Understanding underdevelopment: Characterizing Regional development in Vidarbha With special focus on water use

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Abstract: *Vidarbha comprises of the eleven districts at the Eastern end of Maharashtra state. The region is underdeveloped in absolute and relative sense. This has often led to a strongly held perception of deliberate state neglect in the minds of people in Vidarbha. An attempt is made here to look at relative development of talukas within Vidarbha. We find that there is significant variation in per capita incomes across talukas in Vidarbha. This variation is associated with the differences in the nature and composition of the talukas, the crop mix obtaining in the taluka and most importantly on the extent of ground water use. Surface water use seems to have less influence on the income variations. While abundant unused ground water potential exists in some of the most backward talukas, their exploitation seems to be discouraged by a combination of both supply and demand factors. On the supply side, it is possible to argue that ground water exploitation is both uncertain and expensive. On the demand side, the associated factors are a weak demand for irrigation caused by a dominance of cotton cultivation that has been sustained all these years by artificial props of the monopoly cotton scheme, absence of understanding or skills for cultivation of alternate crops and possibly also a weak drive among the people.*

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1. Introduction:

This paper is based on the work done by author in the research project on "Water Use in Agriculture in Vidarbha" under the IWMI-SRTT research programme. A Report titled "WATER USE IN AGRICULTURE IN VIDARBHA: A STATUS REPORT" was submitted to IWMI in September 2002. This paper draws heavily from that report.

Vidarbha region, comprises now of eleven Districts lying towards the Eastern end of the state. The region claims to be significantly underdeveloped when compared to the rest of the Maharashtra state. To an extent this claim is valid. CMIE had evolved a comprehensive development index that included and combined a range of development parameters. On the scale in which all India average development was scored at 100, Maharashtra was scored at 164, and as can be seen from the Table 1, with the exception of Nagpur, all other districts of Vidarbha were uniformly rated below the level of 100. Thus not only are these districts backward in relation to other districts of the State, they are backward in relation to the country as a whole as well.

Table 1
Levels of Development in different districts of Vidarbha

SN	District	Relative Index of Development as per CMIE
1	Akola	65
2	Amrawati	74
3	Bhandara	73
4	Buldana	59
5	Chandrapur	72
6	Gadchiroli	64
7	Nagpur	109
8	Wardha	99
9	Yavatmal	64

Source: "Profiles of Districts", October 1993, CMIE, Mumbai, various pages.

Note: Circa 2001, Bhandara has been sub-divided into Bhandara and Gondia districts. Similarly, Akola has been sub-divided into Akola and Washim district. As such the current number of districts in Vidarbha is 11, (with no guarantee that this state of affairs will continue till the paper is published)!

There is a popular feeling in Vidarbha that this underdevelopment is a result of deliberate neglect on the part of the State Government and this has often led to the repeated demands for a separate Statehood for Vidarbha. The same Table above clearly brings out significant variations in levels of development *within* Vidarbha! Such differences can obviously and conveniently not be explained by facile attribution to a callous State This paper seeks to push this analysis one step further and attempts to analyse the following questions:

- Are there sharp differences in levels of development at the taluka level of desegregation in Vidarbha?
- What factors seem to be the most likely causes of differential level of development?
- In particular, how is access to and use of water associated with differential regional development?

The paper is based on use of secondary data collected from State government and Central Government sources. It uses in the main, two major data bases: the District Census Abstracts brought about by the Census Commissioner and the District Statistical Profiles that are brought out for official use by the directorate of Economics and Statistics, GoM. In addition to these two the study team has gathered detailed Status Reports on Minor and Medium Irrigation for all the districts of Vidarbha, but that data is not reported here. Gondia and Washim districts were formed very recently and such data bases are not available for them yet. Data is thus presented for nine districts. Data for a total of 106 tehsils of these nine districts has been collated.

II Background Information on Vidarbha

2.1 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. 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 94400 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 4.6 million Ha. Gross cropped area at 5.2 million indicters an average cropping intensity of 1.13. The bovine animal population is nearly 6 million heads at a density of 63 animals per square km. Of the 6 million bovines, 5.3 million (88%) 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 drains the Southern Vidarbha.

As of 1997, of the 4.6 million gross cropped area, 6 lakh (13%)Ha is classified as irrigated area. Of the irrigated area, 3.6 lakhs is classified as irrigated from surface sources and 2.4 lakhs Ha is irrigated from ground water sources. Of the 3.6 lakh Ha area irrigated from surface sources, 3.43 lakhs 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 per sq km. 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 under various kharif crops is shown below:

Crop	Paddy	Tur (pigeon pea)	Cotton	Jwari (Sorghum)	BAJRA	Soy-bean	Other pulses	Total
Area (000 Ha)	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.

In Rabi, 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.

2.2 Ground water Regime in Vidarbha

The soil and the rock formation of various tracts of Vidarbha have been noted above. The lateritic soil in the Eastern tract has primary porosity but very low permeability. Hence ground water based irrigation is difficult in that region as these wells simply do not get recharged once the water is pumped out. That region also has high annual rainfall ranging between 1300 to 1500 mm. A great deal of water runs off through the Vainganga-

Godavari system. There are also a large number (nearly 7000) of tanks locally called "malguzari tanks" in both Bhandara and Gadchiroli districts. Sandstone regions have generally abundant ground water. While there is significant unexplored ground water in the trap soil-basalt trap regions, the access would appear to be difficult and expensive. As a result, overall groundwater development (that is, annual drawl of water as a percentage of annual recharge) is low at about 15% in Vidarbha as a whole. In fact of the 537 micro-watersheds in Vidarbha, only 5 are classified as "Dark", another 7 as "Grey" while the rest are classified as white zones for the purpose of groundwater development. The details are shown in the box below.

