

GANDAK IRRIGATION COMMAND AREA : A GEOGRAPHICAL REVIEW

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Abstract

Being beckoned by the grand success of the Tennessee River valley Authority (TVA) in the U.S.A the Govt. of India constituted the first river valley project authority to harness the tremendous hidden potentialities of the untamed, wandering, capricious and deluging Damodar River through the establishment of the Damodar valley corporation in 1948. Again following the success story of D.V.C, in the Fifth Five year plan, to improve the utilization of created irrigation potential and to take requisite steps for increasing agricultural production the concept of command Area Development programme in integrated manner in selected major and medium irrigation projects in the country was introduced. The Gandak irrigation command area Development programme is progeny of above thinking and its execution rests with the Gandak command Area Development Agency.

To understand the different facets of the area under study it has been divided into three parts Resource base study, Agricultural situation and infrastructure support facilities.

RESOURCE BASE STUDY

The Gandak command Area (GCA) lies between 83°15' E and 85°15' east longitudes and 25°40'N and 27°25' north latitudes . It is bounded by Nepal in the north, U.P. in the west the river Ganges in the south and the districts of Sitamarhi, Seohar and Darbhanga in the east. The total Geographical area of the concerned districts (West Champaran, East Champaran, Vaisali, Muzaffarpur, Gopalganj, Siwan and Saran) in which the project area is located, covers 0.747 million ha and is spread over 116 blocks comprising nearly 12360 Villages. However, all the blocks and all the villages of the command area are not within the canal command project. About 78% land of these blocks are within its command. The Gandak canals have been, extended so far to 92 blocks and the canals have not been extended to the Samastipur district as yet.

PHYSICAL LANDSCAPE

The study area comprising the Gandak valley is a portion of the alluvial plains of Indo & Gangetic basin fringed by the Himalayan foothills of Nepal with small exposures of tertiary rocks in the North-Western part of West Champaran. The thickness of alluvial deposition ranges between 2000 and 10000 m. It is indicated that the entire region has suffered great down warping due to the Himalayan upheaval. Hence it has assumed a saucer like shape and thus has facilitated an ideal ground for water logging and congestion in drainage.

The region is almost a synonym of a homogeneous level seemingly featureless plain from one end to the other and its monotony never loses until it approaches the Shivalik Hills in the north west.

The Gandak valley has more or less established itself now and the various drainage channels in this valley much due to the fact the river has the flat slope in the lower regions. In the Champaran, the General line of drainage is from the north to the south and then from north-west to south-east. A remarkable physical feature of this part is the chain of lakes running through the centre of these districts. These lakes mark the old bed of the river Gandak. There are also a large number of Swamps and marshes.

In Muzaffarpur and Vaisali districts the county lies on a low level, in many blocks intersected with chains of shallow marshes which mark the lines of drainage through which the county run-off and the river spill find their way south wards into the Ganga. The rivers on the other hand flow on raised land formed with the deposition of silt and sand brought down from the hills of Nepal.

In the south-eastern part of the Command mainly in the districts of Vaisali and Samastipur, there are a number of low lying areas locally called "Chours" which have no outlet to the rivers. During high floods in the rivers or when the Ganga is high and the country side drainage water is unable to discharge into the Ganga, the chours get connected with a vast sheet of water. In some years, this water logging condition, Continues till the month of December to January rendering the land unfit for Rabi Cultivation.

SOILS

This region is composed of alluvial soils, Recent alluvial soils are found in Diara. Alluvial soils are both calcareous and Non-Calcareous with problems of salinity, alkalinity and sodality in some cases. However, calcareous soils dominate the region.

FERTILITY STATUS

As per the mobile soil testing Laboratory under GCADA, soils have been found poor in nitrogen (0.3 to 0.5% organic carbon). Individual field management sometime & has brought about a remarkable rise in nitrogen status. The phosphate status varies from low to medium falling within the range of 15-45 kg/ha. The status of potash has been found satisfactory in large areas. The Soils, however, respond to potash application for growing HYV of crops with higher levels of nitrogen and phosphorous.

MICRO-NUTRIENT STATUS

With the availability of canal water farmers of GCADP are using more and more concentrated chemical fertilizers for crop production. The use of such fertilizer coupled with the highly calcareous nature of the soils have caused the deficiencies of micro-nutrients in the soils. Among the micro-nutrients, the deficiency of zinc has become very pronounced. As per the report of GCADA zinc deficiencies have been found in the following proportion in the different districts of the region.

