Positive Effects of Canal Irrigation on Environment in Indira Gandhi Canal Command Area

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(Abstract: Inception of canal irrigation in this rainfed region of the Thar has brought about positive changes in terms of increasing the vegetation cover through crop cultivation as well as increasing the forest and grass cover by means of planned afforestation and plantation. This has helped in upgradation of soil structure as the vegetal cover increases humus and organic matter in the soils. Expanding vegetation cover through crops and introduction of afforestation and plantation under CAD programmes has also played a desired role in reducing wind erosion and siltation in the command area. However, the progress of afforestation and pasture development programmes is not up to the goals of the authority. Another positive impact of introduction of canal irrigation in the region is changes in the quality of native saline underground water. It is evident from the chemical analysis that a fresh water cushion has developed over the saline native ground water mainly due to continuous recharge from percolation/seepage of water from irrigation network developed in the command area.

Key Words:- Irrigation, Environment, Afforestation.)

Irrigation has very significant positive influence in the canal command areas located in arid and semi arid climatic zones where soils have poor structure, land is devoid of forest cover and wind erosion hazard is severe. Irrigation, in these regions has introduced perceptible change in terms of increasing the vegetation cover through crop cultivation as well as increasing the forest and grass cover by means of planned afforestation and plantation. This has helped in up gradation of soil structure and environment as the vegetal cover reduces wind erosion and increases humus and organic matter in the soils.

Water is very significant factor involved in soil formation. That is why, soil moisture deficient regions lack in soil structure and fertility. Introduction of irrigation in such areas helps in improvement in soil structure through physical, chemical and

biological processes. Soil structure is capable of changing the influence of soil textures on infiltration rate, moisture retention capacity, aeration, plant penetration and nutrients of soils and resistance to erosion. Water has both direct and indirect impacts on soil structure (Jaglan, 1990).

Direct influence of water application on soil structure is exerted through aggregation and clustering of soil particles and colloids. According to a theory concerned with electrical charge of colloidal particles, as water evaporates from soil, the combining link is effectively shortened and draws together the colloidal particles and larger soil grains to which they are attached. This process effectively clusters the colloids and large soil particles. As evaporation continues, the colloidal material becomes further dehydrated, the particles may stick or cement into an aggregate (Steila, 1976). Irrigation also has indirect bearing on soil structure as a result of increase in the biomass of land. Generation of numerous bacteria, actinomycetes and soil fauna greatly help in decomposition of inorganic matter, humification of organic residues and nitrogen fixation in the soils. Increase in the humus contents in soil causes structural improvement in sandy soils. Microbial activities associated with humification and soil decomposition result in mycelial growth and production of microbial gums which have the capacity of binding soil separates together.

INDIRA GANDHI CANAL PROJECT (Study Area)

To bring the Himalayas water to this desertic tract of north-western Rajasthan was a Herculean task which was fulfilled in the form of Indira Gandhi Canal Project with its launching on March 31, 1958 with broad objectives of drought proofing, providing drinking water, improvement in environmental conditions, afforestation, employment, rehabilitation, development and protection of animal wealth and increasing agriculture produce. This project was the result of foresightedness of an engineer named Kanwar Sain who conceived this project through his study 'Water Requirements of Bikaner State'.

Indira Gandhi Canal originates at Harike Barrage, the confluence of Sutlej and Beas in Ferozepur district of Punjab (Indira Gandhi Nahar Board). Indira Gandhi Canal covers a distance of 649 km. It is a feeder channel up to a length of 204 km. It traverses for a length of about 159 km. in Punjab and 19 km. in Haryana before entering

Rajasthan. The main canal takes off from feeder channel near Masitanwali in Hanumangarh district and has a length of 445 km main canal runs almost parallel and close (38 km) to the Pakistan border in Rajasthan. The project has divided into two stages for construction and administrative convenience. Construction of Stage I of the canal was completed in 1983 while water in this stage, was released in the canal on October 11, 1961. On the other hand construction of main canal of Stage II was completed in December, 1986 and water was released on January 1, 1987.

