

The Sardar Sarovar dam and its impact

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Abstract: - The Sardar Sarovar dam is western India lynch-pin of a mammoth development project on the river Narmada, one of the oldest and holiest of India’s rivers, almost pre-historic. It was in the Narmada basin that early man is believed to have evolved. Geologists have proved that forty million years back, an offshoot of the Arabian Sea penetrated the landmass, which later became the Narmada. The Narmada River is the only major river in western India. It flows west from the Amarkantak, cutting through the fabulous marble hillsides around Jabalpur, meandering through MadhyaPradesh, Maharashtra, and Gujarat for 1312 km (Sardar Sarovar Project on the river Narmada, Ravindra H. Dholakia) till it empties into the Arabian Sea at the Gulf of Cambay, near Bharuch.

The “Sardar Sarovar Project” is one of the largest and most ambitious river development projects in India. Its aim is to harness the water of the river Narmada and provide much needed water to the arid areas, particularly in Gujarat. The problem of water shortage has always been most acute in Gujarat. The western part of the state in particular has always been subjected to droughts due to paucity of rainfall and shortage of both ground and surface water. The Narmada dam (Sardar Sarovar) with its network of canals was expected to substantially change the land use pattern in Gujarat and help to recharge the ground water resources while ensuring perennial flow of surface water within the command area of the Sardar Sarovar project. A study of the impact of Sardar Sarovar dam on large dam development projects can have numerous positive and negative consequences.

Keywords— Sardar Sarovar Dam construction, River, positive and negative impact on district, consequences.

I. INTRODUCTION

The Sardar Sarovar dam and the area selected for study, i.e. Narmada district. It explains the historical evolution of the river water dam as well as the main characteristics. Some project benefits and problems are also highlighted. For obtaining a better understanding, the course of Narmada River in the central parts of the country and in the State of Gujarat as well as Narmada district is studied from a regional point of view. Also explained is the religious importance of the river. Thereafter, a brief account of Narmada district is presented which describes its origin, location in the State, and its significance.

Rivers of India play an important role in the lives of the people. The river systems provide irrigation, potable water,

cheap transportation, electricity, as well as livelihoods for a large number of people all over the country. This is perhaps an important reason why nearly all the major cities of India are located by the banks of rivers. The rivers also have an important role in Hindu mythology and are considered holy by all Hindus in the country.

Dam building is integral to India's development vision, and the Sardar Sarovar dam was constructed to realize this vision. The project has overcome many engineering and technological challenges during its journey from concept to realization. It is one of the most studied water resources project of the world and has successfully adopted path breaking approaches to arrive at technological solution at every step of its implementation. It is a forerunner in offering new dimensions and evolving fresh engineering standards be they in planning, design or implementation.

Narmada district is primarily a rural, tribal, agricultural district and after the completion of the dam project, people living in the district have benefitted in various ways. The agricultural production has grown over the years due to development of irrigation facilities, and there is increase in the number of households covered by drinking water and electricity. However, the work related to the relocation of villagers due to the dam project could have been carried out in a better way, evident from the non-availability of essential services at the new location sites. Based on the prevailing nature of problems, an attempt has been made to propose a strategy for the balanced development of the district.

II. IMPACT ON DAMS

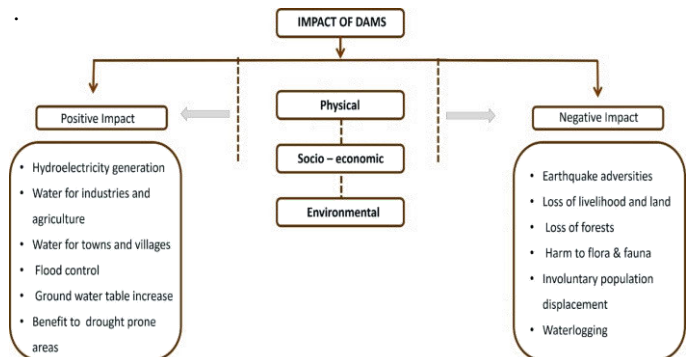


Fig. 1. Flow chart depicting the impact of dams

Figure 1 show the positive and negative impact on dams' considering of physical, social, and environmental, regional

