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PROBLEMS OF IRRIGATION WATER SUSTAINABILITY IN VARANASI DISTRICT, UTTAR PRADESH: CURRENT SITUATION AND NEED FOR EFFECTIVE PLANNING

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Abstract: *Irrigation in an agrarian economy assumes the same importance as blood in human body. Agriculture by irrigation antedates recorded history and is probably one of the oldest occupations of the civilized man. In this study attempt has been made to find out the number of irrigation facilities and problems of irrigation water sustainability in Varanasi district. Second is to find out the present condition of irrigation facilities and to suggest certain remedial measures for it. Varanasi district, extending between the latitudes of 25˚10' N to 25˚37' N and longitudes of 82˚39' E to 83˚10' E, lies in the eastern part of Uttar Pradesh and is a part of Indo-Gangetic alluvial plains. The total geographical area of the district is 1526.78 sq. km. as far as drainage is concerned the study area is drained by perennial rivers Ganga, Gomati and Varuna with some seasonal nalas like Nand nala. The general flow direction of these rivers is from west to east. The district has sub-tropical monsoon type of climate with seasonal variations in temperature, rainfall and humidity. The average annual temperature of the district is 25.6^{0}c and the average annual rainfall is 106.43 cm.The present study is based on the secondary sources; data regarding the availability of irrigation facilities and their block wise distribution in the district were obtained from District Statistical Handbook of Varanasi 2014-2015. ArcGIS 10.1 software was used to create maps for block wise spatial distribution of irrigation facilities in the district. In the study area canal irrigation is less in comparison to ground water irrigation. So there is urgent need for development of canal irrigation in order to decrease over-exploitation of ground water and to increase ground water recharge for sustainable development of both surface and ground water irrigation facilities in the district.*
Keywords: *Irrigation, Agrarian Economy, Irrigation Facilities, Water Sustainability, Ground Water.*

Introduction: In recent times, there has been a tremendous increase in demand for water and water shortage in arid and semi-arid regions due to population increase, industrialization and agricultural activities in parts of the world. Sustainable irrigation water management should simultaneously achieve two objectives: sustaining irrigated agriculture for food security and preserving the associated natural environment. A stable relationship should be maintained between these two objectives now and in the future, while potential conflicts between these objectives should be mitigated through appropriate irrigation practices. Infrastructure improvements and changes in crop patterns will be necessary to sustain the irrigated agriculture and the associated environment in the region. Irrigation permits better utilization of all other production factor and thus leads not only to increase yields per unit of land and time but also to stability in the economic condition of farmer. The availability of water in the right quantity and at the right time is essential for good plant growth and better yields. Irrigation is one of the important factor for assured crop production which permits better utilization of all other production factors [1]. Better results from HYVs depend largely on assured and controlled irrigations as they require water at specific period of growth, development and flowering [2]. Thus, the success of agriculture depends mainly on irrigation which works as a mother factor in the improvement of land use mechanic, cropping intensity and patterns and cropped-land productivity [3]. The 'New Agriculture Strategy' has also given prime importance to the rational development of irrigation, a major determinant in the adoption of high- yielding varieties of seed [4]. The United Nations Foodland Agriculture Organization (FAO) estimate that 60 to 80 million hectares are affected to varying degrees by water logging and salinity. Finally, these irrigation induced environmental problems threaten not only agricultural production systems but also human health and the environment. Irrigation development has always been the priority sector for the policy makers for assuring food security in India. Currently, about 60 percent of the irrigated food grain production depends on groundwater irrigation. Besides, with passage of time, dependency of modern agriculture on groundwater irrigation has increased many fold, due to its well-established comparative advantages over canal irrigation [5] and lackluster efficiency of latter. In fact, the number of shallow tube wells roughly doubled every 3.7 years between 1951 and 1991. In some countries and regions, water is already being transferred out of irrigation and into urban industrial uses, putting additional stress on the performance of the irrigation sector [6]. Although the achievements of irrigation in ensuring food security and improving rural welfare have been impressive, past experience also indicates problems and failures of irrigated agriculture. In addition to large water use and low efficiency, environmental concerns are usually considered the most significant problem of the irrigation sector. Developments in irrigation are often instrumental in achieving high rates of agricultural goals bur proper water management must be given due weightage in order to effectively manage water resources [7]. Better management of existing irrigated areas is required for growing the extra food to fulfill the demand of increasing population [8]. Remote sensing with varying degrees of accuracy has been able to provide information on irrigated area, crop water requirements, etc. [9]. Thus, the irrigation must be essential step for sustaining crop productivity because the rainfall is inadequate and unevenly distributed to meet crop water demands [10].