Objective: To assess the positive effects of irrigation on natural environment.

Data Base and Methodology: Both primary and secondary data has been used for this study. Primary data has been collected through a structured questionnaire from total five villages, i.e. two from Stage I command area and three from Stage II command area. Secondary data has been collected from the offices of command area development (CAD), Bikaner. Various statistical tables and a map have been used to depict the information.

Results and Discussions:

Expansion of Vegetation Cover and Eco-Development

A massive drive of afforestation and pasture development has been carried out in the canal command area and adjoining area under CAD and some other programmes since 1974. Infact the work on increasing vegetation cover was started in 1962 from the Kola block of Hanumangarh district. The objective of these programmes is protection of canals, roads and agricultural field from windblown sand, meeting the demand of fuel wood and timber, creating employment opportunities for local poor and landless people, availing of fodder for livestock and reducing its migration during drought years, and to improve and upgrade ecosystems in the region.

Various forms of plantation have been adopted for afforestation and ecological development in the region which are enlisted as:

(i). Shelterbelt Plantation along canals- It is aimed at reducing wind velocity and sand drift towards the canals and providing fuelwoods to local population. The species to be grown are carefully selected to avoid penetration of the roots into the embankment and damage to lining of the canals.

(ii). Shelterbelt Plantation along roads- This form of plantation is aimed at protecting roads from sand drift, providing fuelwood and improvement in the environment.

(iii). Block/*Abadi*/Fuelwood Plantation- Under this form of plantation, irrigated blocks of land near new settlements are planted with fast growing species of trees. It is aimed at providing fuelwoods and timber to local population. A total of 12.5 ha area in each *Abadi* is reserved for fuelwood plantation and 400 trees are proposed to be raised per ha in the plantation area.

(iv). Sanddune Stabilization- It is aimed at stabilization of unstable sand dunes and reducing siltation in canal and adjoining cultivated land. The stabilization is done in the region of unstable sand dunes along both sides of canal upto a minimum distance of 300 meters. Apart from this active sand dunes in the vicinity of canal are also stabilized. Both trees and grasses are planted for sand dune stabilization.

(v). Pasture Development- Pasture development is aimed at providing fodder to livestock. This programme is prominent in Stage II of canal command area where local population has predominantly livestock economy. Irrigated pasture development is proposed to be carried out in a one kilometer wide belt along both sides of main canal at suitable location in Stage II.

(vi). Environmental and Recreational Plantation- This form of plantation is carried out in and around residential colonies, canal head works, lift pumping stations and other suitable places.

Shisham (Dalbergia Sisso), *Safeda* (Eucalyptus Camaldulensis), *Desi Babool* (Acacia Nilotica), *Subabool* (Leucenea Leuconcephala), Mulberry (Merua alba), *Ardu* (Allanthas Excalsa), Israeli *Babool* (Acacia Tortilis), and *Neem* (Azdirachta Indica) are main tree species planted in shelterbelt and block plantations. For sand dune stabilization and pasture development *Sewan* grass (Lasiurus Sindicus) is planted with *Khejri* (Prosopis Cineraria), *Jharberi* (Zizypus Numularia) and Israeli *Babool* (Acacia Tortilis) trees.

Table 1

Progress of Afforestation and Plantation Programmes under Various Schemes in IGC Command Area

Stage I (Area in ha)

Activity	1974 to 1997-98	2000 to 2007-08	Total
Canal Side Plantation	11562	4600	16162
Road Side Plantation	2769	0	2769
Abadi/Block/Fuelwood Plantation	12800	1245	14045
Sanddune Stabilization	16959	0	16959
Pasture Development	70613	0	70613
Other Plantation	236	0	236
Total	114939	5845	120784

Stage II

Activity	Under CAD 1985-90	Under OECF/JBIC 1991-02	Under RFBP 2003-08	Total
Canal Side Plantation	7316	20455	1626	29397
Road Side Plantation	270	1308	0	1578
Abadi/Block/Fuelwood Plantation	3153	3788	1160	8101
Sanddune Stabilization	8316	35428	2942	46686
Pasture Development	2000	5874	1933	9807
Other Plantation	0	941	610	1551