development imbalances are prominent in India states, and remotely located areas and settlements are lagging behind. (1) Social sphere quality of life, people are generally poor. Many do not have access to basic facilities and services. (2) Economic sphere, the local economy is unable to support the people due to insufficient government support. Inadequate employment opportunities have been created. (3) Territorial sphere availability of a market, education, health care services, infrastructures are matters of concern environmental degradation is noteworthy. The problem of inequalities has not been adequately addressed, with regional disparities persisting. This study looks into the experience of dam buildings on rivers as a strategy for the promotion of regional development.

III. RATIONAL FOR SELECTION OF CASE STUDY

Sardar Sarovar Project and Narmada District of Gujarat have been selected for the study. The following aspects have been considered for selection:

The Ministry of Panchayati Raj named Narmada one of the country's most backward districts in 2006.

The Asian Human Rights Commission reported in 2014 that some villagers from Gadher in Narmada district gave up their lives because they did not get compensation even after 25 years since their eviction from their village.

7 % of the rural population and 61 % of the urban population had access to tap water from treated source in 2011.

During the same year, 82 % of rural population and 94 % of urban population had electricity as the main source of lighting. Gujarat is a water – deficient state. Fresh water availability in the state was only 1.137 cubic meters per annum per person against the national average of 2,000 cubic meters.

The project has the potential to feed up to 25 million people, provide domestic and industrial water to about 30 million people, employment to about 1 million people, and provide electric power.

Multipurpose water development project is unique in many ways. On completion it will have the distinction of being the largest irrigation system in the world.

Sardar Sarovar Project is the first project in the country to obtain environment clearance from Ministry of Environment and Forests.

Background of the Study

The Narmada, also called the Rewa, is a river in central India and is the fifth longest river in India. Narmada basin presents a varying topography, the upper most part of the terrain being hilly which gives rise to the largest west flowing river Narmada at Amarkantak . As the river progresses in its middle part, the terrain becomes a fertile plain. The lower most part of the basin is the coastal region where the river joins the Arabian Sea.

