Chapter 9

Conclusion

&

Suggestions

CHAPTER – 9

CONCLUSION & SUGGESTIONS

Land use is a function of four variables – land, water, air and Man. (Singh, 1980). Each of them plays a vital / significant role; but the significance of man is supreme, as he is the only variable who assigns functions to the land and enjoys the benefit of it. Land is that factor of production, which plays a dual role in human life – It provides the space for all his activities and provides the resources to meet his needs and fulfill his wants. It can be divided into two broad categories according to its use from an agriculture point of view.

The study area stretches between 21° 40' to 22° 50' N Latitude and 72° 30' to 73° 50' E Longitude. Its surface boundaries are constituted by the estuary of river Mahi in the north, Gulf of Khambhat in the west, river Narmada in the south and Narmada main canal – 1 in the east.

Nearness to the Gulf, tidal ingress, existence of several backwater channels, flat topography, poor drainage, patches inundated by rain water, existence of vast areas of Kharland, the high pH values of the soil, brackish subsoil water etc., are some of the prominent physical elements of the region. Therefore, it may be stated that the concept of environmental determinism plays a major role in determining the personality of the area.

The underground water is invariably brackish, up to a depth of varying from1.5 meters to 10 meters or more. The area being in the vicinity of

estuaries and the coast has a bright prospect of access to rich resources of mineral oil and gas.

Its structural history dates back to the beginning of the quaternary period. Its terrain is monotonously flat, composed of debris of the cretaceous lava rocks standing on its opposite directions. Almost the entire area is composed of black soils resting over the alluvium, which goes to the depth of 900 meters.

The varying properties of black cotton soil have to the classification into 18 soil series / zones in the study area which are discussed in detail in Chapter. 4.

The climate is tropical monsoon type with seasonal variations; Temperature sometimes goes above 46°C during the hot summers. Due to moderating influence of Gulf waters, the lower limit of the range remains between 24° C and 15° C during the winters. The rains are as erratic as elsewhere in India. The minimum recorded rainfall was 172 mm in 1948, and the maximum 3060 mm in 1958. The average therefore comes to 650 mm. It is quite sufficient to provide a fairly good cropping season. The ideal conditions would be if this amount comes well distributed over the entire rainy season. But that hardly happens causing crop failures. On the basis of local experiences, it is said that the area invariably encounters partial famine conditions every third year or alternate year. The rains are essential for both, food and drinking water their erraticity not only causes concern for the crops but for the drinking water as well. Absence of irrigation facility made both the necessities dependent on the rains. The lack of irrigation prohibits the growing of more than one crop (Kharif), except when the retreating monsoon

brings some amount of rain during the late October and early November. It helps sowing of "Rabi crops". The significance of rains for the life and economic activities (mainly agriculture) of the area cannot be overemphasized. Thus availability of water acts as a catalyst of land use change in the area.

9.1 Conclusions

The dynamic aspect of land use in this area is the focal purpose of the study. The rural land use type are grouped into two broad categories (1) Non productive & (2) Productive. The first category covers all those uses which fulfill the socio-cultural needs of rural folks. The second category however, is meant to ensure food and other needs. The first is the general land use and the second is the cropland use.

In keeping in the three points of objective of the study present study the following conclusions may be drawn.

9.1.1 Levels of change

According to the rules of dynamics of land use, both positive and negative change has been observed. However, general land use, owing to the rural setting has not showed much change except for those brought about through land use management programme of the government. On the whole, a sluggish and minimal change has been discerned over a period of two decades except in the cases of settlement and roads, all other uses of non-agricultural land have shown decline.

But remarkable change has been observed in the case of cropland. The prominent changes being as follows

- At the first point of time the ratio between the cotton and other crops in respect of their share in the G.C.A., was 4:6, showing a sort of balance between cotton (40.80 %) on one hand and the other crops (59.20%) on the other. By 2000-01, cotton decline to occupy 39.30% of the G.C.A., leaving 60.70% to other crops.
- Food crops in 1980-81, had reasonable significance occupying 39.90% of G.C.A., the lions share going to jowar (16.52%), followed by rice (5.72%0 and wheat (4.86%) each. By 2000-01, the cereals where confined to 23.02 per cent of G.C.A., with wheat occupying 5.23 per cent followed by paddy 4.82 per cent, Jowar 4.74% and bajra 2.79 per cent.
- So far as ranking of crops is concerned, jowar and tur maintained second rank at both points of time and the third rank was occupied by paddy, tobacco and other crops even though their individual share of G.C.A., were much reduced.
- Beside cotton, tur, bajra, oil seeds, sugarcane, and tobacco registered increased in their G.C.A. All other crops showed a downward trend.