Table – 1.1

Sl. No.	Name of District	Area Deficient in Zinc (%)
1.	Muzaffarpur	80
2.	West Champaran	50-60
3.	East Champaran	50-60
4.	Vaishali	70-
5.	Samastipur	60-70
6.	Saran	70-80
7.	Siwan	70-80
8.	Gopalganj	70-80

Source : GCADA, Annual Report, 2016-17.

CLIMATIC CHARACTERISTICS

The climate of the command area is monsoonal with tropical humid to sub-humid type. The thirty year average (1980-2010) rainfall of the command area is 1228 mm. Whereas West Champaran district receives comparatively heavy rainfall (average 1448 mm) and Vaishali receives the least (average 1042 mm). Bulk of the rainfall is received during the south-west monsoon. Due to very uneven distribution of rainfall in spatio-temporal parlance, the importance of agriculture is self evident. The maximum temperature recorded is 45.5°C during the summer season (March to June). In winter season (December to February) it drops to about 7°C with occasional frost at places as well as occasional rains.

NATURAL VEGETATION & WILD LIFE

Natural vegetation of the study area belongs to tropical moist deciduous forest type. An almost unhindered human occupancy and ever dominance of agrarian culture have combined hastened the process of large scale deforestation. As a result, it has become nonexistent almost in the entire region except West Champaran having more than 84% of the its total forested (4.3% of its total Geographical Area) area. Forests are characterized by irregular top story of predominantly deciduous species, heavily buttressed trees, definite second story of many species with some ever greens, fairly complete shrubby undergrowth with patches of bambos, heavy climbers in clouding caner. Sal, Mahua, Sisum, Gular, Kusum, Gamhar, Satpal, Mango, Jamun, Banyan, Dhak, Sirish, Amla, Kathal, Bijasal, Simul, Ber, Guava, Lichi etc. are important. To save the region from the cruel effect of environment degradation, a forestation must be ventured upon without second thought. Herbivorous animals are found. Some tigers, Leopards, and bears like wild ferocious animals are seen in the densely forested area of West Champaran. Many wild animals like fox, nilgai, etc. are on the path of extinction.

LAND USE PATTERN

Land rources form the most important natural bounty of this region. Its whole gamut of development and prosperity is delicately balanced with the use and misuse of this wealth. As per GCADA's annual report, about 67% of the total Geographical area is under cultivation in the project districts and about 70% of the land in the project area is under cultivation. The cultivable command area of the Gandak project where irrigation system has been completed is 989600 ha as against a gross command area of 1371000 ha.

WATER RESOURCE

Truncated Bihar has only three vital resources land, water and human resource. Fortunately the command area is blessed with tremendous water potentials and capable of dictating the economic prosperity and overall development of the whole region-water is everything in the state. It is more valuable than land, because when it is applied to land it increases productiveness at least six fold and renders great extents of land productivity which otherwise would produce nothing or next to nothing.

The region under perusal abounds in both the surface as well as the ground water resources which needs careful discussion.

SURFACE WATER RESOURCE POTENTIAL

On the basis of yearly plan report and expert opinion advanced by a chief engineer the Gandak command area receives about 1192.4 mm rain fall annually. Rough evaluation done by chief engineer is given below :

1.	Total geographical area	-	21260 sq km
2.	Total annual precipitation	-	11.92.28 mm
3.	Total annual volume of rainfall	-	23981.28 million Cubic meters.
4.	Loss by evaporation at rate of 33%	-	7913.73 million Cubic meters.
5.	Loss by Percolation	-	5275.82 million Cubic meters.
6.	Total loss of volume of water by 4 & 5 items.	-	13189.55 million Cubic meters.
7.	Actual flow as surface water	-	10782.50 million Cubic meters.
8.	Actual at 75% dependable flow	-	8086.50 million Cubic meters.
9.	Utilization by irrigational means	-	2571.34 million Cubic meters.
10.	Balance surface water potential to be utilised	-	5515.16 million Cubic meters.