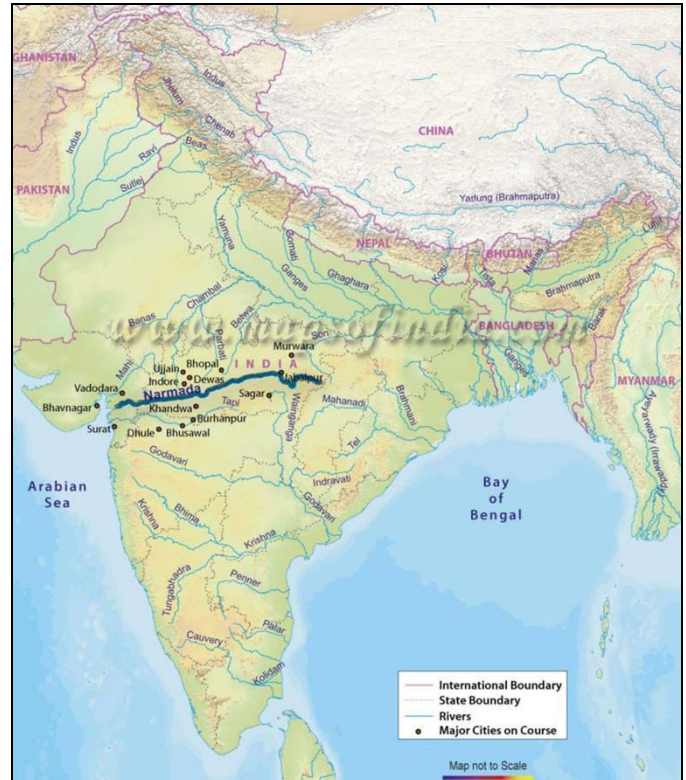


Fig. 2. Stretch of Narmada River on the map of India

Source: -India - WRIS

Figure 2 the basin is divided into 3 sub-basins, i.e., the upper, middle and lower sub-basins having a total of 150 watersheds. 19 important tributaries along with the main river Narmada, drains an area of 92,672.42 Sq.km and lies at longitudes 72° 38' to 81°43' and north latitudes 21° 27' to 23° 37' which is 3 % of the total geographical area of the country.

The total length of the River from the head to its outfall into the sea is 1,312 km. The first 1079 km. is in Madhya Pradesh. The next 35 km at the boundary between MP and Maharashtra, about 39 kms is between Maharashtra and Gujarat. The last 159 km of flow is through Gujarat.

The total basin area of the river is 97,410 square kilometer comprising 85,858 square kilometer in Madhya Pradesh, 1658 square kilometer in Maharashtra and 9894 square kilometer in Gujarat. The drainage area up to dam site is 88,000 square kilometer. The mean annual rainfall in the basin is 112 centimeters. The annual run of the dam site at 75 percentage of dependability is 27.22 MAF. The World Bank computed the yield of 28.57 MAF while the yield computed in May 1992 by the Central Water Commission, Government of India is of 26.60 MAF, i.e. about 27.00 MAF. The utilization of Narmada River basin today is hardly about 10 %. Thus, water of the Narmada continues to flow to the sea unused.

(Sardar Sarovar Project on the river Narmada, History of design, planning and appraisal. Ravindra H. Dholakia, Volume one)

The Sardar Sarovar Dam Project

Sardar Sarovar project was envisaged to solve the water availability problem and provide water to water-stressed areas. The dam is considered as the life line of Gujarat.

This Prodigious project is one of the largest dam projects in India. The importance of this project is in the benefits that will be available to Gujarat after the project has been fully completed. It has been operational since 1997. The ultimate irrigation potential to be created through surface water is 3.94m hectares. The Sardar Sarovar project has potential to create irrigation potential of 1.845m hectares. Will be created through Sardar Sarovar project. The project is planned to provide drinking water to 9633 villages and 131 towns. Since the project is in the implementation stage, the management framework is not fully developed. This gives an opportunity to address water related issues which are prevalent in Gujarat, especially in the Sardar Sarovar command area.

There is today a growing awareness about use of renewable resources for regional development. In this context, large dams are becoming major development investments to meet the growing food and energy needs of developing countries. Much emphasis is being laid to tackle the problems of provision of irrigation, food control, drainage and water supply in an integrated manner, culminating into a multipurpose approach towards planning, pointing to the multiple benefits obtained from large dams, viz, food security through irrigation, clean water for drinking and increased supplies of energy for industrialization. Power is extensively used in industry, agriculture and various tertiary sectors of the economy. It also enhances quality of life. Among the issues raised are problems related to effective water management. Large dams often imply large scale population displacement, conversion of wetlands and forests to water area, issues pertaining to resettlement and environmental damage. In other words, such projects pose various social, economic and environmental challenges. The most important aspect of dam planning which is of particular interest to regional planners is the spatial implication of such projects on the spatial organization and structure of settlements.

The reservoir created by the dam has led to the submergence of 19 villages in Gujarat extending over an area of 7469 hectares, affecting 4,728 families. Consequent to this is the change in the pattern of regional linkage, which would reflect upon the spatial hierarchy of settlements.

Therefore, it becomes imperative to study the impact of water resource development projects on the regional settlement pattern.