9.1.2 Catalysts of Change

The changes in land use are brought by a host of factors both in unison and individually and it is difficult to isolate any one factor responsible for a particular change. But for the purpose of study one could isolate mot significant factors operating in the study area as follows: -

- The embankment constructed along the coastline to check the ingress of sea water has been most effective in the reclamation of considerable area

of land for agriculture as well as non-agriculture uses. About 500 acres of saline waste and has been reclaimed for social forestry and agriculture, while more areas are in the process of reclaimation.

- Rainfall, with its characteristic regime, seems to the present researcher the most important factor of temporal changes in the cropping pattern. The farmers therefore keep on adjusting their cropping schemes accordingly.
- The area experiences shortage of rainfall every third year. However, this can be termed as short term change. The general long term change in rainfall regime has not been ascertained, which could be related to long term changes in the cropping pattern or the general land use pattern.
- The human factor is itself a potent catalyst of change. The growing numbers and density of population can be said to have reflected in the expansion of the area under N.S.A. Human ability, ingenuity, knowledge and experience are the guiding elements in decision making process. In his decision making activities humans are also influenced by the prevailing socio-economic and political factors.

9.1.3 Constraints to Better Land Use Change

The study brings out the following factors, which hamper a better use of land and a change for the better in the area.

- Deficiency, seasonability and erratic nature of rainfall is the permanent factor that determines the land use pattern in the area and hinders the progress towards a desirable change.
- The salinity of soil as well as of the underground water is another permanent feature, which restricts the use of soil and water for growing the

types of crops on desired. Extensive areas are lying as saline waste, which need special treatment.

The preventive and remedial measures to solve the problem will have to be based on geohydrological conditions prevailing in this area. These have been discussed here.

The problem of poor recharge, accelerated withdrawal of ground water and the increase in salinity has to be considered in its totality. No single solution will be applicable to the entire affected area or will be sufficient in isolation. Various measures involving geographical, engineering, agriculture, forestry, social and legal aspects have to form part of an integrated approach. The following measures are considered for providing an effective solution to the problem.

I. Management Techniques

(i) Change in cropping pattern.

(ii) Regulation of groundwater extraction.

II. Recharge Techniques

(i) Check dams.

(ii) Recharge tanks.

(iii) Recharge wells.

(iv) Spreading channels.

(v) Afforestation.

- The nature of black cotton soil with its saline underground water table is such that, canal water cannot be employed for irrigation as this will raise the saline water table resulting into the development of hard pan under the

top soil leading ultimately to water logging and salinity making them infertile.

- The proposed Narmada project irrigation canal also may not serve the agro-climatic regions III and IV on account of the same reasons – the nature of soil. Apprehensions have been voiced about the possibility of soil becoming salt encrusted and waterlogged if Narmada canal water is used to irrigate the fields in the traditional manner.

Thus, the irrigation provided by the Narmada canal may not bring the desired changes in the existing land use pattern unless some innovative measures are taken to adapt the system to peculiarities of soil and terrain.

The main problems resulting in the non sustainability of the drainage schemes and appropriate mitigation measures are given in (Table.9.1)

Table 9.1: Problems and Mitigation Measures for Sustainability of Irrigation and Drainage Schemes

PROBLEM	MITIGATION MEASURES
Degradation of Irrigated Land: Salinisation Alkalization Water logging Soil acidification	- Improve I & D operation to match demand both how much & when. - Provide drainage including disposal of water to evaporation ponds or the sea if quality of river flow adversely affected by drainage water. - Maintain channels to prevent seepage, and reduce inefficiencies resulting from siltation and weeds. Allow for access to channels for maintenance in design. - Provide water for leaching as a specific operation. - Set-up or adjust irrigation management infrastructure to ensure sufficient income to maintain both the irrigation and drainage systems. - Analyse soils and monitor changes so that potential problems can be managed.
Reduced socio-economic conditions:	- Manage I & D to prevent disease spread. - Educate about causes of disease. - Improve health facilities. - Allow sufficient time and money for extensive public participation to ensure that plans are optimal, that all sections of affected society are considered and that local institutions are in place to sustain irrigated agriculture, particularly in respect of land and water rights. - Consider markets, financial services and agriculture extension in conjunction with proposed irrigation and drainage changes. - Ensure that agriculture intensification does not preclude other economic or subsistence activity, such as household vegetables, fodder or growing trees for firewood. - Provide short-term support and/or skills for an alternative livelihood if irrigation removes existing livelihood.
Poor water quality: Reduction in irrigation water quality Water quality problems for downstream users caused by irrigation return flow quality.	- Define and enforce return water quality levels (including monitoring) - Control industrial development. - Designate land for saline water disposal: build separate disposal channels. - Educate for pesticide or sewage contamination dangers. - Monitor irrigation water quality.
Ecological degradation:	- Define ecological requirements. - Operation dams to suit downstream requirement and encourage wildlife around reservoirs. - Designate land (in law and supported by protection institutions) for flood plains: wetlands: watersheds: drainage water disposal: river corridors.
Ground water depletion Dry drinking & irrigation wells Salinity	- Define and enforce abstraction regulation. - Monitor ground water levels - Adjust abstraction charges. - Integrated management approach.