The availability of water potential may be more than the amount computed above but due to certain constraints the available water potential may not be fully realized. The natural conditions like topography which prevent water being transported by gravity canals over long distance. The seasonal pattern of rainfall distribution which causes the artificial reservoirs to be immensely large as they have to store up waters from year to year basis. The nature of soil also determines flow. Keeping all these points into consideration 1st Irrigation commission of Bihar considered only 75% flow of the river to be usable as per agricultural finance corporation Ltd. Mumbai having known expertise in this field, the region has sufficient amount of surface flow for achieving 220% cropping intensity from 148% in 2000.

GROUND WATER POTENTIAL

The Gandak Command area is not only rich in surface water potential but in groundwater potential as well. It is vital source of supply of water both for irrigation and domestic affairs. As per the gazetteer of India and expert opinion of two American geologists, the Punjab plain, the Gangetic plains of UP and Bihar possess an underground lake which is probably the largest and potentially the most productive not only in India but in the whole world. The Himalayan foothill relief and down warping of the entire middle genetic part due to the Himalayan upheaval have created an ideal conditions for the storage of underground pool of water. The ground situation is so congenial that water can easily be tapped by open shallow percolation wells, katcha or pacca borings or deepening of wells and installation of water lifting appliances like pumping sets, Persian wheels and tube wells.

The underground water potential was surveyed by the ground water exploration project in 1953 and also by the agency of state ground water Directorate Patna (SGWD) in 2011 using the following equation:

$$R_g = R_p + R_s + R_1 + R_5$$

Where

R_g	=	Gross annual recharge
T_p	=	Average annual rainfall percolation
R_s	=	Seepage from surface irrigation system (Conveyance and distribution)
R_1	=	Reform flow from applied irrigation, both from surface water and underground water.
R_5	=	Seepage from tanks, lakes and flooded areas or waterlogged areas.

For want of sufficient data the component like influent recharge, sub-surface inflow into the sub-surface outflow from the region has been neglected.

The parameter adopted by SGWD are as follow,

Rp = as percentage of the normal rainfall

and all uvium area = 25%

Hard rock areas = 5%

Seepage factors from canals = 20 ham/day/sqm.

Recharge from irrigated land = 30% of the depth of irrigation.

Recharge from tanks and flood area = 44-60 cm/year on the basis of above formula the ground water potential has been computed below:

- | | | | |
|----|---|---|----------------|
| 1. | Geographical area of GCADA | = | 20.78 lakh ha. |
| 2. | Ground water Availability as per SGWD computation | = | 6236.406 MCM |
| 3. | Actual Availability | = | 5300.946 MCM |

As the state groundwater Estimation committee leaves about 15% ground water to main base flow its ground water availability available for use is 5300.946 MCM. Out of this availability only about 25% have been utilized so for there is tremendous untapped ground water potential at our disposal to be utilized for changing the agricultural landscape of the study area.

DEMO GRAPHIC FEATURES

The Gandak command Area is the most densely populated region of the state with average density of 1020 persons per Km² and at places it exceeds to 1235 persons per Km². As per census Report 2011 (Calculated on the basis area commanded by GCA) its total population stands 22.16 million of which about 87% reside in the rural area. Average growth rate of population was recorded slightly more than 2.8.1 per annum. It constitutes slightly more than 26% the total population and 22.50% of the total population and geographical area of Bihar respectively. Thus it is a fit case of man: land ratio of the total work force (69.1 of the total population) about 59% are cultivators, 9% agricultural laborers, 26.2% marginal workers and about 2.3% engaged are about 2.5%. The average size of the household in the region is 7.4. From perusal of above description it is clear that the region is basically rural and agrarian.

Due to very high density of population the pressure on the cultivated land is very heavy. Thus it has compelled a large number landless laborers and marginal cultivators to out-migrate to seek employment permanently or temporarily. Manageable and efficient population is an asset to any country. It is the indication of its inner strength. It is required for a better and fuller exploitation of natural resources. But if it becomes unmanageable (as the case of region) it eats into the vitality of the nation and becomes rather an unmixed evil.