Box 1

Abstract of groundwater assessment of Vidarbha

1.	Total No. of watersheds	– 537
2.	No. of white watersheds	– 525
3.	No. of grey watersheds	– 7
4.	No. of dark watersheds	– 5
	Net Annual Recharge in Ha-meters (Ham).	10,75,963
	Net Annual withdrawal in Ham.	1,65,581
	Net Annual balance in Ham.	9,10,381
	% of development	15.40 %

Source: GoM data

When carried out at the level of talukas, the analysis reveals that a large majority of talukas have ground water development of less than 30%. The picture at the taluka level is shown in the box below.

Box 2
Ground water development in Talukas of Vidarbha

SN	% Ground water development	#Talukas
1	less than 10%	47
2	between 10 and 30%	41
3	> thirty percent	13
4	total for which data is available	106
5	Talukas that are at risk	5

III Regional Development Issues

The purpose of regional analysis: As noted in Section 1, there is a strong popular tendency to attribute underdevelopment in Vidarbha to state neglect. Yet, as the Table given in Section 1 shows, there is large inter-district variation within Vidarbha. The question is, how is that variation to be explained. Flowing from this is the logical question, to what extent are the factors that cause differential development in Vidarbha a result of state action and to what extent are they a function of natural endowments and social ecology? Finally, it is important to explore what is the role played by access to and use of water in agriculture in shaping the equity or disparity in regional development. In Vidarbha.

We present the analysis in three stages. In the first stage, we to present a comparison between talukas differentiated on a surrogate for income. In the second stage, we attempt to rank talukas on a range of indices of development or other relevant attributes and try to see comparison between talukas put under different categories on these ranks. Finally, we present an overall picture of spatial correlates among different and relevant facets of development.

3.2 Income based comparisons: Using the estimates of areas under different crops, estimates of yields as given by the DSA and current prices, an effort was made to arrive at gross agricultural income per rural head. This estimate is far from being precise estimate of the total per capita income, since it excludes wage, non-farm income and other receipts. Yet at the chosen level of analysis it offers a reasonable surrogate for income levels of individuals in these talukas. Talukas that showed higher per capita income than the universe mean were compared with talukas that had lower income than the universe mean. The comparison is given in Table Income compare 1

Table Income compare 1

SN	Attribute	High percap income group (39 tehsils)	Low percap income group (67 tehsils)	T value of difference of means
1	Sex ratio	945	966	-2.6
2	Child ratio	16.7	17.8	-3.7
3	% of SC in total population	16	12	3.3
4	% of ST in total population	15	23	-2.3
5	Forest cover (as % of GA)	11.96	22	-2.59
6	Land used for agriculture	66	49	4.0
7	Cropping intensity	121	111	3.8
8	Land man ratio	0.38	0.30	2.8
9	Area per tractor	1084	2240	2.5
10	Pumps per well	0.58	0.59	Not sig
11	Gross value per Ha	14336	11338	2.95
12	**Gross value per capita**	**8697**	**4089**	**5.5**
13	Area under paddy as % of kharif area	14	32	-2.65
14	Area under tur as % of kharif area	10.2	5.34	4.49
15	Area under cotton as % of kharif area	29	31	Not sig
16	Area under horticulture as % of cropped area	6.0	1.6	4.03
17	Irrigated area	13.6	30	Not sig
18	Well density	7.17	4.1	2.85
19	% of surface irrigation in irrigated area	5.5	26.0	-1.9
20	Well ratio	2.0	4.39	-3.39
21	Ground water development	23	10	4.5

Sixty seven talukas showed income below the universe mean while thirty nine showed above the universe means. This Table provides the mean for the group of higher/lower income talukas and the "T" value of the difference between the means. The comparison is revealing and is presented under four heads.

3.2.1 Social and Demographic Differences (see rows 1-4)

The high income tehsils show lower sex ratio. This is in conformity of the overall Indian picture where the regions that are better developed economically show lower sex ratio. It is not clear as to why this should happen. Several possibilities offer themselves as explanations. Some of them are: better off regions attract more migrant male labour and hence sex ratio drops; better off districts are dominated with "sanskritising" middle and high castes that are strongly patriarchal and generally show bias against women etc. The higher income talukas show lower child ratio. Child ratio is the proportion of children below the age of 6 years of age in the total population. Smaller the child ratio, the closer

one may say the population to demographic steady state. While the ratios are better than some of the worst offending districts in India (such as Bastar or Dangs) where this ratio can go to as high as 30%, the fact does remain that the higher income talukas are also more demographically developed.