Class	Slope (%)	Land characteristics	Recommended soil erosion control measures
I	0 – 1	Levelled land, deep productive soil, no overland flow, suitable for plant growth and agriculture.	Fertilizing, manuring, green manuring, cover cropping and residues.
II	1 – 3	Productive soil, gentle slope, moderate depth, some overland flow and some drainage required.	Crop rotation, water management special tillage practices, contour farming and strip cropping, contour bunding and terracing.
III	3 – 5	Moderate fertility, moderate slope and severe erosion problem.	Not highly recommended for cultivations: recommended crops: hay and sod, contour cropping and strip cropping, cover cropping terracing and bunding.
IV	5 – 8	Good quality soil, steep slopes and severe erosion problem	Not recommended for cultivation; recommended crops: hay, pasture etc bunding and terracing
Land not Suitable for cultivation			
V	8 – 12	Either too wet or stony, nearly leveled and not so erodable.	Pasture, forestry, vegetative cover and controlled grassing.
VI	12– 18	Shallow soil depth and steep slope.	Forestry, controlled grassing, pasture, grasses and good vegetative cover.
VII	18 - 25	Steep, rough and highly erodable land, shallow soil depth, may be even swampy and draughty.	Even pastures are risky, only dense forest and absolutely controlled grassing.
VIII	> 25	Uneven and rough type of land	Dense reserved forests complete vegetative cover and no grassing.

- There is an extensive area of mud flat along the coastline. This mud flat needs special treatment; no usual land use practices can be employed on them. The local people lack the required technical know how to deal with the special type of terrain.

Finally it may be concluded that the study corroborates the assumptions with which started – that nature very much influences the land

use pattern, with rainfall and soil being the most dominant factors. But the human response, particular the decision making capability of the people, determines the use of land, further the decisions are influenced by various institutional factors, which are in turn moderated by the constraints posed by the natural environment. Thus completing the circle of man-environment interactions.

The overall impact of the SSP Phase–I has been summarized in the form of a matrix for each of the four agro-climatic regions that constitute the study area, using the ICID (International Commission on Irrigation and Drainage) check list. The matrices reveal that Region-II will have maximum positive impact. This will be followed by Region-I, Region-III and Region-IV (Tables 9.2 – 9.5). The last two regions will benefit only if the recommendations and suggestions made in the study, are strictly implemented.

9.2 SUGGESTIONS

Based on the study of the environment at two points of time and of the change in the land use and the cropping pattern brought about by the various factors operating in the area, the following modest suggestions may be derived for a better use of the land in the future.

- The first prerequisite for better land use in the area is the provision of irrigation water. But this is an extremely ticklish question. The Narmada project water is scheduled to be available to the area by the year 2010-11. This is first the area, which is to receive the Narmada water. The traditional

flow irrigation may cause the formation of hard pan and water logging and also increase salinity of the top soil. So it is proposed that instead of letting irrigation water flow through the agriculture fields, the area should be provided with a large number of tanks. Their numbers and spacing to be planned meticulously, from which the farmers may be advised to take water to the field in a well controlled manner. A still better method would be to introduce sprinkler or drip irrigation.