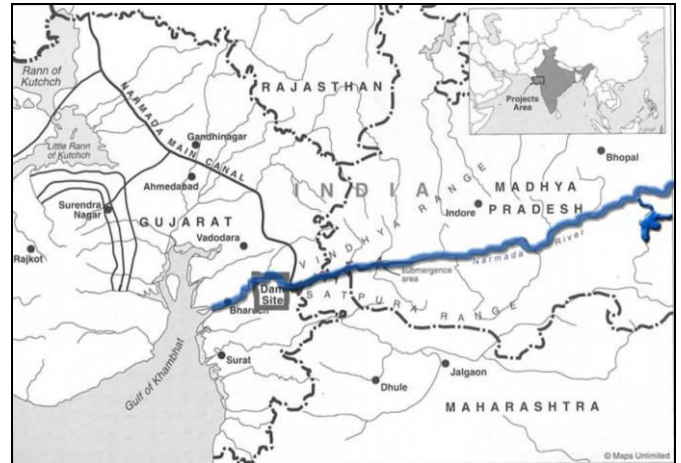


Fig. 3. Narmada District and Narmada River in Gujarat

Source: Maps of India.

The Sardar Sarovar Project is an inter-State multi-purpose project on the river Narmada in Gujarat. It is a joint venture between the States of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. Although the Project was originally envisaged in the year 1946, due to the dispute regarding sharing of waters of the Narmada among the co-basin States, its implementation could not be initiated. Under the Inter-state Water Disputes Act, 1956, Narmada Water Dispute Tribunal (NWDT) was, therefore, set up in 1969 to adjudicate on the dispute relating to sharing of water of the interstate river Narmada and its valley. The NWDT, considering the development of the water resources of the basin as a whole, gave its award in 1979 allocating share of water of Narmada based on 75 % dependability and power of Sardar Sarovar Project. The project was formulated in accordance with the decision of the Tribunal and presented to the Government of India in 1980. It received clearance from the environmental and forest angles in late 1987 and investment clearance of the Planning Commission in October 1988. Allocation of water at 75% dependability is as follows: Madhya Pradesh: 18.25 MAF, Maharashtra: 0.25 MAF, Gujarat: 9.00 MAF, and Rajasthan: 0.50 MAF. (sardar sarovar project on the river narmada, impact so far and ways forward, volume 3)

The full contours of the Narmada Valley Development plan (NVDP) appeared only toward the late 1980s. It is an ambitious plan which envisages the building of 30 big dams, 135 medium dams and 3000 small dams on the Narmada and its tributaries. If all of these dams ever get built then the river as we know will disappear and all that will be left are a series of lakes.

The dam has been operational since 1997 and due to a number of controversial cases before the supreme court of India (1999, 2000, 2003), by 2014 the Narmada Control Authority had

approved a series of changes in the final height and the associated displacement caused by the increased reservoir, from the original 80 m (260 ft) to a final 163 m (535 ft). Its catchment area is 88,000 sq.km., total power generation capacity is 1450 MW comprising an underground River Bed Power House (RBPH) with six units each of 200 MW reversible type Francis turbine, a surface Canal Head Power House (CHPH) with five units each of 50 MW conventional type Kaplan turbine, a GIS switch yard complex, and the 400 KV power transmission network up to MP-Gujarat and Maharashtra -Gujarat borders in Gujarat. Sardar Sarovar project will irrigate more than 18,000 km², most of it in drought prone area of Kutch and Saurashtra.

(Sardar Sarovar Project on the river Narmada, History of design, planning and appraisal. Ravindra H. Dholakia, Volume one)

