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ASSESSMENT OF WATER SURFACE OF RESERVOIRS WITH VARYING TIME AND INCREASING POPULATION IN CONTAI OF WEST BENGAL

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ABSTRACT: Contai, a district of Purba Medinipur, has 79 natural reservoirs of minimum 0.01 hectare capacity. This water is utilised for irrigation and industrial purpose. The population of Contai-has been increased around 19% in last census decade. The decadal growth of population density in Contai is high compared to West Bengal. It had been also found that the perimeter and area of the water surface of these reservoirs were reducing gradually in last decade. Now with increasing population - irrigation and industrialisation has been taken place in Contai manifold. So withdrawal of water from the 79 existing reservoirs of Contai has been taken places in indiscriminate ways. But the recharge of reservoirs is very low since amount of rainfall in whole Purba Medinipur is quite less. In most of the season in 2019 here rainfall is less than 100 mm. From the present study it has been observed that annually the perimeter and surface area of such reservoirs are decreasing around 2.5% and 1.1% respectively. So abstraction is more than recharge of reservoirs. It's a little worried situation for Contai. If such an indiscriminate usage of water from reservoir for increasing irrigation and industrialisation has been taken place then reservoirs will become dry. Since rivers and canals in Purba Medinipur are almost saline prone so no alternative way of getting water for irrigation and industrialisation will be available. So it's high time to conserve the reservoirs of Contai. If irrigation and industrialisation are taking place by the withdrawal of groundwater then groundwater level will be diminished fast. According to Gyben Herzberg principle, for a half metre decline in groundwater level seawater encroaches into the mainland by 20 metres. So if water harvesting can be adapted to store water in reservoirs to supply water for irrigation and industrialisation then that can be benefitted. The usage of water for various units from these reservoirs can also be limited.

Keywords: Reservoir, perimeter, area, irrigation, population, industrialization

1. INTRODUCTION

Contai is one of the districts of Purba Medinipur. Latitude and longitude of Contai is 21°46'41.2" N, 87°45'6.1" E. Contai has been subdivided into three blocks namely Contai-I, Contai-II and Contai-III [Figs. 1-2]. Latitude and longitude of Contai-I are 21°46'32"N and 87°45'00"E, respectively. Latititude and longitude of Contai-II are 21°48'37"N and 87°49'49"E, respectively. Similarly latitude and longitude of Contai-III are 21°51'59"N and 87°45'27"E, respectively. Seventy nine reservoirs were identified from three Contai blocks for this study. This water being stored in these reservoirs are utilised mainly for irrigation and sometimes for industrial purpose. From the Census report 2011 [1] it has been observed that in the year 2011 total number of population in Contai was three lakh twenty eight thousand six hundred eighty seven (328687) and growth of population up to 2020 is 19.85%.