- The same Narmada water may be utilised to wash down the salts or salinity; thus making the vast area cultivable within a few years. Technical feasibility of this measure should be examined and information, advice and incentives provided to the people.
- A proper crop rotation system should be devised so that increasing areas may be brought under double cropping. Presently cotton occupies most of the land for the greater part of the year. A sort of zoning concept may be done for rotating cotton with, wheat rice or other crops, which will go a long way in improving the soil fertility as well as in optimising the production from land and balancing the diet of the people.
- The proposed canal distributaries as well as the existing "KANS" (artificial drainage channel) should be properly firstly aligned to prevent seepage and water logging and secondly soil erosion in the second case.
- The northern coastal areas in the region IV, for example in Degam and Sigma, which have extensive white sand, may be developed as a tourist beach resort.
- The vast stretches of culturable waste land should be made productive by planting a variety of grasses and fruit trees (such as plums and berries).

The Narmada waters may help to make this a reality.

- The reclamation of Kharland should be utilised for social forestry, which may meet the immediate need s of fodder, food and firewood for the inhabitants. Such measures are already afoot, and they should be expanded and accelerated.
- Attention should be paid to reduce extreme specialisation with cotton as the only crop. A move towards greater crop diversification would be beneficial from the point of view of both of balance in land use and balance in diet.

Thus, this will be termed as an attempt to swim against the prevailing current. But this is worth considering; it is also a pre-requisite for ecological and soci-economic development of the area. If these measures are implemented, even in a phased manner, it is hoped, that the area will experience a move towards a quality of life much better than one prevailing today.

9.3 Prospects for Future Research

Some of the areas were further research is possible in future are:

- To identify the site suitability for water recharging at the micro level.
- Experimental research can be carried out for testing the feasibility and impact of crop combination suggested.
- Carryout research for the development of location specific integrated approach for removal of salinity at micro level.

Table 9.2: Environmental Impact Assessment Matrix for Region-I

Environmental Components / Nature of Impact		Positive Impact Very Likely	Positive Impact Possible	No Impact Likely	Negative Impact Possible	Negative Impact Likely	No Judgment Possible at Present	Comments
		A	B	C	D	E	F	
HYDROLOGY	1.1 Flood Regime		+					
	1.2 Operation of Dam.		+					
	1.3 Fall of water Table			x				
	1.4 Rise of water Table		+					
POLLUTION	2.1 Toxic Substance			x				
	2.2 Organic Pollution			x				
	2.3 Anaerobic effects	+						
	2.4 Gas Emission		+					
SOILS	3.1 Soil Salinity					-		In parts of Savli and Waghodia Talukas. salinity is inherent
	3.2 Soil Properties					-		
	3.3 Saline Groundwater	+						
	3.4 Saline Drainage			x				
	3.5 Saline Intruction			x				
SEDIMENTATION	4.1 Local Erosion					-		
	.4.2 River Morphology			x				
	4.3 Sedimentation						x	
	4.4 Estuary Erosion						x	
ECOLOGY	5.1 Project Land	+						
	5.2 Water Bodies		+					
	5.3 Wetlands & Plains		+					
	5.4 Rare Species		+					
	5.5 Animal Migration		+					
SOCIO -ECONOMIC	6.1 Population Change			x				
	6.2 Income & Amenity		+					
	6.3 Human Migration			x				
	6.4 Resettlement			x				
	6.5 Regional Effects		+					
	6.6 Recreation			x				
HEALTH	7.1 Water & Sanitation		+					
	7.2 Nutrition	+						
	7.3 Disease			x				
	7.4 Other Hazards			x				

+ Strong Positive Change - Strong Negative Change x – No Change

\+ Weak Positive Change - Weak Negative Change

Table 9.3: Environmental Impact Assessment Matrix for Region-II

Environmental Components \ Nature of Impact		Positive Impact Very Likely	Positive Impact Possible	No Impact Likely	Negative Impact Possible	Negative Impact Likely	No Judgment Possible at Present	Comments
		A	B	C	D	E	F	
HYDROLOGY	1.1 Flood Regime		+					
	1.2 Operation of Dam.		+					
	1.3 Fall of water Table			x				
	1.4 Rise of water Table		+					
POLLUTION	2.1 Toxic Substance			x				
	2.2 Organic Pollution			x				
	2.3 Anaerobic effects	+						
	2.4 Gas Emission		+					
SOILS	3.1 Soil Salinity					-		Some parts of Padra Taluka
	3.2 soil Properties					-		
	3.3 Saline Groundwater	+						
	3.4 Saline Drainage			x				
	3.5 Saline Intruction		+					
SEDIMENTATION	4.1 Local Erosion					-		
	.4.2 River Morphology			x				
	4.3 Sedimentation						x	
	4.4 Estuary Erosion						x	
ECOLOGY	5.1 Project Land		+					
	5.2 Water Bodies		+					
	5.3 Wetlands & Plains		+					
	5.4 Rare Species		+					
	5.5 Animal Migration			x				
SOCIO -ECONOMIC	6.1 Population Change			x				
	6.2 Income & Amenity		+					
	6.3 Human Migration			x				
	6.4 Resettlement	+						Resettlement of PAFs
	6.5 Regional Effects		+					
	6.6 Recreation			x				
HEALTH	7.1 Water & Sanitation		+					
	7.2 Nutrition	+						
	7.3 Disease			x				
	7.4 Other Hazards			x				