Study Area: Varanasi district, extending between the latitudes of 25˚10' N to 25˚37' N and longitudes of 82˚39' E to 83˚10' E, lies in the eastern part of Uttar Pradesh and is a part of Indo-Gangetic alluvial plains. The total geographical area of the district is 1526.78 sq. km. According to 2011 census the total number of households is 658449. According to Census 2011 the total population of the district is 3676841 in which 1921857 are males and 1754984 are females, density of population is 1113 persons/Sq. Km. 2403903 population of the district is literate of which 1389116 are males and 1014787 are females. The sex ratio of the district is found to 1024 females/1000 males. It is bounded by Bhadohi district in the west, Jaunpur district in the north and north-west, Ghazipur district in the north and north-east, Chandauli district in the east and Mirzapur district in the south. The river Ganga forms its natural boundary in the east, and south-east while northern boundary is marked by the river Gomati (Fig.1). The Grant Trunk Road (NH- 2) passes through the city, linking the study area with major northern and eastern cities of India. Administratively the district comprises two tahsils namely, Pindra and Varanasi Sadar which are further sub-divided into eight development blocks namely Baragaon, Pindra, Cholapur, Chiraigaon, Harhua, Sevapuri, Araziline and Kashividyapeeth altogether consisting of 1336 villages.

Location Map of the Study Area

Figure-1

Objectives of the Study

- To find out the number of irrigation facilities and problems of irrigation water sustainability in Varanasi district.
- To find out the present condition of irrigation facilities and to suggest certain remedial measures for it.

Materials and Methods

The present study is based on the secondary sources, data regarding the availability of different types of irrigation facilities and irrigation sources were obtained from District Statistical Handbook of Varanasi district 2014-2015.Collected data analyzing in MS.Excel. Block wise density of irrigation sources has been calculated from District Statistical Handbook. ArcGIS 10.1 software was used to create maps for spatial distribution of health care facilities in the district. The original map of Ghazipur district was scanned and registered/geo-referenced to specify its location by inputting coordinates.

Results and Discussion

Table.1: Density of Irrigation Sources in Varanasi District, 2015

Block Name	Length of Canals per 1000 hect. of Net Area Sown	No. of Public Tubewells per 1000 hect. of Net Area Sown	No. of Private Tubewells per 1000 hect. of Net Area Sown	No. of Others Sources (PW & MW) per 1000 hect. of Net Area Sown
Baragaon	2.38	7	192	8
Pindra	3.50	6	200	1
Cholapur	2.52	5	203	1
Chiraigaon	1.59	9	197	1
Harahua	0.45	11	231	2
Sevapuri	2.78	9	155	8
Arajiline	1.95	9	172	4
Kashividyapeeth	0.27	12	150	21
Total	2.12	8	189	5