Fig.1. Location of Contai in India

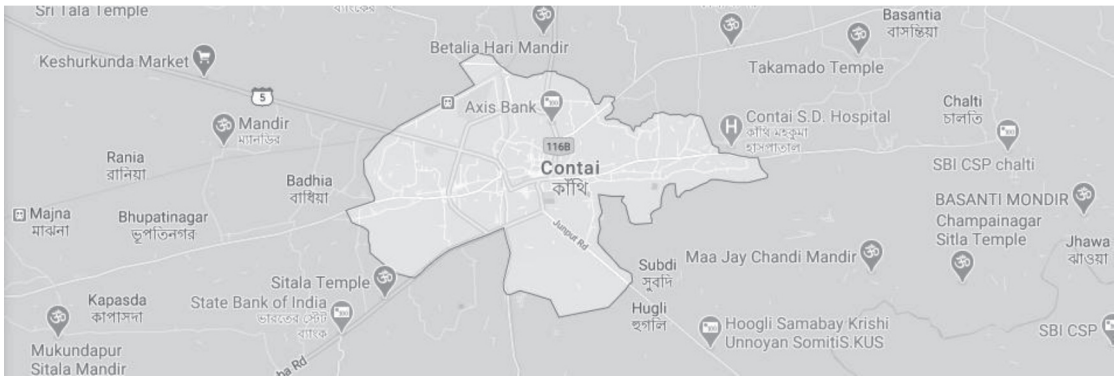

Fig.2. Boundary line showing Contai as study area

The population density of Contai is 6472/ km^2. As the district is of very small area about 14.25 km^2. Since the population is high and area is low of Contai that is why the population density is one of the highest in West Bengal. Compared to decade growth of population of West Bengal between 2011-2020 is100/km^2 in 2011 which is less than Contai population growth which is 6472 /km^2, but Contai population growth is also enormous. There are total seventy nine reservoirs in 2020 at Contai. But one more extra reservoir was found which was present in 2011 but had been converted to constructional activities. It had been also found that in the year 2011 total perimeter of reservoir was 8077 metre with area 46577 square metre whereas in 2020 perimeter of reservoir was 6458.5 metre with area 44052.6 square metre. Similarly capacity of reservoirs in Contai in the year 2011 was obtained. From the Indian meteorological department it has been found that in most of the season in 2019 in Purba Medinipur rainfall is less than 100 mm. These are elaborated in results and discussions.

A reservoir optimum operation was made to coordinate diverse profit-making goals that were a typical multi objective optimization problem (M.O.P.) with difficult restraints [2]. With advancement of multi aim evolutionary algorithms (M.A.E.A.s) in the recent past decades, large number of researches had focused on multi objective evolutionary algorithms M.O.E.A.s to solve M.O.P. Acknowledging that multi objective reservoir optimal operation (R.O.O.) was also a distinctive multistage decision building problem - the careful application of multi objective dynamical programming (M.O.D.P.) was introduced to formulate objective R.O.O. in detail. The time of calculations enhances not in a linear way. Appropriate different systematically process of the variable is main determinant to equilibrium the higher range and calculation efficacy including required solutions by applying M.O.D.P. and M.O.D.P-based on reference lines (B.R.L.).

Water storage at Change in lake, reservoirs of China was assessed over three decades [3]. Volume of reservoir or lake water available at their study area was calculated and also showed the various usefulness of that amount of water. The different quantity of water utilized by different units was also assessed in study area.

It was shown that the surface water was insufficient in Purba Medinipur district, West Bengal. So application of groundwater extraction is becoming more and more due to increased population, industrialization, and urbanization [4]. Due to over utilization of ground water, sea water intrusion was taking place in that district. To support this various field studies related to sub soil characteristics, ground water quality parameter assessment had been carried out. Piezometric surface of underground water at various seasons had been also developed. It had also been estimated the permissible withdrawal of water from various types of small water bodies in that locations. It had also been concluded from the journal that vertical riser coupled with quanta well were suitable for that district.

A numerical model based on which future prediction of ground water level of Purba Medinipur district was developed using field measured data [5]. It was shown that the ground water leveling was declining every year at a huge rate. The data had been validated too. On that discussion it could be assumed that saline water intrusion was taking place in that district. Since sea water intrusion was taking place in Purba Medinipur district, so that ground water was taking the shape of cone of depression [6]. It was observed that due to excessive overdraft of groundwater, sea water intrusion was taking place in Purba Medinipur district, India [7]. On the experimental studies it was found high values of ground water quality parameters at various locations of the district. Also remedial measures were suggested to mitigate the problem of sea water intrusion.

Modelling of hydrological cycle was done to simulate the water resource in arid region of Tamilnadu [8]. It had been well researched over a decade. The inflow database of Stanely reservoir, Tamilnadu was explored. A modelling framework had been established that predicted the reservoir inflow taking the future climatic scenarios.

The changes in rainfall frequency and amount, increasing body heat of Earth, enhancing in number of times of occurrence and volume and duration of floods were highlighted and its counterpart droughts, spreading of ice into water, and contraction of wrapping of snow were few water related pattern which has been documented change

related with change in climate all over the world. [9]. Different climate change can be put effect on the demand of water and supply of water which ultimately creates Demand Supply- balance in study area. It put greater responsibility over strategy of water management therefore lied on water management strategies. The eccentricity of water resources strategies towards floods and droughts would enhance. The trade-offs flood and drought control and reservoir outflow, per capita water demand, energy evolution must be revised. The networks which works neural can be used operation method of general reservoir were used to calculate the applications change of climate for hydraulic structures on a regional scale. It might necessary to increase the area and quantity of hydraulic structures, in addition to changing its working principle. Then only water resource management became effective. Then only the most populated areas of the Northeast United States could meet up per capita water demand.

