CHAPTER - 10

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GEO- ENVIRONMENTAL EVALUATION: OPPORTUNITIES, CONSTRAINTS AND ISSUES

INTRODUCTION

The study area posses a complex geo-environmental set up providing a range of natural resource potentials that are available as opportunities for the human developmental activities related to the urbanization, industrialization and agriculture. At the same time there are in built risks and hazards confronting as natural constraints in the process. The developmental activities, as has been observed, have not paid due consideration to the resource regenerative capabilities or the potential power of threats. However, wide ranging resource potential with greater absorbing capacity, has allowed the unplanned interventions without much adverse impacts in the initial stages of developmental stresses. But as the system has now become complex with aggravated power of constraints, many a times compelling to change the course of development activities. The signals are clear and warrant for modifying the activity course and device an environmental appropriate strategy. Fortunately, it appears that the local and regional geo-environs have still greater potential even to bear further burden of another anthropogenic actions.

Several issues have been identified in the foregoing chapters. In the following paragraphs, a brief evaluation of the geo-environmental opportunities and constraints in respect to human intervention has been given. The issues have been broadly classified as per predominant geo-environmental attributes for the sake of facility of discussion.

HYDROMETEOROLOGIC FACTORS

The hydrometeorologic parameters of this semi-arid region having a wide range of variation has provided rich water resources potential on one side and extreme conditions of droughts and floods on the other side.

Water Resources

The low average rainfall of 765 mm has interestingly produced a significantly high potential of groundwater and surface water resources. The local hydrogeomorphic conditions provide a high recharge index of 15% of rainfall and additional indirect recharge receipt from the Aravalli foot hill zones. The area being located at the lower reaches of Sabarmati has an advantage of receiving large quantity of surface runoff. Of course the runoff index for the semi-arid basin being low (25% to 35% of rainfall), the 20,000 sq km catchment bring about 2000 MCM of surface flow.

Droughts and floods

It is a paradoxic situation that the area has been subjected to the extreme hydrologic conditions of droughts and floods. The extremes of rainfall pattern has

produced the conditions of 6 normal, 3 droughts and 1 flood years in a period of 10 years.

The situation has been further aggravated by the human intervention in the upper catchment by way of dam construction and deforestation. The average rainfall is mainly stored in dams leaving almost no flow condition in Sabarmati during 5-6 years out of 10 years and there would be some seasonal flow only during 2 years. The usual 3 drought years would turn more severe, since there would not be any inflow in the river. Contrary to this, during the flood year, the dams would open all their gates as emergency measures and it would add extra flood to the normal flood, making the resultant flood situations more intense and severe. Further the loss of vegetal and soil cover in the catchment because of quick outflow discharge, which would add to the intensity of the flood hazard. Thus, the human interventions in the upper catchment have made the drought more frequent and flood more intense (Plate 10.1)

GEOMORPHOLOGICAL FACTORS

The terrain has endowed with a valuable land and soil resource and at the same time high rate erosion and other degrading agents have threatened it.

Land and Soil Resource

The alluvial plain provides a valuable land and soil resource. The plane landscape allows a variety of land use options for agriculture, habitation, construction, social forestry, industry etc. Such multiple land use capability is a special and more

Plate 10.1: River Bank Flood near Nehru Bridge, Ahmedabad.

Plate 10.2: Contaminated Water in Fatehwadi and Khari Cut Command Area.

favourable terrain condition for the area. The soil cover on this amicable landscape that has developed during the recent- past – Holocene period – climatic condition has rendered well developed mature profiles with rich nutrients. The predominantly loessic composition has rendered them suitable for a variety of agricultural and horticultural usages. The soil cover also allows a high rate of percolation to facilitate greater recharge.

Gully erosion and silt discharge

The Sabarmati river centrally traversing the terrain cutting down to a depth of about 15-20 m has adversely affected the land and soil resources. The loess rich land-soil composition, along the river bank facilitates the large scale gully erosion. The erosion keeps on advancing, causing greater and greater loss of land and soil. The erosion has threatened the stability of buildings too. The gully erosion all along the banks of river for about 150 km upstream area brings in a large scale silt discharge with the river flow. The silt causes bed deposition and blocking water ways. This in turn renders over flanking the flood conditions and large scale inundation to the bank area.