Total	21055	67794	8271	97120

(Source:- Chief Conservator of Forests, IGNP, Bikaner)

Stage I

Afforestation work in the command area of Indira Gandhi canal began in 1962. It has been further intensified since the implementation of CAD programme in 1974. About 1.15 ha land had been brought under various schemes of afforestation by the end of year 1998. Afforestation programmes again started in 2000 and 5845 ha land has been afforested till 2007-08. Progress of afforestation and pasture development works in the command area is shown in table 1. It is evident from the table that sand dune stabilization and pasture development occupy more than 70 percent of total afforested land in Stage I. It is evident that over 1.2 lakh ha land in the region has been brought under afforestation till 2007-08.

Stage II

There is an enormous scope of afforestation and pasture development in the command area of Stage II. Main canal and its branches and distributaries pass through active sand dune areas which have to be stabilized in order to realize the dream of desert development. About 10 lakh ha afforested area was the estimate of Forest Department in eighties. However, only 21055 ha area was afforested till 1990 under CAD programmes (Jaglan, 1990).

To begin with, afforestation work in Stage II of the project area was started on small scale to protect the channels from getting silted by blown sand. Canal side plantation was done in 800 ha during 1980-81 and in 333 ha in 1984-85. A major effort was made in 1983 when a project of afforestation and pasture development was started in 50000 ha of land on left bank of the Indira Gandhi Main Canal within 2 km wide belt. Afforestation work was also taken up under World Food Programme in 1985-86. From 1987-88 onwards large-scale work was started under CAD and DDP funds" (Indira Gandhi Nahar Board, 2001). To gear up the afforestation activities in Stage II an externally assisted project was launched with aid from Overseas Economic Co-operation Fund (OECF), Japan namely Afforestation and Pasture Development along the project area. Afforested area under this programme up to 2002 was 67794 ha. In 2003, afforested started again in Stage II command area under RFBP project and 8271 ha of

land afforested up to the year 2008. It is evident from the table 1 that total afforested area in Stage II has increased to 97120 ha till 2008. Canal side plantation and sand dune stabilization occupy near about 80 percent of the total afforested land in Stage II.

Increase in vegetal cover and expansion of cultivated area has set in progress of eco-development in the command areas of the project. However, the progress of afforestation and pasture development programmes is not up to the mark. Wind erosion and siltation continue to be a threat to canal systems and cultivated land, particularly in the command area of Stage II. Following are the reasons of continuation of this problem:

(i) There has been found difference between the reported afforested area on records and actual afforested area. During the course of field survey, it has been observed that large area under sand dune stabilization, afforestation and pasture development devoid of vegetal cover. However, canal side plantation is effective in both the stages of the canal project except along the lift canals of Stage II which severely faces the siltation problems.

(ii) Block/*Abadi* plantation also looks like a counterfeited task. In sample villages Kheersar, 1 RSM and 4 RSM not a single acre of block/*abadi* plantation is present. No effort has been made to stabilize the sand dunes in the sample villages of Stage II which are highly prone to the problem wind erosion.

(iii) Local people are not actively involved in afforestation and forest management. Hence, people are completely ignorant about the benefits and utility of afforestation, sand dune stabilization and pasture development.

Indira Gandhi Canal Command Area, being a drought-prone arid expanse, was a bare land before the project came into existence. Wind erosion is a serious problem in the command area for crop cultivation and vegetation growth. Loose and poor structure sandy soils, absence of vegetal cover and presence of strong wind regime have aided the process of desertification in this region. Wind velocity in the region remains exceptionally high during the period of May to September (table 2 and 3). Sand storms and hot waves (*Loo*) are common weather phenomena during summers in the region. Wind regime is particularly strong, in the command area of Stage II where mean daily wind speed remains above 20 km per hour during summers specially in Phalodi, Jaisalmer and Jodhpur areas. Annual mean daily wind speed in Stage II is more than double of that in Stage I. About 80 to 100 percent area in this region is affected by wind

erosion in lower parts of Stage II command area. The command areas of Pugal branch in Stage I and Nachana and Charanwala branches in Stage II are also severely affected by wind erosion (60 to 80 percent). Other areas in the region infested with unstable sand dunes also experience strong wind erosion. The general direction of sand drift is from south west to northeast, opposite to that of water flow in the main canal.