The higher income talukas also show greater population of SC and smaller population of ST. There is no causality what so ever between these two sets of data but the association is interesting for the following reasons. The problems of social infirmities caused by disparities in a community that has greater proportion of SC population relate much more to bonded labour, landless-ness and social exploitation. In fact, a preliminary analysis of landholding pattern in these talukas indicates significant inequality in land holding and presence of a large class of "agricultural labourers" as opposed to farmers in the working population. On the other hand the problems of tribal population relate more strongly to incomplete integration in the mainstream, poor access to amenities and poor income and nutrition. Together, this association indicates essentially that the higher income talukas are essentially "mainland" type of talukas and not the forest-and-hills kind of tribal dominated talukas. This also reinforces the greater association of tribals with poverty.

3.2.2 Intensity of Resource Use (see rows 5-10)

The above Table shows that the higher income talukas have smaller forest cover, greater land use for agriculture, higher cropping intensity and, surprisingly higher (cultivated) land man ratio. Forest cover is the proportion of forestland in total geographic area. While this is usually smaller than area actually covered by forests, it does indicate the land that is in the control of Forest Department. In Vidarbha (and unlike Western Maharashtra), there is a major hiatus connected with "zudupi jungle" (the translation is scrub forest but this refers to village forestlands) which has also got covered under the Forest Conservation Act. Popular argument has it that this makes the development tasks more difficult since the Forest Cover as well as zudupi jungle areas would together account for a lot of land which can not be touched for executing development projects of any kind. Clearly, the lower income talukas are at a disadvantage in this regard.

Land used for agriculture represents the proportion of Net sown Area (NSA) in Geographic Area (GA). As can be seen, the higher income talukas use the land resource more completely than the low income talukas. Cropping intensity in high income talukas is also substantially higher, though quite modest on an absolute scale. On the whole, the high-income talukas use their natural endowments more intensively. We shall also see the same inference while talking about ground water resource.

Surprisingly, the cultivated land man ratio, that is the amount of land in hectares per head of rural population is higher in talukas having more incomes. This happens, one suspects, because the low income talukas have much smaller land use and populations densities do not differ significantly! Thus, not only do the high income talukas use land resources more completely, there is more resource per head too.

3.2.3 Crops (see rows 13-16)

High income talukas show much lower area under paddy, about the same area under cotton and higher area under tur (pigeon-pea) and horticultural crops (banana, orange). A causality is implicit here. Paddy grown in Vidarbha is largely rainfed. Thus this paddy

cultivation is more akin to that in adjacent Chattisgarh and Jharkhand than the green wonderlands of Kheda or Punjab. Average yields are quite low (around 1500 kilograms per Ha) and there is a great deal of rain induced variation in the yields. Cotton too has become a harbinger of poverty and depravation in recent years and the low income tehsils have marginally high area under cotton. Often, extensive tur cultivation indicates high soil fertility. It serves both subsistence and cash needs for the growers. Finally, horticulture is indeed far more paying in Vidarbha and the high income taluka group includes all the known major orange and banana talukas (Katol, Saoner, Narkhed, Morshi, Warud, Nagpur, Ashti, Jalgaon Jamod etc.)

3.2.4 Role of water (see rows 17-21)

This is the key aspect of this analysis and needs to be interpreted carefully. We find basically that the high income talukas use their water resources much more intensively than the low income talukas. We find that the high income areas have much smaller irrigated area than the low income talukas! This is a peculiar result and while the difference is statistically not significant, it is noticeably large. We also find that the proportion of surface irrigation in irrigated area is much smaller for high income talukas than for low income talukas. We argue that this is a paradoxical situation created by the way the data is collated and recorded. It appears that if a village land is under the command of an irrigation scheme, it is deemed to be irrigated irrespective of the certainty and dependability of irrigation to that land. By a complete contrast, we find that often lands on which wells exist are still classified as unirrigated for convenient reasons to the farmers. But the data also shows that the well density (the number of wells per square kilometer) is much higher for the high income group. And most clinchingly, the data shows that the ground water utilisation (proportion of annual withdrawal as a proportion of net ground water balance) in high income talukas is double that in low income talukas.

Three inferences are inescapable and of crucial importance:

- Dependability of access to irrigation is very critical to income generation and in the absence of that mere inclusion in a command area means nothing,

- The dependability of surface irrigation sources in Vidarbha is very low compared to that of ground water sources and that is despite much lower proportion of irrigated area in these talukas, the high income talukas show high cropping intensity.

- Finally, while ground water exploitation is possibly a strong determinant of the income in these regions and while there is scope to increase utilisation very significantly, the people in low income talukas suffer poverty.

3.3 Ranking in terms of levels of development on other fronts:

Comparing talukas in terms of levels of development or prosperity is useful to place the level of water-use in agriculture and the issues connected with it in perspective. Yet, there can be other bases for ranking/comparing talukas. Basis of ranking can be in terms of development parameters including non-economic ones. Categorisation can be done on bases such as stress to natural resources, irrigation status, cropping intensity, types of

crops grown and so on. Neither are these factors orthogonal nor would the categorisation on them completely match.

Among the analysis we did, data on demographic features, land-use, water-use, crops and animal husbandry were used to develop indicators of status/development of the tehsils on these aspects. An a priori, but reasonably justifiable, judgment was made about which level of any indicator indicates desirable state and which less desirable. The tehsils were then ranked on final combination of all these indicators.. Definition of these indicators are given below:

Demographic status indicator: combines Sex Ratio (number of females per 1000 males), Child Ratio (proportion of population under age of 6 yeas.), Workers Ratio (proportion of population that is :classified as "main workers" etc. It was judged that if the Sex ratio is higher, it indicates a more developed tehsil, if the child ratio is lower then it indicates a better tehsil, if the workers ratio is smaller, then it is a better tehsil etc.