+ Strong Positive Change - Strong Negative Change x – No Change

\+ Weak Positive Change - Weak Negative Change

Table 9.4: Environmental Impact Assessment Matrix for Region-III

Environmental Components \ Nature of Impact		Positive Impact Very Likely	Positive Impact Possible	No Impact Likely	Negative Impact Possible	Negative Impact Likely	No Judgment Possible at Present	Comments
		A	B	C	D	E	F	
HYDROLOGY	1.1 Flood Regime		+					
	1.2 Operation of Dam.		+					
	1.3 Fall of water Table			x				
	1.4 Rise of water Table		+					
POLLUTION	2.1 Toxic Substance			x				
	2.2 Organic Pollution			x				
	2.3 Anaerobic effects	+						
	2.4 Gas Emission		+					
SOILS	3.1 Soil Salinity					-		Some parts of Padra Taluka
	3.2 soil Properties					-		
	3.3 Saline Groundwater	+						
	3.4 Saline Drainage			x				
	3.5 Saline Intruction		+					
SEDIMENTATION	4.1 Local Erosion					-		
	.4.2 River Morphology			x				
	4.3 Sedimentation						x	
	4.4 Estuary Erosion						x	
ECOLOGY	5.1 Project Land		+					
	5.2 Water Bodies		+					
	5.3 Wetlands & Plains		+					
	5.4 Rare Species		+					
	5.5 Animal Migration			x				
SOCIO-ECONOMIC	6.1 Population Change			x				
	6.2 Income & Amenity		+					
	6.3 Human Migration			x				
	6.4 Resettlement	+						Resettlement of PAFs
	6.5 Regional Effects		+					
	6.6 Recreation			x				
HEALTH	7.1 Water & Sanitation		+					
	7.2 Nutrition	+						
	7.3 Disease			x				
	7.4 Other Hazards			x				

✚ Strong Positive Change - Strong Negative Change x No change

\+ Weak Positive Change - Weak Negative Change

Table 9.5: Environmental Impact Assessment Matrix for Region-IV

Environmental Components \ Nature of Impact		Positive Impact Very Likely	Positive Impact Possible	No Impact Likely	Negative Impact Possible	Negative Impact Likely	No Judgment Possible at Present	Comments
		A	B	C	D	E	F	
HYDROLOGY	1.1 Flood Regime		+					
	1.2 Operation of Dam.		+					
	1.3 Fall of water Table			x				
	1.4 Rise of water Table		+					
POLLUTION	2.1 Toxic Substance			x				
	2.2 Organic Pollution			x				
	2.3 Anaerobic effects	+						
	2.4 Gas Emission		+					
SOILS	3.1 Soil Salinity				-			Severe salinity intrusion problem
	3.2 soil Properties				-			
	3.3 Saline Groundwater		+					
	3.4 Saline Drainage			x				
	3.5 Saline Intruction		+					
SEDIMENTATION	4.1 Local Erosion					-		
	.4.2 River Morphology			x				
	4.3 Sedimentation						x	
	4.4 Estuary Erosion						x	
ECOLOGY	5.1 Project Land				-			
	5.2 Water Bodies		+					
	5.3 Wetlands & Plains		+					
	5.4 Rare Species		+					
	5.5 Animal Migration		+					
SOCIO -ECONOMIC	6.1 Population Change			x				
	6.2 Income & Amenity		+					
	6.3 Human Migration		+					
	6.4 Resettlement			x				
	6.5 Regional Effects		+					
	6.6 Recreation		+					Beach Resorts possible
HEALTH	7.1 Water & Sanitation		+					
	7.2 Nutrition	+						
	7.3 Disease			x				
	7.4 Other Hazards			x				

+ Strong Positive Change - Strong Negative Change x No change

+ Weak Positive Change - Weak Negative Change