Drainage and Ponds

The flat topography and sandy soil cover has produced poor drainage and development of innumerable local ponds. The discharge rate of the runoff is therefore very low and under the storm rainfall conditions the space of drainage

net proves inadequate and causes almost a land-locking condition. This results into a temporary condition of regional inundation and flooding hazards.

The random construction works, inadequate provision of cross drains under the roads etc. further aggravate the situation. At most of the places the drainage have been choked or blocked and the ponds have been filled and covered. All that has resulted into large scale inundation and flooding conditions (Plate 10.2). This in turn leads to several related hazards of public health, land subsidence, failure of building foundations etc.

GEOLOGICAL FACTORS

The geological succession has provided with rich natural resources and some risk related to seismotectonic stability.

Fossil Fuels

The Tertiary formations are richly endowed with oil, gas and lignite resources. The development of oil and gas from the area has given an economic boost. The yet unexploited lignite has near future development potential.

Seismicity

The area has been included in the seismic zone - III and earthquakes of low to medium intensity are expected. Considering the thicker loessic soil horizons supporting building foundations, under saturated condition, even a minor earthquake shock can generate quick sand condition and the foundation can fail. In

view of the large scale working for groundwater, oil and gas extraction up to the depth of about 2500 m and expected in situ gasification of lignite horizons, the structural stability of the earth block has become vulnerable and when subjected to even a low magnitude earthquake the resultant damage could be of much higher order. A possibility of induced seismicity is also a matter of further study in this complex basin.

HYDROGEOLOGICAL FACTORS

The Quaternary sedimentation in the sinking Cambay basin block has given rise to excellent condition of multiple aquifer system down to the depth of about 400 m. This hydrogeologic basin has a very high storage potential of ground water. The aquifers have boundary conditions with the western boundary fault of the Cambay basin and the system being open towards the eastern side gets recharged from the Aravalli foot hills. The artesian aquifer so formed provided an exceptionally rich underground storage reservoir. It sustains the concentrated draft part for several years in the area.

The aquifer storage has an excellent natural condition for the area that not only supports the concentrated supplies but also acts as drought proofing arrangements.

Groundwater Mining

The concentrated extraction from the aquifers has created an overdraft conditions since last two and a half decades. The static storage lift has created the situation of the mining of groundwater and with the accelerating rate; it would exhaust the

groundwater storage in very near future. Today the groundwater extraction shares more than 80 % of the total water supply. In its absence, arrangement for 80-90 % surface supplies is going to be a big challenge to the authorities. The progressive depleting water levels lead to greater quality deterioration that makes it unfit for drinking and other uses.

HUMAN INDUCED ISSUES

Apart from the natural resource exploitation and related hazards, there are several issues that endanger the environment and pose the problems of long term sustainability of the developmental activities and the infrastructural support systems.

URBANIZATION AND INDUSTRIALIZATION

The process of urbanization in the AUDA area has witnessed interesting fluctuations of population growth. The decennial growth rate in the area during 1951- 61 was 20 %. It declined to 9 % during 1961-71. There after during 1971-81 it showed a sharp jump of 40% and then it showed a slightly declining trend of 34% during 1981-91. It is interesting to observe that this pattern of fluctuation has been governed by the changing trends of industry in the area. Till 1960, the textile industry was dominating and it rapidly declined during the following decade. Thereafter mainly chemical and pharmaceutical industries emerged with a greater force during seventies. It stabilized in eighties and the nineties showed a slow declining trend. The transition period of textile to chemical phases has registered a

lower population growth rate. While the advent of chemical phase showed a sharp rise in urbanization process.

The two processes of urbanization and industrialization are going hand in hand. So far, the geo-environmental factors have not controlled the growth process adversely. Certain infrastructural facilities have showed adverse indications like water supply and waste disposal. The water supply has been managed by importing major share from exogenous sources while the waste disposal is partly managed and partly neglected. These geo-environmental aspects are increasingly showing their adverse impacts and warrant for due consideration in the future course of infrastructural services and industrial growth.