Wind erosion and sand drift has posed a serious problem for raising crops and flow of water in canal and water courses. Presence of unstable sand dunes within the command area and adjoining non command area and strong wind regime are the causes of siltation and erosion of cultivated land. However, if we compare the mean daily wind speed during the period 1931-60 of the project area with that of the period 1968-97, it seems to be declining (table 2 and 3). The mean daily wind speed in Sriganganagar district has been reduced to almost by half than that of 1931-60 periods. In the lower command area of Stage I and the command areas of Stage II such as Bikaner, Jaisalmer, Phalodi and Barmer have also witnessed the decline in mean daily wind speed. Hence, it may be inferred that expanding vegetation cover through crops, afforestation and plantation have played a desired role in reducing wind erosion and siltation in the command area.

Table 2
Mean Daily Wind Speed at Different Stations
(1931-60) (kmph)

Months	Sriganganagar	Bikaner	Phalodi	Jaisalmer	Barmer
January	4.0	4.6	10.0	8.6	7.6
February	5.0	5. 1	8.8	8.2	7.5
March	6.4	6.5	12.9	10.9	9.1
April	6.8	7.3	14.1	12.7	10.6
May	8.0	13.1	20.7	18.3	12.9
June	10.7	13.3	25.6	27.2	14.2
July	9.6	12.8	23.6	24.8	12.4
August	8.0	11.0	19.4	21.7	10.6
September	6.2	9.4	16.6	16.1	9.6
October	4.7	5.3	11.6	8.5	7.2

November	3.3	3.5	11.8	5.5	5.3
December	3.4	3.7	8.3	6.5	6.4
Mean	6.34	7.97	15.28	14.08	9.45

(Source:- Indira Gandhi Nahar Board, 2001)