A digital elevation modelling (D.E.M.) and images of satellite were used to identify changes in capacity of storage of Aswan high head dam reservoir (A.H.H.D.R.) in last five (5) decades in Egypt [10]. The total capacity of storage of the A.H.H.D.R. was calculated by the D.E.M. which was reduced around 12%. The diminishion was mainly occurred in last live decades and the capacities of dead storage. Reservoir properties were different in the south of China and at entry point of particular soil property portion. A slow change of entry point to the small river portion was seen. The area of the surface of A.H.H.D.R. reduced at minor water surface because of sediment accumulation. Average lowering of the surface area was between water surfaces of 140 m to 168 m which was about 15%, which was equivalent to almost 10 km^3.

Reservoir water quantity established between 1997 and 2014 was changed markedly, the measured evapotranspiration patterns at study area [11]. Water level fluctuation of lakes, reservoirs in Xinjiang of China was analysed by adopting ICES at laser altimetry data from 2003 to 2009 [12].

Reduction of evaporation was the suppression of changing water to gaseous state by adjusting by that water vapour rate by which it escaped from the water level [13]. There was requirement for saving of water was huge concern in localities at low precipitation moreover little runoff. Amount of water reduction from change of water to gaseous state from water bodies could be decreased for the purpose of noble and constraint inflow. Adopting polyethylene along with changing densities as cover which is floating to water filled up container of cylindrical shape with 8 cm diameter. It led diminished the evaporation intensities. An applicable density the value of which 800 kg/m^3 produced decreasing of evaporation intensity around 57% of the theoretical value resulted that was brilliant result.

The application of water was shown that became more necessity of determination of issue related with environmental equality as well as development of human related activities as per as objective of UN [14]. Deficiency of water was maximum challenges which had overarching applica-tion for another global crisis like money crisis, lack of food, environment crisis, climate change, decreasing global peace along with safety. This study could be defined as: neutralisation of salination of plants and other vegetation; retention of water (for an example precipitation, reservoirs, and recycling); reuse of wastewater; hydraulic structures and impounded water bodies.

A world determination of reducing storage capacity of water was shown at bigger impounded water bodies might affect the normal behavioural pattern of human life [15]. It was predicted that rise of the sea water level might change the sign of relatively fresh water reservoir, surface water and aquifers.

It was detected in variety of reservoirs, lakes, rivers at Neotropical Region, Argentina from 1990 [16]. The colony system started at lakes in south portion of study area, and for the period of the last ten years of the research the dinoflagellate has come along with flourished in reservoirs at subtropical region. With respect to this the colony system of C. hirundinella and population of this area as well as its prosperity have been scrutinized from first documented result in Río Tercero Reservoir (From February 1999 to one decade).

2. MATERIALS AND METHODS

In Goggle Earth Pro the location Contai, Purba Medinipur had been identified first. In Contai district of Purba Medinipur reservoirs had been identified. The annual rainfall data of Purba Medinipur for the years 2010-2018 has been collected from India-Meteoro-logical-Department (IMD). The annual rainfall data for the year 2019 was estimated based on the data available in different websites.

At first time scale was set in the year 2020. The Goggle Earth images for a particular date in the months April 2011, July 2012, December 2013, March 2014, March 2015, March 2016, April 2017, February 2018, April 2019 and April 2020 have been captured. Therefore 80% images were considered either for the month March or April. After that each reservoir outline was marked by polygon. The perimeter and area of each reservoir was found outs in meter and square meter scale respectively. After obtaining total perimeter and area of reservoirs in the year 2020, then time scale was drag behind to obtain the same properties of reservoirs in the year 2019. Likewise total perimeter and total area of all reservoirs in Contai were found out for one decade i.e. from 2011 to 2020. It had been seen that both the total perimeter and total area of reservoirs were decreasing as time was marching ahead. The population of Contai from the year 1921 to 2011 is obtained from official website of Census India. It was seen that it is increasing rapidly. Since with the increase of population the development of any location has been taken place as well as requirement of water becomes more. So it has been seen that total perimeter and total area of reservoirs or in terms of reservoirs capacity is becoming less as the population increases as more water is utilized for irrigation and industry from reservoirs.