Source: Calculated from District Statistical Handbook, Varanasi, 2015

Density of Canals

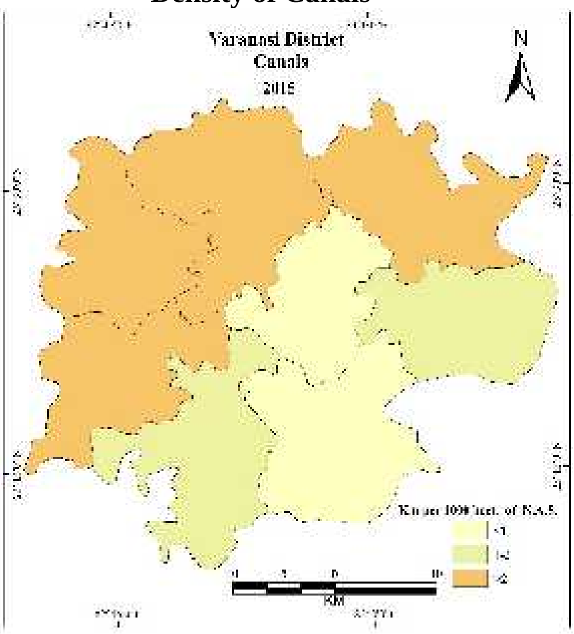

Figure-2

Density of Public Tube wells

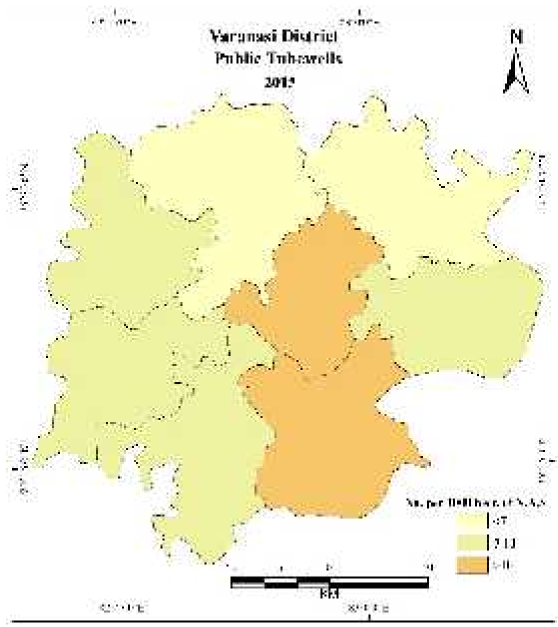

Figure-3

Block Wise Density of Irrigation Sources: Since the size of development blocks is not uniform, hence, the density analysis of irrigation sources seems to be important (Table.1). The low density of canals (<1 km/1000 hect.) in 2015 has been found in Harahua (0.45) and Kashividyapeeth (0.27) blocks, medium density of canals (1-2 km/1000 hect.) has been found in Chiraigaon (1.59) and Arajiline (1.95) blocks and high density of canals (>2 km/1000 hect.) has been found in Baragaon (2.38), Cholapur (2.52), Sevapuri (2.78) and Pindra (3.50) blocks (Fig.2). The low density of public tube wells (<7 tube wells/1000 hect.) in 2015 has been found in Cholapur (5) and Pindra (6) blocks, medium density of public tube wells (7-10 tube wells/1000 hect.) has been found in Baragaon (7), Chiraigaon (9), Sevapuri (9) and Arajiline

(9) blocks and high density of public tube wells (>10 tube wells/1000 hect.) has been found in Harahua (11) and Kashividyapeeth (12) blocks (Fig.3).

