particular method (use separate page if needed)					

Impact of Water Availability on Cropping Pattern				
Has there been any change in the cropping pattern over the years?	Y/N		Year of Change	
Earlier (before water came)				
Now				
Has there been a change in the method of irrigation? Y/N				
Source of change				
Year of change				
Description				
Main reasons for adopting the change				
What was the total investment/financial outlay involved?(Rs.)				
What was your contribution? (Rs.)				
What benefits did you anticipate?	More Income	Addl. Output		
Were the benefits in accordance with your expectations? Y/N				
Reasons for variation				

1. Water Markets

2. Do you have to depend on water supplied by some one else for irrigatioon?

3. Describe the arrangement covering

4. Source of water

5. Water extraction mechanism

6. Method of charging: Rs./hour or Rs per day/share of the crop or fixed charge +diesel or any other

7. What is the actual value of the charge?

8. Are there any other services/expectations?

9. When is the charge payable?

10. Is the supplier related to you?

11. Is the supplier a Co-operative or a Government/Panchayat Scheme?

12. Is the supplier obliged to give water when you want?

13. Do you always get water when you want?

14. If you have own source of irrigation

15. Rating of the motor/Diesel pump

16. Electricity charge payable

17. How much water do you have? Enough for own use/less/more

18. Do you give water to neighbouring farmer?

19. Method of charging: Rs./hour or Rs per day/share of the crop or fixed charge +diesel or any other

20. What is the actual value of the charge?

21. Are there any other services/expectations?

22. When is the charge payable?

23. Is the buyer related to you?

24. Are you obliged to give water when he wants?

25. Do you always get water when you want?

26. If you do not have a any well or a reliable well

27. Have you tried digging/deepening one?

28. At what level do you expect to get good supply of water?

29. What investment in digging the well do you anticipate?

30. What is the reason you are not digging?

    - Can not afford
    - Too risky
    - No loans
    - Past effort failed
    - Crop does not need
    - Have you ever tried to assess ground water level in your farm?
    - From whom?

31. For all cotton Growers

32. Do you believe cotton crop does not need watering?

33. Have you given water to cotton before? If yes, what impact did it make on the yield?

34. Have you seen any one giving water to cotton? If yes, what impact did it make on the yield?

35. If you think it does need, at what stage?

36. How many watering does cotton need?

37. If you had a reliable source of water what crop would you grow instead of cotton?

38. Do you grow cotton because you do not.