International Journal of Academic Research and Development
ISSN: 2455-4197
Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 3; Issue 4; July 2018; Page No. 15-19

Indira Gandhi canal project environment and changing scenario of western Rajasthan: A case Study

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Abstract
In the Western part of Rajasthan state lies the extensive Thar Desert, which is covered in rolling dunes for almost its whole expense. The annual precipitation on an average in between 200 -300 mm. The Indira Gandhi Canal Project (IGCP) has been constructed in the North-Western part of the state of Rajasthan covering a part of Thar Desert districts i.e. Ganganagar, Churu, Hanaumangarh, Bikaner, Jodhpur, Jaisalmer and Barmer. It is a multidisciplinary irrigation cum area development project aiming to do desertify and transform desert waste land into agriculturally production area. The project objectives include drought proofing, providing drinking water, improvement in environment, afforestation, generating employment, rehabilitation, development and protection of animal wealth, greenification, increase of tillable land, road construction etc. The Indira Gandhi Canal has been transforming the Western part of Rajasthan lither to, covered with vast sand dunes into a land of grainary and greenery. Crops of wheat. Mustard, paddy, groundnuts, sugarcane and cotton etc. flourish with available canal irrigation where nothing but sand rules the root for the year. The main aim of the present work is to highlight how Indira Gandhi Canal Project become the boon for Western Rajasthan.

Keywords: IGCP, climate, aforestation, moisture regime, agriculture and water logging

Introduction

Indian desert extends approximately between 210 to 310 North latitude and between 660 to 760 East longitudes, comprising an area of about 295,000 km2. The Indira Gandhi Canal Project (IGCP) is the largest desert area irrigation cum multipurpose project system in the world. It has been constructed in the extreme North-Western districts of Rajasthan i.e. Ganganagar, Churu, Bikaner, Jodhpur, Hanumangarh, Jaisalmer and Barmer. The IGCP formally commenced on 31st March 1958 after the signing of the Indus water treaty with Pakistan through which India became entitled to the exclusive use of the three Eastern rivers of the Indus system- Ravi, Beas and Satluj.

This project was a gigantic human efforts to transform a part of the lands of hot desert into a land of prosperity. This canal is 40 meters wide and 6.4 meters deep. The carrying capacity of canal is 18,500 cusecs of water at its head. The Indira Gandhi canal project comprises two different stages of their construction.

Stage 1: The construction work under stage-1 has been completed. It comprises 204 km long feeder canal, 189 km long main canal and 3123 km of distribution system. Stage-1 has five flow branches and one lift canal. The canal command area and intensity of irrigation are 528 thousand hectares and 110% respectively. Out of 528 thousand hectares, 46 thousand hectares of land irrigated by Kanwar sain lift scheme.

Stage 2: Construction work of stage-II is still in progress (in some parts). It includes the Indira Gandhi main canal from its 189th km to the tail upto 445km and distribution system having a length of 5409 km. This stage has five flow branches and five lift scheme. The main flow branches are Dattor, Birsalpur, Charanwali, Digha and Lilwa branches while Gajner, Kolayat, Phalodi, Pokaran and Nohar-Sohwa are lift schemes. This stage would cover a canal command area of 1100 thousand hectares at 86% intensity of irrigation. Out of 1100 thousand hectares, 301 thousand hectares having by five lift scheme.

The Indira Gandhi Canal Command Area (IGCCA) however, covers approximately 4.7% of the arid zone of India and nearly one twelve part of the Rajasthan state. With the completion of main canal it will lay over 649 km and to flow through mainly Ganganagar, Bikaner, Hanumangarh, Jaisalmer and Barmer districts. The canal is oriented approximately parallel to the India and Pakistan border at an average distance of 40 km (Figure 1).