Density of Private Tube wells

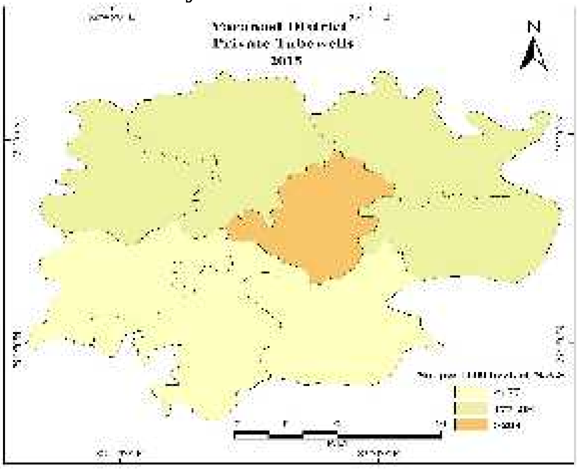

Figure-4

The low density of private tube wells (<177 tube wells/1000 hect.) has been found in Kashividyapeeth (150), Sevapuri (155) and Arajiline (172) blocks, medium density of private tube wells (177-204 tube wells/1000 hect.) has been found in Chiraigaon (197), Baragaon (192), Pindra (200) and Cholapur (203) blocks and high density of private tube wells (>204) has been found in only Harahua (231) block (Fig.4). The low density of other irrigation sources i.e. PW and MW (Persian wheel and Masonry wells) (<8 wells/1000 hect.) has been found in Pindra (1), Cholapur (1), Chiraigaon (1), Harahua (2) and Arajiline (4) blocks, medium density of other irrigation sources (8-14 wells/1000 hect.) has been found in Baragaon (8) and Sevapuri (8) blocks while high density of other irrigation sources (>14 wells/1000 hect.) has been found in only Kashividyapeeth (21) block (Fig.5).

Density of Others Irrigation

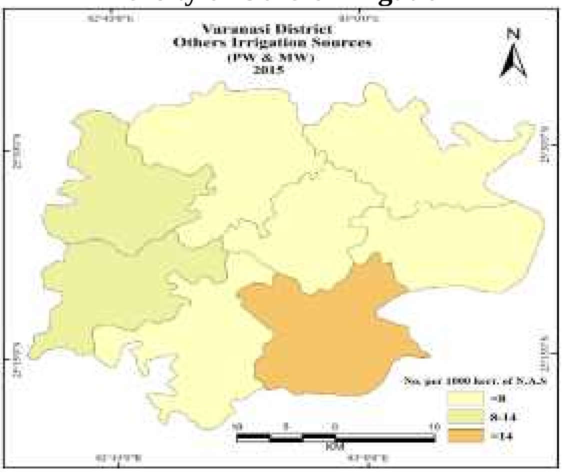

Figure-5, ***Sources (PW & MW)***

Table.2 Block-Wise Net Irrigated Area by Different Sources in Varanasi District, 2015

Block Name	Canals (%)	Public Tubewells (%)	Private Tubewells (%)	Others (Wells & Ponds) (%)
Baragaon	13.62	19.86	65.23	1.29
Pindra	8.42	21.64	69.17	0.76
Cholapur	17.86	21.50	59.62	1.02
Chiraigaon	10.06	24.06	64.48	1.41
Harahua	9.30	41.85	47.49	1.36
Sevapuri	10.35	26.36	62.18	1.12
Arajiline	3.80	29.57	65.82	0.81
Kashividyapeeth	5.17	4.66	88.31	1.86
Total	9.76	24.60	64.50	1.14