Natural Resources Stress Indicator: Low proportion of forest area in the tehsil, high the land man ratio and the high well density, higher was considered to be the stress on Natural resources. This stress is obviously a negative point and hence the value of Nrstress was subtracted while calculating the total "overall development" indicator.

Irrigation status indicator combines the values of cropping intensity, proportion of irrigated area, proportion of surface irrigated area and proportion of energised wells.

(It may be noted that above procedures introduce specific biases. for example, a tehsil like Bhamragadh (or Chikhaldara for that matter) that is almost completely tribal and covered with forests gets a boost in its ranking. In the first place, tribal societies have little anti-women practices and hence have better Sex Ratios. As is well known from analysis of Census data at national level, the greater the proportion of patriarchial, perhaps even prosperous Caste Hindu population in a district or a locale, the worse is usually the Sex Ratio. Also, Sex Ratio in highly industrialised cities tends to be artificially lower due to greater influx of male-migrants. Secondly, the population density of tribal tehsils is usually lower. Thirdly, the forest cover there is high and there is very little exploitation of natural water resources, so NR stress indicator has a zero value. Having known these biases of the procedure, more reasonable inferences can be drawn..)

When ranked on the Overall Development Indicator, tehsils in Bhandara score very high while tehsils that are in Central Vidarbha region score low. A complete list of tehsils ranked in order of increasing overall development indicator is attached at Annex 1.

3.4 Categorising on cropping pattern:

Tehsils in Vidarbha were ranked in ascending order on proportion of kharif area under cotton. The Eastern tehsils come at the very low end with zero cotton area while tehsils in Yavatmal come at the top with area under cotton exceeding 50%. Highest cotton area is reported for Umarkhed, at 77% of all kharif area..

Based on this ranking, three categories of tehsils were made. The lowest cotton growing tract made the first category with 35 tehsils. The average cotton area at less than 1%. The middle group has a diversified cropping pattern with an average cotton area of 35%. The third group is dominated by cotton with an average cotton area exceeding 56%. Other features of these three tehsils are summed up in Table Crop 0 through Table Crop 5. given below.

TABLE: Crop 0

SPREAD OF TEHSILS IN THE THREE TYPES			
DISTRICT	**# PADDY**	**# DIVERSIFIED**	**#COTTON**
AKOLA	0	3	4
AMARAWATI	2	3	8
BHANDARA	14	0	0
BULDHANA	0	11	1
CHANDRAPUR	2	3	6
GADACHIROLI	12	0	0
NAGPUR	7	7	0
WARDHA	0	5	3
YAVATMAL		1	13

From this it is clear that only the Eastern districts are under paddy, rest are either diversified or cotton dominated.

TABLE: Crop1

DEMOGRAPHIC DIFFERNECES							
	Sex Ratio	**Child Ratio**	**Popden**	**SCST**	**workers**	**Fw/workers**	**landman**
PADDY	980.07	17.49	396.98	44.22	45.86	78.47	0.26
DIVERSIFIED	931.29	17.88	201.66	25.88	43.47	75.16	0.36
COTTON	958.41	16.95	187.99	32.73	43.47	84.70	0.38
ALL	957.30	17.44	263.79	34.57	44.35	79.71	0.34

This Table Crop1 clearly demonstrates that the paddy growing tracts are largely tribal. The sex ratio is so much higher and the SCST population is so much higher. The land man ratio is the smallest for this region and the population density is the highest. The diversified cropping region seems to be the one dominated by caste Hindus with the least SC/ST population and also the least Sex Ratio.

Activity diversification is seen to be very low in cotton dominated areas, with 85% of all workers engaged in farming or farm labour. Activity diversification is the highest, though by itself quite small in the diversified cropping region.

TABLE: Crop2

DIFFERENCES IN LAND USE			
	FOREST/GROS SAREA	NSA/GROSS AREA	CROP INTENSITY
PADDY	30.60	39.40	116.85
DIVERSIFIED	11.26	64.53	114.42
COTTON	13.33	65.77	111.94
ALL	18.73	56.27	114.41

Paddy growing area also has more forests. This association is due to the fact that the Eastern forested areas are primarily the ones with higher rainfall, lateritic soils and hence more suited for growing paddy. As a consequence, the paddy growing area has the least cultivated area given that the proportion of the land tilled (NSA) is smallest at just 39% of the geographical area.

Table 3 shows that the diversified region is the most aggressive in development of ground water resources, it has the highest dependence on ground water, yet the least irrigated area. Naturally, the well density is the highest and so is the number of pumps per well.

TABLE : Crop 3

IRRIGATION STATUS				
	% Irra area	% GW based irrigation	Well density	Pump/well
PADDY	51.68	24.75	4.11	0.44
DIVERSIFIED	9.81	90.84	6.93	0.80
COTTON	10.18	78.11	4.87	0.54
ALL	24.28	64.14	5.25	0.59

The Table 4 demonstrates the value of calling the tehsils as "Diversified", given the cropping pattern.