The study area gets sharply divided into parts from the anthropogenic point of view, viz. the Ahmedabad Urban Complex (AUC) within AUDA limits and the new state capital of Gandhinagar. The AUC has grown over several centuries having well defined developmental history while, the city of Gandhinagar is a very recently created urban centre with just 30 years of age. The town has well defined planning for almost all aspects of modern city with adequate infrastructure and also blended with industrial estates and thermal power plant. Its environmentally sound planning has almost no conflict with the natural attributes. However, there are large tracts of unproductive land, lots of rainfall runoff goes waste and the land along the Sabarmati bank has been subjected to increasing pace of gully erosion.

WATER SUPPLY

Groundwater has been the major source of water supply. A part of the supply is obtained from Sabarmati river. Considering the present population of about 5 million the requirement at urban supply rate of 150 lpcd works out 750 mld. Adding industrial and other requirements of about 250 mld, the total need is 1000 mld i.e. 350 MCM/yr. Allowing distribution losses, the annual demand could be considered at 400 MCM/yr. As against this, groundwater exploitation from the area is about 200 MCM/yr. Almost 70 % of the AUDA population has been concentrated in the AUC area where local groundwater is supplemented by the Sabarmati-Dharoi surface source. Similarly Gandhinagar is also supplied by both, the Dharoi and groundwater sources.

This has caused the problems of overdraft i.e. groundwater mining, and quality deterioration. It warrants for alternative source. Dharoi source itself is in short supply. Since the reservoir has lower dependability (70%) and there being free release in the river for 160 km, there are heavy looses and irrigation pilferages. The actual availability at Dudheshwar intake is relatively low. In fact, nearly 900 mld is being released from Dharoi for AMC, Gandhinagar and AEC. The regular flow is difficult to maintain. Thus, the groundwater and Dharoi water are inadequate for the present supply. It calls for other dependable sources. A definite quota has been allocated for AMC from the Narmada project. However, looking to the uncertainties of the Narmada and Dharoi sources and fast depleting ground

water source as against the rapidly increasing demand, the area faces a serious problem at the present and needs a long term planning.

Considering the 35% growth rate, the population of the area after 30 years (2031) would be of the order of 15 million. Considering the 200 lpcd supply including industrial and others, the requirement would be 3000 mld (1100 MCM/Yr.). This calls for development of combined sources of groundwater and surface. It also warrants for water saving, recycling and other appropriate technology. The local and regional environment has its own limitations to provide this high scale demand. The geo-environmental compulsion calls for a fresh and integrated planning approach.

WASTE DISPOSAL

Considering liquid waste generate at a rate of 1:0.7 (fresh water supply to waste) the present waste is being generated at the rate of about 525 mld and the same after the 30 years (2031) would be the order of 2000 mld. This causes a problem of appropriate disposal. This large quantity could be viewed as an opportunity and be considered as a 'resource out of place'. Appropriate technology of recycling would serve the dual purpose of disposal as well as supply source. This is a unique challenge as well as opportunity from environmental and technological angles. Unfortunately, at present, there is no adequate system of the waste disposal especially that for the industrial effluent. It has also been observed that, some of the highly toxic waste is being disposed by the industry itself to the underground

aquifers through secret injection wells. This is a severe environmental threat to the precious groundwater resource. The other 'treated' effluents and sewage are being used for irrigation through the Vasna-Fatehwadi canal project. The accumulation of toxic trace elements in the soils and ground water system increasingly degrades the command area. The present system of disposal for irrigation is also not an environmentally sound practice.

There is growing awareness for environmental protection. The present practice of waste disposal is environmentally not acceptable. Recently, there have been court cases too. The industrial growth has been checked by the waste disposal practice and that in term checks the process of urbanization. This therefore warrants for a policy level review of industrial development in respect to environmental protection. The Khari-cut irrigation canal has of late, been converted into effluent disposal perennial channel. It has adversely affected the command area of the nearly a century old sustained canal irrigated practice.