Source: Calculated from District Statistical Handbook, Varanasi, 2015

Irrigated Area by Different Sources

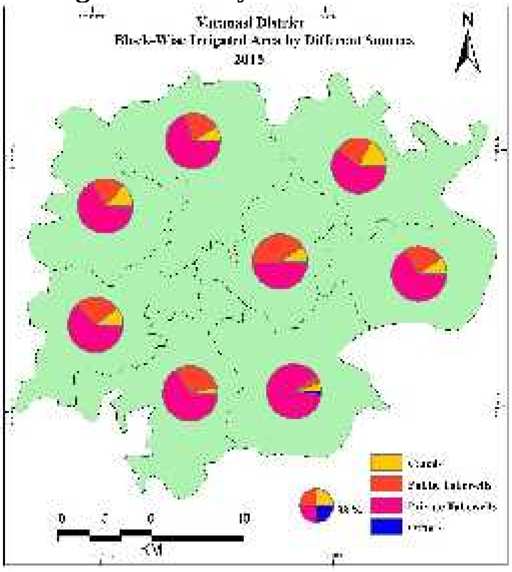

Figure-6

Block Wise Net Irrigated Area by Different Sources: In study area block wise net irrigated area in percentage has been shown in (Table.2). Through canals maximum percentage share of irrigated area was found in Cholapur (17.86%), Baragaon (13.62%), Sevapuri (10.35%), Chiraigaon (10.06%), Harahua (9.30%), Pindra (8.42%), Kashividyapeeth (5.17%) and lowest percentage share was found in Arajiline (3.80%) blocks. Through public tube wells maximum percentage share of irrigated area was found in Harahua (41.85%), Arajiline (29.57%), Sevapuri (26.36%), Chiraigaon (24.06%), Pindra (21.64%), Cholapur (21.50%), Baragaon (19.86%) and lowest percentage share was found in Kashividyapeeth (4.66%) blocks. Through private tube wells maximum percentage share of irrigated area was found in Kashividyapeeth (88.31%), Pindra (69.17%), Arajiline (65.82%), Baragaon (65.23%), Chiraigaon (64.48%), Sevapuri (62.18%), Cholapur (59.62%) and lowest percentage share was found in Harahua (47.49%) blocks. Through other irrigation sources maximum percentage share of irrigated area was found in Kashividyapeeth (1.86%), Chiraigaon (1.41%), Harahua (1.36%), Baragaon (1.29%), Sevapuri (1.12%), Cholapur (1.02%), Arajiline (0.81%) and lowest share was found in Pindra (0.76) blocks (Fig.6).

Suggestions and Planning: Irrigation is the major consumer of water in the area and therefore it must be carried out with high efficiency. It is expensive and as such, farmers must determine the correct timing and quantity to avoid waste. This scheduling depends on knowledge of many factors, including evapotranspiration, water-holding capacity of the soil, water needs of the crop, the consequence of insufficient water on crop performance, available water for irrigation and quality of irrigation water. Water sustainability measure comprises not only creation of reservoirs for storing water but also prevention of losses. In the study area, about 78 per cent of the total water is being used in irrigation but hardly 50 per cent of it goes to meet the crop water requirement. The other half is lost due to application losses on the field, following adoption of faulty irrigation practices and seepage from canal system. The application losses result from over-irrigation, and also when field irrigation channels, grading and shaping of fields, consolidation and ractangulation of holdings, suitable methods of irrigation, irrigational scheduling, rotational supply of water, appropriate cropping patterns etc. are either inadequate or non-existent. The irrigation water losses in the study area are mainly due to over irrigation, and by seepage from canal system. Apart from loss of a valuable resource, it may also lead to various problems like water logging, soil salinity and alkalinity and adverse effect on community health, in combination with factors like poor drainage due to almost flat topography and flooding from streams. Most of the water losses could be minimized by adopting the concept of ‘conservation irrigation’, that is, a combination of irrigation and cropping pattern, best suited to the area, keeping in view the physical and socio-economic conditions of the area. In the study area loss of irrigation water also occurs due to unscientific method of irrigation, that is, by inundation from one field to the other. In fact, there should be provision of field irrigation channels so that each field would have direct access to irrigation water and drip and sprinkler method of irrigation should be increasingly adopted for irrigation water sustainability in the district.

Conclusion: Sustainable irrigation water management should reach a two-part objective, simultaneously sustaining both irrigated agriculture (required for food security) and the associated environment. The way to achieve sustainability is to resolve the conflicts arising from the interactions between water use and the environment, and to balance the benefits between current and future generations. To achieve sustainability, decisions at all the various levels—from crop field management to water allocation at the drainage source and agricultural policy at the regional and national levels—must follow the newly developed sustainability principles. There are significant spatial variations in availability of irrigation facilities in all the blocks of the district. In Varanasi district the pattern of disparity in the distribution of irrigation facilities is well pronounced. Analytical results show that the current irrigated agriculture cannot be sustained because it may put at risk the flow release to the irrigation sources, aggravate the degradation of water and soil salinity, and adversely affect crop yield and harvested area. Improvements in the current infrastructure, such as improving water conveyance/distribution efficiency, upgrading irrigation efficiency and drainage systems. The concepts and analytical framework are applied to irrigation water management in the district, where current practices have led to an environmental disaster that is likely irreversible in some parts. Lessons from the study area problem include the need for an appropriate agricultural development strategy, the need for developing and monitoring an early warning system, and the need to take appropriate actions when creeping processes of change are detected. However irrigation is the basic need of agricultural development. So, to develop the irrigation facilities the State, Central Govt. and other official and non- official groups will have to take dutiful steps giving financial assistance in constructing irrigational projects, establishing pumps deep tube wells and awareness programmes among the farmers for sustainable development of irrigation water in the district.

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