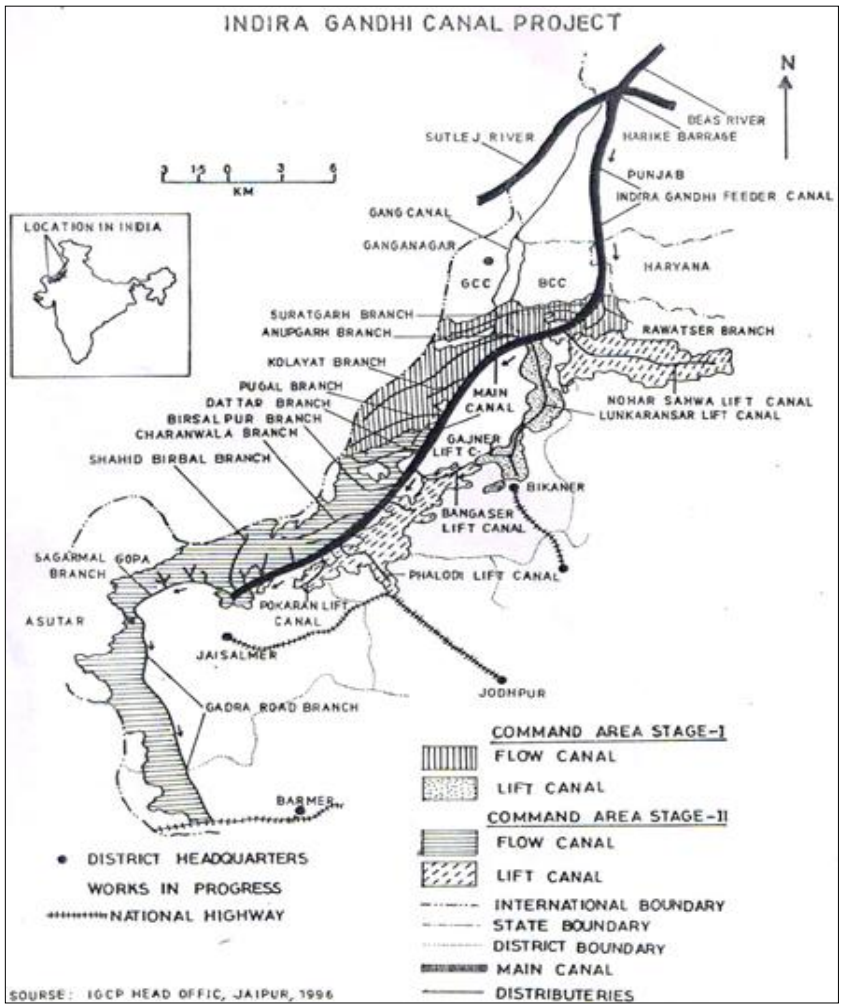

Fig 1

The introduction of Indira Gandhi Canal Project in the barren and thirsty climatic land of Western Rajasthan is bound to have a profound influence on the ecosystem. The irrigation facilities provided by the Indiara Gandhi Canal, the conservation of arid land into cultivable field and the tremendous increase in population will have a great influence on the ecosystem. The IGCCA could be classified into various major landforms. These landforms had been created by endogenic and climatically controlled by exogenic processes. The fluvial process created vast alluvial plains under prolonged wet phase. The sand dunes and sandy plains were formed by Aeolian process during the prolonged dry phase. Fluvial and aeolian landforms due to significant variations in the morphopedological characteristics have different production potentials. Before the introduction of irrigation facilities, these landforms by and large were used for growing rainfed crops and for grazing purpose. The introduction of Indira Gandhi canal had resulted into the good and ill effects on the biophysical potential of different ecosystem.

Database and Methodology

The present research work depends on both primary and secondary sources of data, collected from the head office of Indira Gandhi Canal Project Jaipur, district head office, regional office-Bikaner, and command area development office, forest department of Rajasthan-Jaipur, district hand book etc. and personal observation: apart from this many experts have contributed individually.

This research paper is based on secondary as well as primary source of data therefore, a well-structured questionnaire prepared for the field investigation. Village is considered as the primary unit and on the basis of random sampling 5% households have been taken into consideration. The collected information processed, tabulated and analysed for interpretation for getting the purposeful result. Imperial observation have also and impact on the final result of the study.