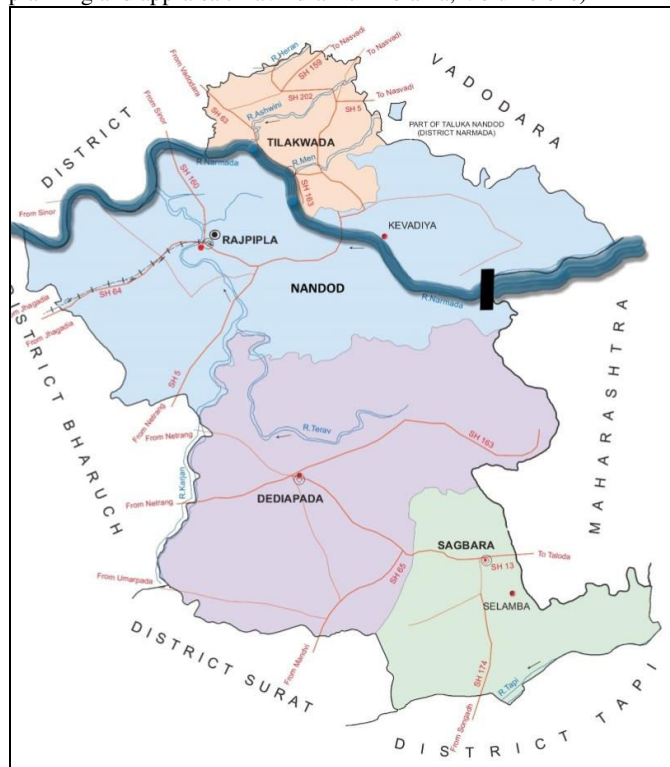


Fig. 4. Narmada District and Location of Sardar Sarovar Dam
Source: - census of India,

Narmada District and Location of Sardar Sarovar Dam

Sardar Sarovar Dam (SSD), on the Indian Narmada River, is built near Navagam located in the village of Kevadia in the state of Gujarat. It is one of the largest and most controversial Interstate, multipurpose river valley infrastructure development projects in the country. The Sardar Sarovar Project (SSP) also consists of auxiliary works and a 1,450 MW power complex.

Narmada district is located in the southern part of Gujarat. It shares its border with the State of Maharashtra and is bounded with Surat in the south, Vadodara in the north, and Bharuch in

the west. Geographical location of Narmada district is 21.24 degree to 22 degree North (Latitude) and 72.4 degree to 73.15 degree East (Longitude). The main rivers of this district are Narmada, Karjan, Mahi, Ashwini and Tarap. Average rainfall here is 1,100 mm.

The nearest airports to Narmada district are in Surat and Vadodara. Major State roads connect Narmada with key industrial centres in the State: Ahmedabad (195km), Rajkot (357 km), Jamnagar (467 km), Ankleshwar (75 km), Bhavnagar (357km), Mehsana (269 km), Surat (83 km), Gandhinagar (223 km) and Vapi (150 km). There are four railways stations in Narmada district.

Religious importance

The Narmada River is one of the five holiest rivers in India and the other four are the Ganges, Godavari, Yamuna, and Kaveri. It is assumed that a dip in any of these rivers will help you get rid of your wrongdoings. In mythology, it is stated that the Narmada is older than the Ganga. The Mahabharat, the Ramayana, and the Puranas mention about the Narmada quite often.

There are many fables about the source of the Narmada. According to a myth, once, Lord Shiva, meditated so hard that he started perspiring. Shiva's sweat gathered in a tank and started flowing in the form of a river - the Narmada. Another legend has it that two teardrops that fell from the eyes of Lord Brahma, the Creator of the Universe, yielded two rivers - the Narmada and the Son.

Impact of multipurpose dam projects

Recent years have witnessed a growing awareness of the impact of dam construction. While dam advocates points multiple benefits of dam in terms of irrigation, water supply, energy etc. on the contrary dam opponents happen to be highlighting the social-economic and environmental costs of large dams which often imply large scale social disruption. Submergence of forest area is an overlapped economic and environment problem. Regional scientists/experts working on this project see following areas of concern:

Social impact

The social impact of multipurpose projects are related to factors such as population mobility, density displacement, community growth, education and other public facilities, transport network etc. The area submerged by the dam results in disruption of family and community patterns. All affected population is shifted and resettled in a new location. The change means, a shift from an area to which they are traditionally and emotionally attached. In other words the social fabric of the affected villages gets destroyed.