MITIGATION AND ENVIRONMENTAL PLANNING

Of late, the recent development stress has posed the problems of water supply, waste disposal, floods, land erosion, inundation, and droughts. If the process continue unabated, it may lead to serious environmental problems in the near future. This present situation therefore calls for programme of hazard mitigation and environment appropriate future planning. Some of the issues are briefly discussed here under:

RAIN-HARVESTING AND RECHARGE

The GWRDC considers 50 % of rainfall as natural rate of recharge. However, considering the covered land area and other bad land areas, the actual effective land available for natural recharge is less. Taking advantage of the most favourable hydrogeomorphic conditions of the area, augmenting and artificial recharge has got tremendous potential. The terrain could be treated by way of developing the existing system of drainage and ponds so that maximum of rainfall could be harvested and a bare minimum runoff may go out of the area. This way about 25 % of rainfall runoff be harvested, and 20 % be effectively used for recharge purpose by natural bed percolation and artificial injection. This way about 300 MCM/yr new resource could be generated. In addition Sabarmati river flows from catchment could also be effectively used for recharge and from its 20-km stretch from Gandhinagar to Ahmedabad about 100 MCM/yr could be recharged. Further, roof collection at 60% of rainfall from 100 sq km built up area would yield about 5 MCM/yr for recharge. Thus cumulative recharge of the order of the 600 MCM/yr appears feasible. This way, total water supply needs could be satisfied on sustainable basis.

The present practice of imparting surface water from Dharoi is environmentally not sound. It has less dependability and the supply is at the cost of the upper catchment environment. Mahi and Narmada are better and more reliable sources for supply.

TERRAIN DEVELOPMENT

The harvesting, conservation and storage of run-off through the development of terrain features like ponds, drains, slopes, cuts etc. would help in relieving the present land locking conditions and solving the problem of monsoon inundation, flooding, public health hazards etc. The available water is used for recharge and environmental regeneration.

The soils of the area are subjected to fast degradation due to faulty irrigation practice with industrial effluent and high dose applications of pesticides and chemical fertilizers. The industrial effluent need be treated to the extent acceptable for crops. Shift from chemical fertilizer to organic manure and paste system will not only help maintaining the soil fertility but the groundwater contamination could also be checked.

The landscape has good potential for development and can be put to productive uses. The lands along the banks of drain lines are subjected to high rate erosion. Especially, the Sabarmati bank area in the ravines, the soil loss is extremely high. A well planned programme of soil conservation and reclamation through organic techniques will help conserving the loss of precious resource. The specially designed programme of gully erosion zones can provide more stable land for a variety of uses like horticulture, agriculture, recreation, etc.

The terrain offers the scope of more high rise buildings, so the large population be accommodated in small area and large pockets of open lands can be saved within

the built up areas. This land will have multiple uses like garden, ponds, recharge zones, etc.

INDUSTRY OPTIONS

The present intensive chemical industrial setup is most adverse to the environment especially from the waste generation and disposal point of view. The present growth rate is already showing declining signs. In view of the local geo-climatic conditions it is essential that the chemical base industries change to electro-mechanical and electronics. The shift is environmentally warranted.

SUMMARY STATEMENT

The study area has been endowed with several favourable geo-environmental attributes, especially those related to sub-surface geology and geomorphology. The climatic attributes have mix impacts of harsh conditions but reasonably favourable hydrometeoric conditions. The dynamics of geo-environmental system have produced rich natural resources like fossil fuels, extensive aquifer system for large scale storage and recharge for groundwater. A good landscape offering multiple use options, well developed soil profiles, etc. The Sabarmati basin providing high potential of surface run-off and at the same time richer and better developed basins in the close vicinity. The rich resource base has supported high load of development from the urban and industrial stress. Of late, some signals of over stress are being observed by way of short water supply, industrial pollution to the land and water system in the SW downstream parts and the neighborhood. However, there is ample scope of arresting the degrading trend by mitigating measures like rain-harvesting, terrain development, waste management, adopting proper industrial option, modifying the land use pattern, etc. The contrast of unplanned growth of the Ahmedabad urban-industrial complex with degradational fallout from that of the reasonably well planned township of the Gandhinagar city present an ideal example from this single and small study area. Outcome of the study indicates a need of perspective planning for the future developmental programmes which should be based on the considerations of the local and regional geo-environmental setup. The nature has to offer a greater resource potential for environmentally sustainable development plans.