TABLE: Crop 4

CROPPING PATTERN					
	%Paddy	%Sorghum	%Cotton	%Tur	%Horti
PADDY	66.98	10.78	0.79	3.32	2.74
DIVERSIFIED	1.60	27.69	34.89	10.44	5.27
COTTON	4.68	20.69	56.85	8.04	2.01
ALL	24.72	19.60	30.77	7.24	3.29

(Figures show average proportions of land under the stated crop from the net area sown in kharif.)

TABLE: Crop 5

ANIMAL HERD				
	Animal density	Buff/cattle	%Fcattle	%Fbuffaloe
PADDY	102.05	0.20	27.51	46.75
DIVERSIFIED	71.05	0.20	32.57	62.83
COTTON	72.91	0.18	31.35	60.93
ALL	82.41	0.19	30.43	56.59

IV Correlation among Socio-economic Features

4.1 Inferences and discussion To see what influences income levels and what drives irrigation, we attempted to undertake an analysis of a cross-sectional (spatial) association between some important parameters. The definitions of the chosen parameters are given in Annex II. Table 6 shows the coefficients of correlation between diverse pairs of socio-economic features for talukas Vidarbha.

Table Cor 1: Correlation Coefficients between pairs of parameters.

Item	%Irrigated area	%Surface irrigated area	%GWw development	Pop density	Land / man ratio	Cultivation Intensity	Gross value per Ha	Gross value per cap	% area under cotton	% area under horticulture
%irrigated area	1									
%surface	0.995	1								
%gw development	-0.153	-0.20	1							
Pop density	0.096	0.074	0.072	1						
Land / man	-0.366	-0.34	0.236	-0.324	1					
Cultivation Intensity	-0.265	-0.265	0.465	-0.135	0.52	1				
Gross value per Ha	0.230	0.213	0.144	0.14	-0.426	-0.296	1			
Gross value per cap	-0.137	-0.167	0.59	0.81	-0.20	0.069	0.35	1		
% cotton	-0.241	-0.241	0.30	-0.118	0.385	0.488	-0.67	-0.16	1	
% horticulture	0.26	0.189	0.636	0.20	-.225	-0.044	0.49	0.37	-0.057	1

Source: Compiled by us based on secondary data.

Some inferences that emerge from the above table (Table Cor 1) are:

- Surface irrigation seems to influence the overall irrigation status of the taluka: in other words, a taluka that has higher surface irrigation also has high overall irrigation percentage. One may infer that surface irrigation seems to also encourage greater use of ground water due to certainty of recharge and access.
- Ground water development (withdrawal as a proportion of recharge) is smaller in areas that have more surface sources, that is at least at the moment, the recharge caused by surface sources is more than compensating the withdrawal from ground water for irrigation.
- Ground water development is encouraged by digging of more wells rather than increasing the discharge per well. Actual Number of wells seems to rise in areas that have high ground water development, making the well ratio smaller. This clearly indicates that competitive struggle between different well owners and then some new ones is the main cause of ground water development, not continuous or excessive pumpage from existing wells.
- Fall in well ratio is associated with higher population density, an inference that is consistent with the above.
- Talukas having more Irrigated areas have smaller land man ratio, that is greater land pressure.

- Land pressure and ground water development move together, more the smaller holders, the greater is likely to be the ground water development. Does it indicate a desire for water independence?
- Greater cultivation intensity, that is the more complete the use of geographic area for cultivation, greater is the pressure for development of ground water, the underlying cause possible being the population pressure, common to both.
- Smaller the land available, better is the gross value per unit of land. This could be interpreted in two ways: there is greater land pressure in more fertile areas, or that the areas where there is greater land pressure have learnt to become more efficient users of land resource. Perhaps both are true in Vidarbha, as elsewhere.
- (The ghost of Malthus) Population density in talukas that have better per cap gross crop value is higher.
- Ground water development and per capita crop output move together. Again, which is the cause and which is the effect is difficult to predict.
- Gross value of crop output per hectare falls as the proportion of land under cotton rises, and quite sharply too. Cotton does not seem to be a good crop for income it would appear.
- Similarly, gross value per capita falls as area under cotton rises.
- Cotton cultivation seems to be less common in talukas that have more surface sources of irrigation.
- Cotton cultivation and ground water development move together.
- Cotton cultivation occurs in talukas that have easier land man ratios and have more completely brought the available land under cultivation.

From some other correlation not reported in the above table, we infer that

- Talukas with higher tribal populations have lower ground water development, thus permitting more scope for livelihood interventions based on ground water extraction,

- Talukas with higher tribal populations show smaller activity diversification and lower per capita gross value of crop output and less adoption of dairying activity;

- There is no difference in levels of dairying activity in irrigated and non-irrigated areas,

- Talukas that have higher per capita gross value of crop output also have higher activity diversification.

4.2 Activity Diversification and Water use: We argue that the smaller the proportion of farm workers in total number of workers, the higher is the activity diversification in the taluka. We arranged the talukas in order of decreasing activity diversification. We calculated the averages for some important socio-economic variables for the talukas that have low activity diversification and for those which have high activity diversification. We tested them for differences by using the t test. We discover statistically significant differences in the two groups of talukas in regard to the parameters listed in Box IV.