3. RESULTS AND DISCUSSION

Fig.3 shows the variation of annual rainfall during 2010 to 2019 where the actual rainfall data is plotted in blue, average annual rainfall (equal to 1688.1 mm) for the same period is highlighted in dashed red and a linear trend line in black is fitted against the actual annual rainfall. This linear trend line shows a slightly decreasing tend as the year progresses. Based on daily rainfall data, the average annual rainfall for the period 1989 to 2018 was estimated 1813.1 mm for Purba Medinipur [17]. Therefore a significant decrease (around 6.9%) of average annual rainfall is observed in last decade 2010-2019. Therefore the present study is equally important based on this context.

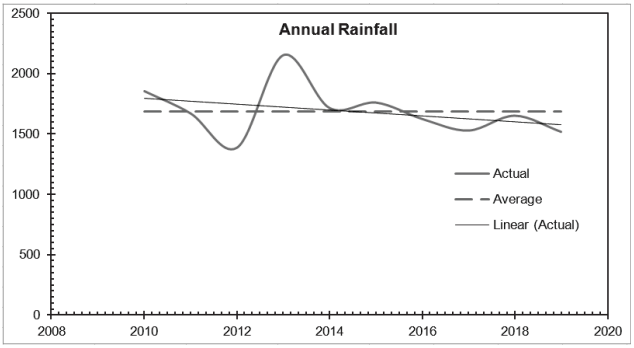

Fig.3. Variation of annual rainfall of Purba Medinipur during 2010 to 2019

In three Contai blocks, total seventy nine (79) numbers of significant reservoirs have been found whose surface areas are of minimum 0.01 hectare capacity. The total water surface perimeter (Fig.4) and surface area (Fig.5) of such reservoirs in the year 2011 to 2020 in Contai are shown graphically. The increase in population of Contai from 1921 to 2011 is shown in Fig.6. In Fig.4 and Fig.5, on the abscissa, 2.1.12 indicates 2nd January 2012.

Water withdrawal has been enhanced many more times in 2020. Now with increasing population irrigation and industrialisation has been taken place in Contai manifold. So withdrawal of water from the existing reservoirs of Contai has been taken places in indiscriminate ways. But the recharge of reservoirs is very low since amount of rainfall in whole Purba Medinipur is quite less since 2014.

In the year 2013, yearly rainfall in Purba Medinipur was gauged 2153.3 mm which was found around 27.5% higher than the average of yearly rainfall of last decade. This was because in that year South Indian Ocean generated a cyclone which made all over the Gangetic plain of West Bengal rainfall high. In that year all the low lying land of Contai, Purba Medinipur was filled up with water and became reservoir or pond. Rest of the reservoirs became fully saturated. That was why surface area of reservoirs in that year became reasonably high. After that due to population increasing and human related activities became increasing, that's why abstraction from reservoirs became higher compared to its recharge. For that reason area and perimeter of reservoirs became decreasing.