Table 3

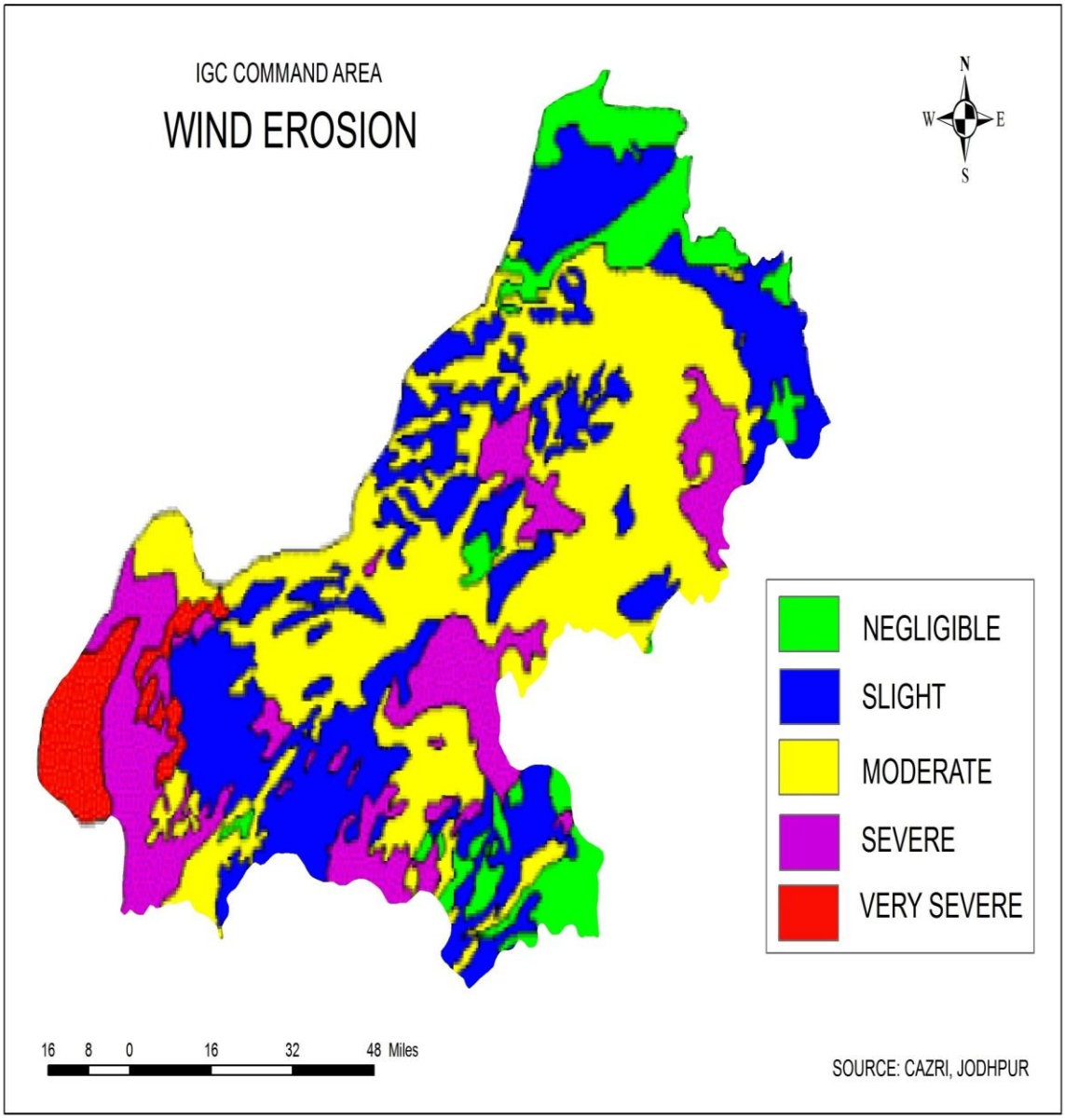
Mean Daily Wind Speed at Different Stations

(1968-1997) (kmph)

Months	Srigangan agar	Bikaner	Phalodi	Jaisalmer	Barmer	Churu	Jodhpur
January	2.10	3.30	6.90	6.90	6.10	4.60	7.10
February	3.00	4.30	8.70	7.60	6.50	6.20	7.00
March	4.00	6.00	11.30	10.00	7.90	7.60	8.80
April	4.10	6.70	12.40	11.30	8.90	8.70	9.40
May	5.00	9.00	17.30	16.60	10.90	10.90	13.40
June	6.90	13.30	24.40	25.30	12.20	15.90	18.00
July	6.50	11.90	20.40	21.80	10.80	13.30	14.90
August	5.50	10.00	17.60	18.90	9.60	10.90	12.40
September	4.00	8.10	14.40	15.40	7.50	8.90	9.40
October	2.60	4.80	9.60	8.20	5.90	6.10	6.20
November	1.70	3.70	7.50	6.70	5.50	4.60	7.00
December	1.70	3.60	7.60	7.20	6.10	4.50	7.00
Mean	3.92	7.05	13.17	12.99	8.15	8.51	10.05

(Source:- Indira Gandhi Nahar Board, 2001)

Fig. 1



It is also evident from fig. 1 that development of irrigation and increase in vegetal cover in the command area has also helped in reduction of wind erosion. Wind erosion which is the root cause of desertification in such arid climate seems to be under control. It is also evident that the upper reaches of Indira Gandhi Canal Project have negligible wind

erosion. The rest of the command areas of Stage I (flow as well as lift) are under slight and moderate wind erosion except the area around Bikaner (under lift command) and near Churu (area beyond canal command).

In the command areas of Stage II the flow command area before Mohangarh comes under slight and moderate wind erosion. But the lift command areas of Stage II and area beyond tail of main canal are still under severe and very severe categories of wind erosion. One should also bear the fact that the lower and lift command area of Stage II are not fully developed in terms of irrigation expansion.

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