Box IV

Parameter	T-value and whether direction is expected
Sex ratio	**2.55** smaller activity diversification associated with higher sex ratio
Child ratio	**1.79** smaller activity diversification associated with higher child ratio
Proportion of ST in the population	**3.2** smaller activity diversification associated with higher ST population
Average Area serviced by one tractor	**1.74** smaller activity diversification associated with less tractor density
Gross value of crop output per hectare of land	**-1.7** smaller activity diversification also means smaller gross value per Ha
Prevalence of Dairy	**-2.7** smaller activity diversification associated with less prevalence of dairying
Proportion of land under cotton	**1.99** smaller activity diversification associated with greater land under cotton
Workers in total population	**4.5** smaller activity diversification means more people in the population classified as main workers

V Inferences and discussion

5.1 A quick Recapitulation

The following inferences were drawn in the earlier sections and are reproduced for a quick recapitulation.

Higher income talukas are more commonly the mainland type talukas and not "forest, hills and tribals" type talukas. There is a strong association of tribals with poverty in Vidarbha. ***Higher income talukas seem to use their land resources more fully and also have more resources for use per rural head. High income talukas use their ground water much more intensively***. Horticulture and tur are more strongly associated with higher income. Cotton and paddy seem to be more associated with low income talukas. Surface water irrigation seems to be less reliable and hence cropping intensity is not expanded in regions that are reported to have more access to surface water. ***While ground water is more closely associated with incomes and while the scope to improve ground water utilisation exists, the poor income talukas use much less ground water than the high income talukas.*** Vidarbha can be divided in three major regions: the talukas dominated by paddy, those dominated by cotton and those that are diversified. In economic terms, the diversified talukas seem to be the best as indicated by a range of economic parameters. Smaller the land available, better is the gross value per unit of

land. This could be interpreted in two ways: there is greater land pressure in more fertile areas, or that the areas where there is greater land pressure have learnt to become more efficient users of land resource. Perhaps both are true in Vidarbha, as elsewhere. Population density in talukas that have better per capita gross crop value is higher. And these talukas also have greater activity diversification.

What sense does one make of this picture? To interpret this, we need to conceptualize the development process unfolding in Vidarbha as elsewhere.. This is represented in the Diagram below.