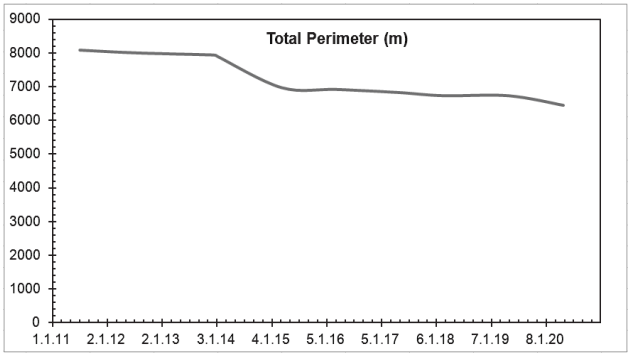

Fig.4. Total perimeter of reservoirs of Contai during 2011 to 2020

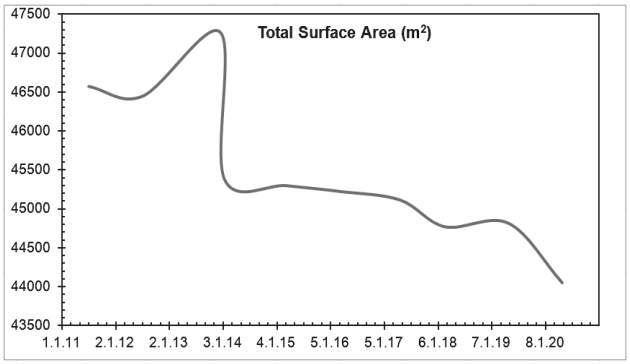

Fig.5. Total area of reservoirs of Contai during 2011 to 2020

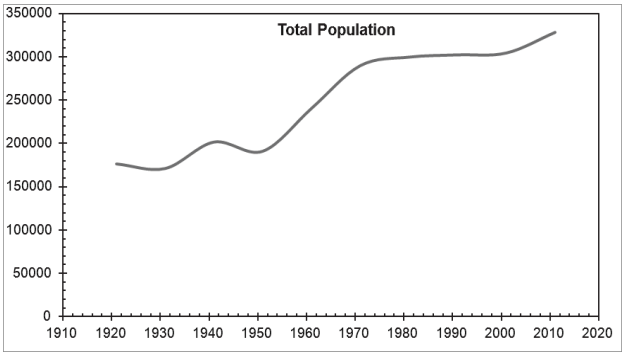

Fig.6. Population of Contai from 1921 to 2011

Moreover, based on the availability of Google Earth images, the images for the year 2013 were taken for the month of December instead of the month March or April. Therefore for this case post monsoon rainfall data played an additional role for which the surface area and perimeter of the reservoirs both were found quite higher in magnitude than that of the other years.

From IMD data also it has been found that in part of the season in 2019 in Purba Medinipur rainfall was less than 100 mm. So abstraction is more than recharge of reservoirs. It is an alarming situation for Contai. If such an indiscriminate usage of water from reservoir for increasing irrigation and industrialisation has been taken place then reservoirs will become dry. Since rivers and canals in Purba Medinipur are saline prone so no alternative way of getting water for irrigation and industrialisation will be available. So it's high time to conserve the reservoirs of Contai block.

So, it is evident that due to human related activity at Contai there is acute shortage of water. The graph (Fig.6) shows the growth of population of Contai from year 1921 to 2011 decade wise. Increasing number of population is shown in graphically below. These data are taken from Census India website.

4. REMEDIAL MEASURE

The protection of reservoir water is very much necessary as it is used for irrigation and industrial purpose. To protect reservoir water human awareness is very much needed. For getting water for irrigation and industry people are taking surface water and ground water as an alternative. But surface water like Haldi River is highly saline and cannot be used for human related activities. For that reason a high ridge at between Bay of Bengal and Haldi River can be provided. To protect ground water harvesting can be provided which will create additional reservoir. It is become very much necessary to limit the withdrawal of water from reservoir by government. Additionally thick clay and thick bentonite can be added at soil profile of Contai at a depth 50m from ground surface to protect the fresh water from groundwater.

5. CONCLUSIONS

From the above analysis it has been seen that Contai, a district of Purba Medinipur, India is not a large district. Its area is small. But in the year 2011 a sizeable population was found to be residing there. Also, the high population density, higher than that in West Bengal, has increased in a decade. Seventy nine reservoirs that were present in Contai subdivision in 2011 have been reduced to 18 in 2020. Out of these 18 reservoirs, one became empty due to some constructional activity done by large number of population. Additionally it has also been observed that perimeter and area of reservoirs in the year 2011 was higher than that in the year 2020. So this reduction of water storage changed the pattern of water usage in Contai. This reservoir storage is basically used for growing irrigation and industrial activity. As the surface water is mostly saline it is unfit for usage in irrigation and industrial purpose. For that reason people of Contai are inclined to use groundwater. Due to indiscriminate use of groundwater, its level declines. According to Gyben Herzberg principle, if groundwater level declines sea water intrudes into the mainland which makes the problem more complex requiring a proper water resources management strategy. It creates alarming situation in Contai district. Treatment can be given to lithology character and surface water and Bay of Bengal so that there is no

hindrance in obtaining reservoir water for irrigation and industrial purpose. The Government may come out with a law so that extraction from reservoirs is brought under a limit. Reservoirs must be conserved now, otherwise in near future drought may occur in Contai.

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