AGRICULTURAL SITUATION

Agriculture dictates the density of the people of the region. It is merely not an occupation rather tradition. Here every economic activity revolves round agricultural pursuits. Despite overwhelming importance of this prim ary occupation, it has been neglected by our policy makers. Consequently it is beset with manifold problems. The phenomenal rise in the number of people has not been accompanied by a proportional rise in the number of persons deriving livelihood from "secondary" and tertiary sectors. Consequently pressure of population is obviously reflected in the land holding pattern and cropping pattern. Per capita share has declined to 0.06 acre in 2016 from 0.34 acre in 1961. The average size of land holding is 1.5 ha. In general about 94% of the land holders comprising marginal and small farmers hold

about 61% of the landholders hold about 39% of the land holding. The prevailing proportion of land holding clearly indicates that agriculture lags behind on the path of scientific progress and it reflects in cropping pattern and other agricultural characteristics.

CROPPING PATTERN

In the study area most of the cropped area (83.3%) is under food grains comprising mostly rice, wheat, maize barley, pulses etc. Rice is the most predominant crop (43.29%) followed by Wheat (28.5%), Maize (7.8%), Pulses (7%), Potato (2.0%) other vegetables (1.7%), Barley (05%), other food grains (1.3%), Spices (0.4%), Oilseeds (1.6%), Sugarcane (5.4%) and other crops (0.6%) of the cultivated area. The cropping pattern in the cultural command of Gandak command area is in 9.60 lakh hectares as against a cultivable area of 14.17 lakh hectares in the command districts as a whole.

CROPPING SEASONS

There are three cropping seasons. The maximum area (1.032 million he.) is sown during the Kharif season from June to October. Rabi crops covering about 0.812 million hectares are grown during November to April. Summer crops covering 0.121 million ha are grown from March to June. In Kharif rice is predominating crop while as wheat outpaces all other crops as rabi crop. Rice, maize, moong and vegetables are important summer crops. The sugar cane is the most important cash crop cultivated as an annual crop.

CROP ROTATIONS

The following crop rotations are being followed in the command area:

Table – 1.2

Sl. No.	Rain fed	Kharif	Rabi	Summer
1	Upland	Paddy	Maize	Moong
		Paddy	Mustard	Moong
		Maize/ Arher	Pulses/Oilseeds	Moong
2	Medium land	Paddy	Mustard	Moong
3	Lowland	Paddy	Wheat	Fallow
4	Irrigated	Paddy	Wheat/Maize	Fallow/morning
		---	Pulses	Paddy
		Maize	Wheat/Maize	Fallow/moong

Source: GCADA, Report, 2016-17.

On sub-regional basis paddy-wheat rotation is predominant in East/West Champaran, Muzaffarpur, Vaishali and Gopalganj, Paddy/Maize rotation is common in Saran and Siwan districts. Pulse crops seldom find place in crop rotation in irrigated areas.

CROPPING INTENSITY

As per GCADA annual report 2016-17 the present cropping intercity is 146% (72.8% Kharif and Rabi) 57.2% Summer 8.5% and sugarcane (Annual) 7.5%.

HIGH YIELDING VARIETIES (HYV)

HYV seeds are mostly used in rice, maize, Wheat, and sugarcane. Its percentage to rice, maize, wheat, and sugarcane is about 40%, 20%, 90% and 80% respectively.

STATE OF IRRIGATION

The study Area is known as the Gandak irrigation command area. But tube wells occupy the foremost position in the field of utilization of water resource. As per GCADA annual report the total irrigated area was 137006 ha (2016) out of net sown area of 1467000 ha in the command districts. Out of the total irrigated area 50.04%, 49.39% and 0.55% are irrigated by tube wells, canal and other sources, respectively.

SOURCE WISE & SEASON WISE IRRIGATION

Out of the total irrigation annually is 1335206 ha, the contribution by different sources is given below.

Table - 1.3

Sl. No.	Source	Season			Total
		Kharif	Rabi	Summer	
1	Canal	4,08,735 (60.9%)	2,50,770 (40.6%)	----	6,59,505 (49.4%)
2	Tubewells	2,60,182 (38.7%)	3,62,202 (58.5%)	45,842 (100.0%)	6,68,226 (50.0%)
3	Other Sources	2,540 (0.1%)	4,935 (0.8%)	----	7,475 (0.6%)
Total		6,71,457 (100.0%)	6,17,907 (100.0%)	45,842 (100.0%)	13,35,206 (100.0%)

Source: GCADA, Annual Report, 2016-17.

From the above Table, it is seen that tubewells and canals contribute almost equally, other sources being negligible. Season wise, it is 50.5% in Kharif, 46.3% in Rabi and 3.2% in summer season.