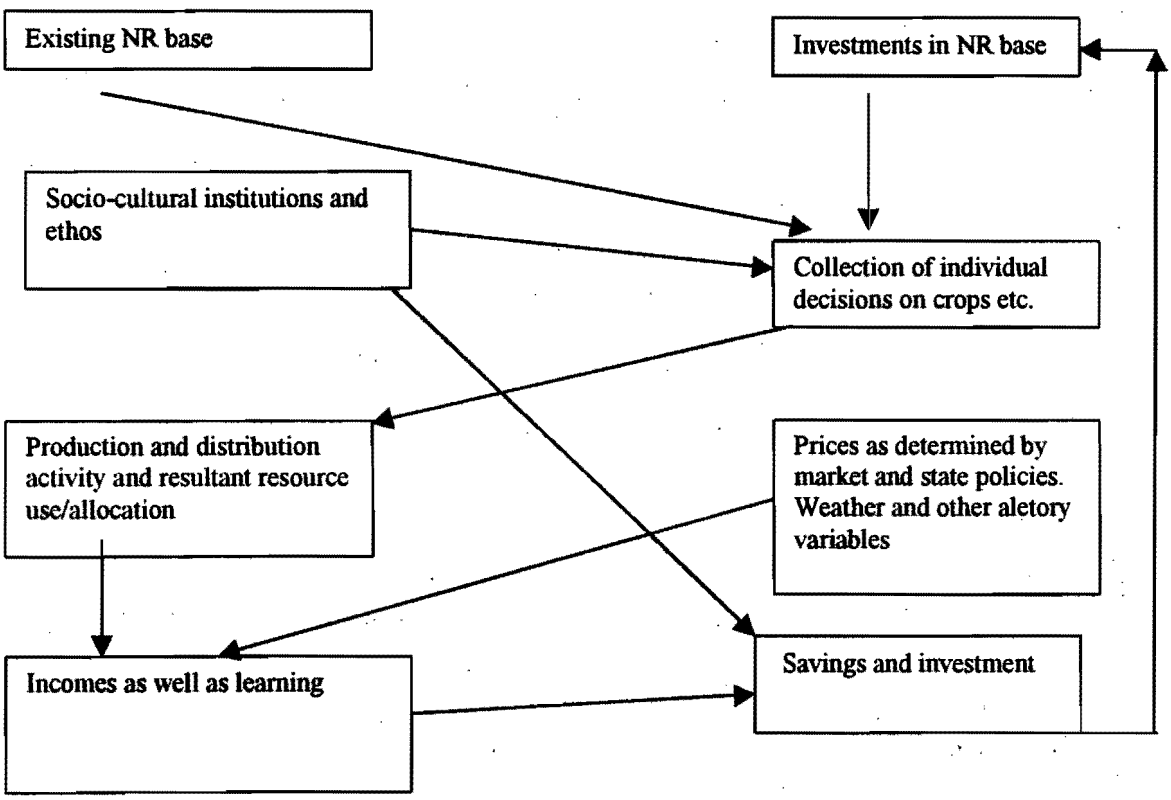

Diagram 1 :
Representation of a common development process

We argue that there are two major inputs to decisions that result in resource allocation and use. The first is the kind of resource base that exists, the production possibility frontier it opens and its inherent limitations. The way an individual at any given point looks at this is in a static sense: what exists in the month or on the day he decides. Thus, his decision incorporates his understanding and expectation of the investments that might be happening in the resource from the State as well as the investment he has made till the point of decision making. The second input comes from his own individual attributes of abilities, access, attitudes and objectives. Some farmers are enterprising and risk taking; they seek high gains and are willing to make risky choices. Some are risk averse. Still others look at farming mainly as a livelihood activity and not as an activity of wealth creation and so on. Choices are also shaped by access to working capital, whether from own resources or from borrowings. Then there are the knowledge and skill of growing a crop, expectations on price, the access to information and similar other cognitive factors. It is conceivable that some farmers will take options that lead to high incomes and savings while others do things that help them merely subsist, in the very same locale and constellation of resource factor. Theories abound as to what kind of peasants/farmers tend to take risk, who is acquisitive, who is passive and so on.

The collection of all such individual decisions lead to overall resource allocation and use pattern. Nature plays its moves and production is shaped by the influence of weather and occurrence of pest attacks etc. The market dynamics as well as State policies shape the prices and these together determine the income earned by the farmers, and more importantly lead to learning for them which feed into next year's cycle. The incomes create the potential for savings which may be invested in the resource base.

Now we notice that the utilization of water resource is associated with better per capita incomes etc. We also notice that a specific and perhaps critical resource namely water is singularly underutilized in Vidarbha. This can happen only because myriad individuals are under-utilizing the water resource potentially useful to them. Is this due to the nature of the resource base? Is this due to under-investment? Is this due to State neglect? Is it due to the omnibus factor we have named "social and cultural milieu and ethos"? Is it due to absence of enterprise and risk taking attitude? Is it due to poor knowledge, technology base or skills of the farmers? Is it due to non-acquisitive nature of the tribal people? This

causality can not be explained by the secondary data alone and must at the moment remain in the nature of hypothesis. Since we have found that surface irrigation does not seem to influence incomes but ground water does, and since we have also reasons to believe that ground water development is largely in the control of the individuals, the argument about state neglect however seems weak to us. On the other hand, we have reasons to believe that the overbearing presence of cotton may be the principal reason for low ground water use. This may have happened because the monopoly scheme induced an artificial degree of price security creating the image of the crop as a remunerative cash crop for farmers. And since cotton itself needs only a little supportive irrigation (compared to many other crops) and since cotton cultivation during June-January effectively rules out a second crop, demand for developing water resources remains subdued. This is coupled with the uncertainty of ground water access and its cost.

Together these factors discourage ground water exploitation and as a result this resource is underutilized.

5.2 Some Hypotheses

We suggest some hypotheses that may well bear testing through future research/action research.

H1: The surface water irrigation seems to have weak influence on incomes across Vidarbha because the potential created remains underutilized possibly due to a poor operations and management system.

H2: Evolving reliable and lucrative options to cotton cultivation will lead to larger exploitation of the ground water resource in Vidarbha.

H3: Demand sluggishness rather than supply constraints are possibly holding back flow of investment credit for irrigation resources.

Annex 1 Ranking of Tehsils in terms of overall development

SN	TALUKA	Demostat	Nrstress	Irristat	Animalstat	mechstat	Overall
	AVERAGE						
C12	KORPANA	0	3	0	2	0	-1
C03	WARORA	1	2	0	2	0	1
W04	HINGANGHAT	2	3	1	1	0	1
Y06	WANI	1	3	1	1	1	1
Y02	BABHULAGAON	2	3	1	2	0	2
Y03	KALAMB	2	3	1	2	0	2
Y14	NER	2	3	1	2	0	2
C10	GONDPIPRI	1	1	0	2	1	3
G04	DHANORA	1	0	0	1	1	3
GO7	AHERI	2	0	0	1	0	3
G10	KORCHI	3	1	0	1	0	3
W05	DEOLI	2	3	1	3	0	3
AK02	AKOT	1	3	2	1	2	3
AK03	MURTIZAPUR	2	3	2	1	1	3
AK04	BARSHI T	2	3	1	2	1	3
AK05	PATUR	2	2	1	2	0	3
Y13	DARWHA	1	3	1	3	1	3
B09	DEWARI	1	0	0	2	1	4
C02	BHADRAWATI	1	0	1	2	0	4
C04	CHIMUR	3	1	0	1	1	4
C11	RAJURA	3	1	0	1	1	4
G01	GADCHIROLI	1	0	1	1	1	4
G05	ETAPALLY	2	0	0	2	0	4
G06	SIRONCHA	2	1	0	1	2	4
GO8	CHAMORSHI	1	1	1	1	2	4
N05	MAUDA	1	3	2	2	2	4
N12	KATOL	4	3	2	1	0	4
AM05	CHANDUR RLY	2	3	2	2	1	4
AK06	BALAPUR	3	3	1	2	1	4
Y05	MAREGAON	3	3	1	2	1	4
Y07	KELAPUR	3	3	1	2	1	4
Y08	GHATANJI	2	2	1	2	1	4
Y10	MAHAGAON	2	2	1	2	1	4
C08	MUL	3	1	1	1	1	5
G03	KURKHEDA	1	1	2	2	1	5
G11	BHAMRAGADH	3	0	0	2	0	5
G12	MULCHERA	4	1	1	1	0	5
W06	ARVI	3	2	1	3	0	5
N06	KAMPTEE	1	2	4	1	1	5
N07	KUHI	4	3	0	3	1	5
AM04	TEOSA	2	3	2	3	1	5
AM09	A SURJI	1	3	2	4	1	5
AK01	AKOLA	2	2	1	2	2	5
AK07	TELHARA	1	3	2	3	2	5
BU10	MEHEKAR	1	3	1	4	2	5
BU13	DEOLGAON R	1	3	2	4	1	5
Y11	PUSAD	1	2	1	3	2	5
B06	AMGAON	2	1	2	2	1	6
B11	ARJUNIMOR	2	1	2	2	1	6
G02	ARMORI	2	1	2	2	1	6
W03	SAMUDRAPUR	3	3	2	3	1	6
W08	KARANJA	4	3	2	2	1	6
N02	SAONER	3	2	3	1	1	6
N03	PARSIVANI	1	0	2	2	1	6
N08	BHIVAPUR	4	3	0	3	2	6
N10	NAGPUR(R)	3	2	2	1	2	6