Results and Discussion

The introduction of irrigation through the Indira Gandhi canal project in sandy, barren and hot climatic land has caused both positive and negative impacts on ecology of Thar desert.

Positive Impact

Irrigation was commenced in the Indira Gandhi Canal project in 1961. The major positive impact of canal irrigation has been as follows:

A. The aeolian activities which were responsible for sand drifting and degrading large acreage of agricultural land are minimised and acreages under degraded land has

decreased particulrly in Hanumangarh, Bikaner and Western parts of Jaisalmer districts command areas. The sandy hummocks and low dunes have been levelled and reclaimed for growing cereals, pulses, some cash crops like cotton, groundnut and vegetables.

B. The irrigation in hot arid land of Western Rajasthan through Indira Gandhi Canal, particularly in the districts-Ganganagar, Hanumangarh, Bikaner, Jaislamer and Barmer has improving the micro-climatic conditions. It has resulted in minimising the dedicating effects of temperature and strong winds on biomass production and settlements. In other words, the harsh and inhospitable climate of these region has become milder and favourable for growth of plants and raising of habitation.

C. The 649 km long Indira Gandhi Canal project is to cover the Western Rajasthan districts such as Ganganagar, Hanumangarh, Churu, Bikaner, Jodhpur, Jaisalmer, Barmer to irrigate more than 9.8 million ha. of parched but extremely fertile and virgin land. The moisture regime within the soil, after the irrigation has improved and their erodability has decreased. These tremendous changes have also influenced the fertility status of the soil particularly in Bikaner, Hanumangarh and Jaisalmer districts command area, the compactness and moisture reteintion capacity of the sandy soil has also improved.

D. Massive aforestation along the canal, roads and newly settled areas has been done with the water supply by canal leading in reducing the intensity and impact of blown sand. Pastureland development and sand dunes estabilization works have been carried out so that the supply of fodder can be made available to the livestock in the adjoining villages as well as to the migrating flocks of the animals (Table 1 & 2).

Table 1: Afforestation Programme in Indira Gandhi Canal Command Area, Stage-I

S no.	Particulars	Unit	Tree Plantation	Expenditure (million)
1	Stage-I, Phase-I, Under World Bank			
2	Canal side plantation	Ha.	5500	72.89
3	Road side plantation	Ha.	700	
4	Fuel wood plantation	Ha.	1800	
5	Pasture development	Ha.	35000	
6	Stage-I, Phase-II			
7	Canal side plantation	Ha.	1500	127.35
8	Road side plantation	Ha.	500	
9	Fuel wood plantation	Ha.	700	
10	Pasture development	Ha.	9780	
11	Farm trees	Million	10.0	
12	Stage-I, Phase-III			
13	Canal side plantation	Km. (R)	800	115.50
14	Road side plantation	Km. (R)	120	
15	Fuel wood plantation	Ha.	470	
16	Block plantation	Ha.	600	
17	Sand dunes stabilization	Ha.	268	
18	Form Forestry	Million	7.0	

***Source*:** Office of the Rajasthan Forest Department, Jaipur

Table 2: Afforestation Programme in Indira Gandhi Canal Command Area, Stage-II

S no.	Particulars	Unit	Phase-I	Phase-II	Phase-III	Total
1	Shelterbelt along canals	Ha.	11760	6850	10346	28956
2	Shelterbelt along roads	Ha.	1000	1500	2200	4700
3	Village plantation	Ha.	3000	3000	4500	10500
4	Industrial plantation	Ha.	5000	5000	5300	15300
5	Sand dunes stabilization	No. of plants	45000	30000	42000	117000
6	Farm forestry	Million	1.5	2.0	1.8	5.3
7	Total expenditure	Rs. in million	256.20	277.90	268.70	802.80

***Source*:** Office of the Rajasthan Forest Department, Jaipur

E. To obtain fuel wood, plantation of trees has been carried out so as to meet the daily energy needs of the rural folk Forestry, pastureland development and sand dunes estabilization have been taken on thousand and thousand hectares of land under first and second phase of the project.