IRRIGATION INTENSITY IN THE COMMAND AREA

The irrigation intensity in the cultural command Area of GCADA is given below.

Table – 1.4**IRRIGATION INTENSITY IN THE STUDY AREA**

Sl. No.	Source	Area (000 ha)	Irrigation intensity (%)
1	Canal	660	68.8
2	Tubewell (67% of the Command district)	448	46.8
3	Other Sources (67% of Command district)	5	0.5
Total		1113	116

CROP - YIELDS & PRODUCTION

Favorable climate, prospective sun-shine almost round the year, fertile soils, tremendous reservoir of water and cheap labor has combined favored the round year cultivation of crops. Hence varieties of crops are grown. The average productivity per hectare of rice is 1200 kg, wheat 1900 kg, maize 1800 kg etc.

Over the time productivity of different crops has increased but the productivity status of different crops in comparison to Punjab, Haryana, West Bengal and Tamilnadu is not favourable. The factors responsible have been low seed replacement, low levels of fertilizer and inadequate form of practices. Vast irrigation potential remain unutilized:

The NPK consumption in terms of nutrients is estimated at about 50 kg, 20 kg and 10 kg respectively, per hectare much lower than the recommended doses.

INFRASTRUCTURE SUPPORT FACILITIES

Infrastructure support facilities (ISF) include input supply centers, marketing place, storage facilities processing facilities financial institutions, conventional and non-conventional sources of energy, communication and others. In each district head quarter marketing yards have been established to enable the farmers to dispose of their produce at remunerative prices, reduce the price difference between the producer and this consumer and ensure availability of agricultural inputs at reasonable prices. Bu these marketing places are not executing its chartered functions. Hence it needs strict vigilance so that malpractices can be stopped to benefit the farmers and NSC are not working in favor of farmers. Fake supply of fertilizers and seeds have assumed alarming proposition in the region.

Energy is key to agricultural modernization of 12363 villages, number of villages electrified are 6298 (2002). A 220 MW thermal power station has been set up at Kanti near Muzaffarpur. The generation is extremely poor. Prices of diesels and petrol are skyrocketing. Nothing has been done to develop alternative non-conventional sources of energy to modernize agriculture in the command area.

Communicational the region presents the same scene as is revealed elsewhere in the state. District headquarters are connected with each other by metalled roads. Recently railways have seen some extensions. The villages are still backward from the point of view of communication. Till 2016 the total length of roads was 29950 km of which 15006 kms are metalled, 3861 km are non-metalled and 8057 km are earthen. The road length and the surfaced long & road length in the command area for every 100 sq km of Geographical area is 81 km and 16 km respectively.

The command area is served by the broad gauge and meter gauge railway tracks of North central Railway and N.E.R. and important district towns are well connected to major cities like Mumbai, Delhi, Kolkata, Pune, Bangalore, Dehradun, Ahmedabad, Guwhati and other important cities of UP and cities of other states also. Airways facilities are also available at certain places like Muzaffarpur, Motihari, Raxaul, Valmikinagar, Chapra, Siwan etc.

PROSPECTS

From preceding discussion it is obvious that the Gandak command Area primarily derives its resources from the rich fertile soil, surface and ground water storages and vast and cheap human resources enriched by a cultural heritage of millennia of years. From physical resource point of view another the lower genetic part nor the upper Gangatic one can compete it. But ground reality tells opposite story of success and development.

Fertile soils with its all the year round growing season and tremendous water reservoirs, availability of unique herbal plant, and thick undergrowth of greases of different types, profuse supply of husk and sticks and abundance of bagasse and fry leaves of sugarcane and varieties of bruits all are spectrum of its rich raw-materials awaiting careful utilization for overall development of the command area.

But casual handlings of their resources have pushed the region in the state of inertia. It suffers from recurring stings of floods and drought almost each year. Soil erosion and out-migration of cheap labor force are other facets of problems.

From perusal of all these aforesaid points it is clear that the region is pregnant with vast possibilities of growth and development. Many problems are our contributions. Problems like soil reason, floods and droughts can be easily remedied by the introduction of a well articulated irrigation cum drainage system and reforestation and management schemes. By setting up agro based industries and electronic industries the economic landscape can be favor ably changed. The effort of GCADA is not upto mark due to crunch of fund and political interference.

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