N11	HINGNA	2	1	1	2	2	6
AM02	MORSHI	2	3	3	3	1	6
AM06	NADGAONK	3	3	2	2	2	6
AM08	DARYAPUR	2	3	2	3	2	6
BU07	SHEGAON	3	3	1	3	2	6
BU08	KHAMGAON	1	2	2	3	2	6
BU11	LONAR	2	3	1	4	2	6
Y01	YAVATMAL	1	0	1	3	1	6
B08	SALEKASA	2	0	2	3	0	7
B12	LAKHANDUR	2	2	3	2	2	7
C01	CHANDRAPUR	5	0	0	2	0	7
C05	NAGBHID	2	0	2	2	1	7
C09	SAWALI	4	0	1	2	0	7
GO9	DESAIGANJ	3	0	3	1	0	7
W07	ASHTI	4	2	2	2	1	7
AM01	AMRAWATI	3	2	2	3	1	7
AM13	CHANDUR BZR	3	3	2	3	2	7
BU02	MOTALA	2	3	2	4	2	7
BU04	NANDURA	3	2	2	3	1	7
BU09	CHIKHLI	2	3	2	4	2	7
BU12	SINKHEDRAJA	4	3	2	3	1	7
Y04	RALEGAON	5	2	1	2	1	7
B05	GONDIA	5	2	2	2	1	8
B07	GOREGAON	2	0	3	2	1	8
B10	SAKOLI	3	1	3	2	1	8
C06	BRAHMPURI	2	0	2	3	1	8
W01	WARDHA	3	1	4	1	1	8
W02	SELU	4	3	3	2	2	8
N09	UMRED	3	1	1	3	2	8
N13	NARKHED	4	3	3	2	2	8
N14	KALMESWAR	3	2	3	2	2	8
BU03	MALKAPUR	3	2	3	3	1	8
BU06	SANGRAMPUR	3	3	2	4	2	8
Y09	UMARKHED	3	0	1	2	2	8
Y12	DIGRAS	3	2	2	3	2	8
B14	S.ARJUNI	4	0	2	3	0	9
C07	SINDEWAHI	3	0	2	2	2	9
AM07	BHATUKALI	4	3	3	4	1	9
AM10	DHARNI	3	1	2	4	1	9
AM11	CHIKHALDARA	2	1	2	4	2	9
B03	TUMSAR	6	1	3	1	1	10
N01	NAGPUR	5	1	3	2	1	10
N04	RAMTEK	3	0	2	3	2	10
AM03	WARUD	4	2	4	3	1	10
AM12	ACHALPUR	5	2	3	3	1	10
BU01	BULDHANA	4	2	3	4	1	10
BU05	JALGAON J	4	3	3	4	2	10
B01	BHANDARA	4	1	3	4	1	11
B04	TIRODA	5	1	3	3	1	11
B13	PAONI	5	2	2	4	2	11
B02	MOHADI	4	0	3	3	2	12

Annex 2 : Definitions of Parameters Used

%irrigated area: The proportion of irrigated area in the Net sown area of the taluka, expressed as percent of the latter.

%surface: The proportion of area irrigated by surface sources in the net sown area of the taluka.

%gw development: The extent of development of groundwater as defined by GoM, being the proportion of the net withdrawal of water in annual recharge expressed as percentage.

Well Ratio: The ratio of "number of feasible wells" as defined by the GoM divided by the actual number of Wells in the taluka.

Popdensity: population density, being the number of persons per sqare kilometer in the taluka.

Land/man: Amount of cultivated land per person in the taluka, in Ha per cap.

Cultivation intensity: The ratio of net sown area to geographic area of the taluka expressed in percentage form.

Gross value per Ha: Gross value of crop output per Ha, expressed in rupees thousands. This is calculated by projecting the gross value of all the principal crops produced, calculated at the per hectare yield reported by DSA and valued at approximate current producer prices.

Gross value per capita: The above gross value divided by the rural population, expressed in Rupees.

%cotton: Area under cotton expressed as percent of the net kharif sown area.

%horti: proportion of the land reported to be under horticultural crops in the net sown area, expressed as percentage of the latter.