Furthermore, there is an influx of construction workers which strain the existing housing supply and education facilities. The existing transport facilities get overloaded with the influx of construction workers and later by recreationists and project induced growth yielding a shoot up in vehicular traffic.

Reservoir created by dam results in a transformation of the spatial organization of settlement; some settlements get fully submerged and others remain partially affected. Moreover, the submergence of regional network results in the relocation of new routes which completely transcends the structure and organization of settlements resulting to change in their socio-functional relationship. Thus there is a need for an altogether new organization of these settlements, required to fulfill functions related to their new developments.

Economic impact

Economic implication of multi – purpose project one is of the major characteristic of employment pattern. The employment opportunities are based upon the standard of living.

Further the occupational pattern of the affected population undergoes a change, in response to a new working condition, and the change environment.

Environment impact

Amongst the various environmental influences of dam construction, variation in river's discharge and course at the downstream level gives a vital and direct impact. The tropical continents have occasional downpour and fog occurrences. There is a possibility of induced earthquakes and landslides, polluted discharges, accidental spills and decreased rate of natural dilution of water discharges resulting in the deterioration of water quality. Water discharge from thermal power plants and variability of stream flow adversely affect fisheries and other aquatic organism. There is a loss of wildlife resources due to inundation at the downstream and destruction of their habitat.

Findings of the study

A study of impact of Sardar Sarovar Dam on Narmada district the population of the district has benefitted from the dam project in various ways. The district is dominated by tribal population and its economy is driven by the agricultural sector. With the operation of the dam project and the increased availability of water, there has been a rise in food crop production. The study shows that due to flourishing agricultural activities, employment has been generated. This also implies increasing incomes of the population engaged in the agriculture sector. The second impact of the dam project is the increased availability of electricity. This is particularly noted in rural areas of the district, where the percentage of households having access to electricity. The third impact is seen on the place of residence of the district population. Due to creation of reservoir, the families located in the submergence area were relocated to new sites at various places in the district and provided with basic amenities. This study also found that several problems of social and economic development exist in the district. These are described below along with suggestions to overcome.

Agriculture

Water logging in 1.5km on both sides of canal affects cultivation in monsoon season and also results in increase in ground water table by 4 to 7 feet. Positive and negative impact of this problem on the cropping pattern may be described here: some crops can grow well in short term and thus large benefit of production is achieved while in some cases due to seasonal variation it not possible to get good productivity. This creates losses to the economy. Seasonal farming is disturbed as agriculture zone remains flooded during monsoon season and sufficient crop storage and selling facilities are not available.

To overcome these issues, new network of drains should be built. To divert the excess rainfall and floods caused thereby, this is very essential. The canal network can reduce this problem by carrying water away. Additional storage centres and mandis should be provided. Economy of Narmada district is agriculture based and in the present scenario there is acute shortage of mandi facilities in the district.

Infrastructure

Road connectivity is very poor in rural areas. In the regional context, many settlements are not connected with proper

roads. Absence and limited presence of public Transport system adds to the problem. Other infrastructure issues are power supply in urban and rural areas. 100% electricity is not available in Narmada district. The district lacks social infrastructure such as dispensary as well.

The rural environment is often the growth engine of a country. The food supply and the rural population are custodians of the environment and ecosystems. Planners of rural development need to address the complexities of these interconnecting priorities and need to know how the road provision fits into the larger goals of rural development, and the priorities for economic and social growth. There exists an urgent need for conversion of kutchcha roads into pakka / metal roads, and Provision of public Transport system in the district.

Substations are required to be provided in Tilakwada Taluka of 10 MVA / Nandod 10 MVA / Dediapada 20 MVA / Sagbara 10MVA.

Provision of more Health facilities and Infrastructure is required at District level.