F. The agricultural production and productivity per hectare is steadily increasing and the average in dry farming of pearl millet and sorghum in progressively declining from 90% of the total sown area. The sown area under cotton, sugarcane, wheat, rice, pulses, peanuts, vegetables and fruits has increased in recent years. According to the field survey (2017) conducting in 30 villages across different locations, morethan 42% of them are using hybrid seeds, 57% chemicals fertilizers and morethan 55% spray pesticides as plant protection measures (Table 3).

Table 3: Per heaters yield of some selected crops in IGCP command area (in quintal)\

S no.	Sample Villages	Wheat	Gram	Mustard	Cotton	Paddy	Groundnut
1	Husengser	27.90	7.90	9.95	8.90	18.00	13.15
2	Godu	20.17	6.30	7.25	8.10	14.10	14.65
3	Beethnokh	23.50	5.85	8.80	6.90	12.85	13.50
4	Rawara	12.20	4.60	4.10	4.20	13.10	7.60
5	Chinno	11.95	5.20	5.35	3.95	8.15	9.60
6	Nedai	13.00	4.40	6.00	3.85	7.10	8.20

***Source*:** Field Survey

G. The Indira Gandhi Canal is a major step in reclaiming the Thar Desert and checking desertification of fertile areas. There is a planting programme for greening the desert in canal command area of Indira Gandhi was started in 1965. The tree species being used for planting are Dalbergia sissoo, Eucalyptus tereticornis, Eucalyptus camaldulensis, Morus alba, Tecomella undulata, Acacia tortilis, Azadirachta indica, Albizia lebbeck, Cassisa fistula, Populus ciliata, Melia ozedarach and Vachellia nilotica etc.

   The other benefits of Indira Gandhi Canal project in Western Rajasthan are grouped under the following headings:

H. Rise in ground water table at the rate of 0.8 meters/year.
I. Elimination of drought conditions.
J. The canal water is also used for domestic needs.
K. With the plantation along canal and roads, changes the vegetation of the area.
L. Improving the household income and expenditure structure.
M. Rapid rise in the population, increase in the number of villages, new colonies and mandies.
N. Changing the attitude and life style of people resulting in greater urge for education and rise in mobility and communication.

Negative Impact

The Indira Gandhi Canal Project (IGCP) is both glory and sorrow of Rajasthan, no one can have dispute over the fact that the building of such a canal in a hostile desert environment is a tremendous technological feat, experience foresight, planning has combined effects on the beneficial aspects of the canal. The IGCP was deliberately planned to run parallel along the India and Pakistan border. But, now it appears that these strategic and political compulsion might have blinded the project authorities to the ecological and socio-economic problems that would come up with the IGCP.

A. Water logging and salinity are the major problem developed due to the presence of hard-pan at a shorter distance below the surface. The authorities were aware of the existence of large areas with hard-pan of gypsum along the route, but they lined the canal to minimise seepage. However, only to cut the cost, the distributaries and water courses were not lined. The existence of the hard-pan especially in stage-II was not known. Hydrological and Geological surveys are under way and suggest that the previous findings, which put the critical area at around 22% of the command area under estimation. Two decades ago, this area was also studied by Food and Agriculture Organisation (FAO) to assess the impact of canal irrigation in desert area. They recommended the development of pasture land on the basis of topography and the tradition occupation of the people, but the advice of the FAO and others were not taken into consideration. The cumulative effect of all these have led to a gradual rise of water table, even in areas where there is no hard-pan close to the surface. As a result vast areas along the canal have become water logged. Several families have become homeless and landless and more settlements and agricultural land will be affected in future if the suitable measures are not adopted. The official estimate is that 34% of irrigated area in stage-I, is affected by water logging or salinity, chiefly in Ganganagar, Hanumangarh and Bikaner districts command area.