Table 1 Conclusion, issues and suggestions

Sector	Description	Suggestion
Agriculture	<ul style="list-style-type: none"> • Water logging in 1.5km. on both sides of canal affects cultivation • Rise of ground water table (4 to 7 feet) • Seasonal farming disturbed as agriculture zone remains flooded during monsoon season. • Sufficient crop storage and selling facilities are not available 	<ul style="list-style-type: none"> • Network of drains to be built • Additional storage centers and mandis to be provided
Infrastructure Road Connectivity Transportation Electricity Dispensary	<ul style="list-style-type: none"> • Many settlements are not connected with good roads • Absence and limited presence of public Transport system • 100% Electricity not available in Narmada District • Limited Social Infrastructure 	<ul style="list-style-type: none"> • Conversion of caccha road / village road into pakka / metal road • Provision of public Transport system at Required area • More Electricity to be provided in Tilakwada Taluka 10 MVA / Nandod 10 MVA / Dediapada 20 MVA / Sagbara 10MVA • Provision of more Health facilities and Infrastructure at District level
Displacement and Resettlement	<ul style="list-style-type: none"> • Senior citizens not happy with compensation package • Many basic facilities (Flour mill, post office, fair price shop, bus stop, dispensary) not provided at new sites • Water logging during rainy season 	<ul style="list-style-type: none"> • Identification of beneficiaries who either had not claimed or missed out their compensation package for some reason during the process of land acquisition • Provision of basic facilities • Improvement of drainage

Environment

Major environmental impact has been in the upstream area: 13,700 hectares of forest in submergence zone have mostly been cut. There are changes in flow patterns in river in the downstream region. This has had adverse effects on the aquatic life and thereby on the life of fishermen.

Compensation by way of a forestation has been done by the government. Though there is high bamboo production in Narmada district there is no proper marketing mechanism available. Therefore a bamboo center has been proposed in the district by considering the locational feasibility.

Fishermen families who lost their means of living have to be identified and included in the Sardar Sarovar Project Rehabilitation Package.

Displacement and Resettlement

Many families are not satisfied with the compensation package received. The land obtained as compensation had problems related to accessibility. The resettlement was done without considering the cultural differences. The new land provided displaced the tribal population into different parts of the area. This has created problems in their social life which

depended on them being together. Lack of basic facilities also create problems in the region. The problem of water logging is also prominent in the region.

For the citizens who have not claimed or missed their

compensation, an identification process should be carried out so that it is ensured that the beneficiaries are found out and compensation given. Basic facilities should be provided in the region which will ensure better standards of life. Improvement of drainage facilities also requires attention. District Development Strategy.

District Development Strategy

The development strategy proposed will ensure overall development of the region. New roads have been proposed in such a way that the connectivity is improved among the villages. It is to be ensured that these roads fit in to the existing road network. To improve the economy of the region, proposals have been made keeping in mind the existing

scenario of production and distribution. The proposed storage depots and mandis will ensure that the farmers get a fair price for their produce. Also, a bamboo center has been proposed in the region. In order to improve the power supply system new substations have been proposed. The proposal of the dispensaries will ensure better access to healthcare facilities in the rural area.

Conclusion

A study of impact of Sardar Sarovar Dam on Narmada district presented in the population of the district has benefitted from the dam project in various ways. The district is dominated by tribal population and its economy is driven by the agricultural sector. With the operation of the dam project and the increased availability of water, there has been a rise in food crop production. The study shows that due to flourishing agricultural activities, employment has been generated. This also implies increasing incomes of the population engaged in the agriculture sector. The second impact of the dam project is the increased availability of electricity. This is particularly noted in rural areas of the district, where the percentage of households having access to electricity. The third impact is seen on the place of residence of the district population. Due to creation of reservoir, the families located in the submergence area were relocated to new sites at various places in the district and provided with basic amenities. This study also found that several problems of social and economic development exist in the district.

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