   The main factors responsible for rapid rise of water level are liberal use of canal waters for irrigation and ground water recharge due to Ghaggar flood inflow. The other factors responsible may be as under.

   1. Seepage of canal water
   2. Over-irrigation by cultivators
   3. Absence of natural drainage and out-falls in the area
   4. Continuous pounding of water in Ghaggar diversion depressions

   In most of the area the problem is likely to be eased with the reduction of availability of water due to opening of more and more areas in stage-II, since the share of water of stage-II is also hitherto used in this area. This hypothesis finds support from the observed behaviour of ground water system during the drought year of 1987-88, in which year there was significant reduction in the affected area.

B. The irrigation raises the salt content of the ground water because about 65% areas of the Rajasthan desert has highly mineralised ground water with dissolved soil content over 3200 ppm. Similarly at shallow depth the sub surface salt rich formation may also contribute in the mineralisation of ground water. The large acreage of fertile land in Barmer, Hanumangarh, Bikaner, Ganganagar and Jodhpur districts have been degraded or turned into waste land, because of the use of mineralised ground water. The soil working and water infiltration has been difficult in parts of Barmer and Bikaner districts because of the irrigation with ground water, exploited from granitic formation which has higher content of residual sodium carbonate.
C. The incidence of malaria and others water born diseases are also the major adverse impact of IGCP in the Western-Rajasthan. However, at least survey conducted by NCAER in 1991 & 2000 on the health, impact of the

canal has discounted this too, saying that the reporting of such cases are more because of higher level of awareness among the people in canal command area.

D. As far as colonisation is concerned, the authorities are seemingly happy about stage-I, but feel the rate of settlements in the stage-II is low due to lack of proper water facilities, the difficult terrain and remoteness. It is a vicious circle, as long as the rate of settlements are low the terrain too is likely to remain in hospitable. The distribution systems gets chocked with sand unless water flows continuously and blown sand is removed from time to time. The other negative impact of Indira Gandhi Canal project in Western Rajasthan are grouped under the following headings:

E. Seepage of water through canal
F. Problem of soil siltation due to high velocity of winds
G. Continuous ponding of water in Ghagger diversion depression
H. Over irrigation by cultivators, particularly in stage-I command area
I. Opening of more and more areas in stage-II command area
J. Excessive loss of water in deep percolation
K. Leaching of soil in some areas
L. Transportation of salt and
M. Raising of ground water level

In order to check the negative ecological impact of the canal irrigation in IGCCA of Western Rajasthan to reclaim the already desertified land, the following suitable measures are suggested:

1. To the lining of distributaries and minor channels also with suitable materials to check the seepage of water losses, rise of water level and development of salinity.
2. To the water level should be maintain the critical limited of 6 meter by providing vertical drainage. The shallow well should be dug and the excess water should be pumped out which may be used for irrigating higher land and to recharge the adjoining aquifers.
3. To excess and injudicious use of water for irrigation particularly in light texture permeable sandy soil should be avoid to check the development of salinity and water logging hazards. The irrigation by drip and sprinkler systems should be done to control these hazards.
4. To check the negative effects of canal irrigation, the unfavourable geomorphological sites such as the confluence of the buried courses of the prior drainage channels should be avoided to construct irrigation network like tanks, reservoirs and well.
5. The salinity/alkalinity could be reclaim by leaching and applying proper quantity of Gypsum.

Conclusions

After foregoing discussion it is concluded that the Indira Gandhi Canal Project has proved itself as a boon of hot desert climatic land providing drinking water, improving environment condtion, generating employment opportunity, increasing soil moisture regime, afforestation, rehabilitation, greenification, road construction, changing cropping pattern etc. on one hand and curse in bringing its negative ecological impact, which are of long duration could be seen in the form of the depletion of productivity of the landforms due to water logging, increasing salinity. alkanity hazards of the region due to high evapotranspiration, siltation of canal by sand, soil erosion, seepage of canal water, increasing ground water level, various unforeseen diseases etc. on the other hand.

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