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New York Science Journal

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Parameters Related to Importance of Irrigation in State of Haryana (India)

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Abstract: Agriculture is the major activity in the state of Haryana and large volume of water is required to meet the irrigation demands of the crops grown. But, there is limited water availability in the state. Haryana receives water from Yamuna River and Bhakra system. Sowmelt, rainfall and groundwater are main sources of water in the catchment. It is essential to integrate the manmade canal system with hydrological system. This paper focuses on integrated hydrological modeling framework to conceptualize the system and to assess the Water Resources of the state. Snowmelt and Rainfall runoff modeling using GR4JSG model were combined to model the inflows to the irrigation system of Haryana. Irrigator canal model of eWater Source has been used to generate water demands from crops grown. The water balance and water use efficiency have been worked out for each district of Haryana. The hydro climate input data, stream flows, crop data and soil data have been used in the study. The flows modeled at Tuini (P), Yashwant Nagar, Bausan, Haripur, Poanta and HKB sites were compared with the observed flows. The objective function of NSE Daily and log Flow duration was used for model calibration and validation at various locations up to Mathura, the outlet of the study area. The value of the objective function at Mathura was 0.54, a fairly good value. The results of the Irrigator canal model have shown that all the Inflows, Outflows and the Utilizations of water have been properly balanced for each district. The water use efficiency of districts varies from 27% to 59%. The overall water use efficiency for Haryana canal system has been calculated as 39%. This is low value indicating excess water is being extracted to meet the water demands.

[Kiran. **Parameters Related to Importance of Irrigation in State of Haryana (India).** *N Y Sci J* 2022;15(8):30-34] ISSN 1554-0200 (print); ISSN 2375-723X (online) http://www.sciencepub.net/newyork. 04. doi:10.7537/marsnys150822.04.

Keywords: Irrigation, Importance, Future Prospective, India

Introduction:

Irrigation is the process of applying water to soil, primarily to meet the water needs of growing plants. Water from rivers, reservoirs, lakes, or aquifers is pumped or flows by gravity through pipes, canals, ditches or even natural streams. Applying water to fields enhances the magnitude, quality and reliability of crop production. According to the Food and Agriculture Organization of the United Nations, irrigation contributes to about 40% of the world's food production on 20% of the world's crop production land. Various irrigation methods have been developed over time to meet the irrigation needs of certain crops in specific areas. The three main methods of irrigation are surface, sprinkler and drip/micro. Water flows over the soil by gravity for surface irrigation. Sprinkler irrigation applies water to soil by sprinkling or spraying water droplets from fixed or moving systems. Microirrigation applies frequent, small applications by dripping, bubbling or spraying, and usually only wets a portion of the soil surface in the field. A fourth, and minor, irrigation method is subirrigation where the water table is raised to or held near the plant root zone using ditches or subsurface drains to supply the water.

According to the International Commission on Irrigation and Drainage, surface irrigation is used on about 85% of the 299 Mha of irrigated crop land in the world. India and China each irrigate more than 60 Mha of crop land, accounting for almost half of the irrigated land in the world (FAO, 2013). Approximately 95% of the irrigated land is surface irrigated in India and China. The United States and Pakistan each have about 20 Mha of irrigated land. All other countries each have less than 10 Mha of irrigated land. In the United States, sprinkler and microirrigation are used on a greater percentage of irrigated crop land compared to the other three countries, and the percentages have steadily increased during the past 20 years. Sprinkler irrigation is used on 54% of the 22 Mha of crop land irrigated in the United States, while microirrigation is used on about 7% of the irrigated crop land (USDA NASS, 2008).

2. Haryana State – Haryana isthe land of rich culture and agricultural prosperity. It was formed on November 1, 1966 and was initially part of Punjab.

Later on, it was carved out from it and declared as a separate state. Haryana shares unique geography, which is an amalgamation of the hilly region as well as plains. It is spread over an area of 44,212 km^2. There are 22 districts in Haryana. It lies on the location coordinates of 29.0588° N, 76.0856° E.

Haryana is developing at a very fast rate in current times. Faridabad, the largest city of Haryana has been regarded as the eighth fastest-growing city in the world and the third most in India. Gurugram is yet another city that stands as an example of rapid development. It has been ranked number 1 in terms of the growth of various industries such as IT, Infrastructure, and startups.

Haryana shares a strong traditional essence as much as it is moving towards modernization. The land of Haryana is mesalamine in the remote pasts of India. Kurukshetra, one of the cities in Haryana is the place where the globally revered epic war i.e. Mahabharata took place. There are sites in Hisar (a city in Haryana) which were earlier a part of the Indus Valley Civilization. Scroll down below to know in detail about Haryana.

3. Types of Irrigation in Haryana

There are many different types of irrigation systems, depending on how the water is distributed throughout the field. Some common types of irrigation systems include:

Surface irrigation: Water is distributed over and across land by gravity, no mechanical pump involved.

Localized irrigation: Water is distributed under low pressure, through a piped network and applied to each plant.

Drip irrigation: A type of localized irrigation in which drops of water are delivered at or near the root of plants. In this type of irrigation, evaporation and runoff are minimized.

Center pivot irrigation: Water is distributed by a system of sprinklers that move on wheeled towers in a circular pattern. This system is common in flat areas of the United States.

Lateral move irrigation: Water is distributed through a series of pipes, each with a wheel and a set of sprinklers, which are rotated either by hand or with a purpose-built mechanism. The sprinklers move a certain distance across the field and then need to have the water hose reconnected for the next distance. This system tends to be less expensive but requires more labor than others.

Sub-irrigation: Water is distributed across land by raising the water table, through a system of pumping stations, canals, gates, and ditches. This type of irrigation is most effective in areas with high water tables.

Manual irrigation: Water is distributed across land through manual labor and watering cans. This system is very labor intensive.

Furrow Irrigation: When furrow irrigating, water flows in evenly spaced furrows or corrugates that are typically 0.1–0.3 m wide on fields with slopes of 0.1–3%. Water commonly flows in furrows for 12–24 hours during an irrigation, but shorter or longer durations may be used depending on furrow length, soil properties, and water management considerations. Inflow rates for individual furrows can vary from about 10 to 100 L min1 , again depending on soil, slope, field length and management considerations. Ideally, water should advance across the field in about 25% of the total irrigation time to uniformly irrigate the field. Since soil erosion increases as field slope and inflow rate increase, flow rate must be carefully managed on fields with steeper slopes (>1%). Low inflow rates and long irrigation durations may be needed to apply the desired amount of water during an irrigation on soils with low infiltration rate. Conversely, higher inflow rates are often needed on fields with low slopes and/or high infiltration rate soils in order for the water to flow across the field and uniformly irrigate the upper and lower portions of the field. Inflow to irrigation furrows may be supplied from gated pipe or ditches (earthen or concrete). Siphon tubes are frequently used to convey and regulate water flow from ditches to individual furrows. By creating a siphon, water flows through the tube, over the ditch bank and into the furrow as long as the tube outlet is lower than the water elevation in the ditch. Furrow inflow rate is controlled by tube diameter and the elevation difference between the ditch water level and tube outlet. Gated pipe distributes water to furrows through evenly spaced outlets on the pipe. Furrow inflow rate is controlled by outlet opening and water pressure within the gated pipe. With earthen ditches, water flows through a breach or other opening in the ditch bank to individual furrows or a smaller feed ditch that distributes water to several furrows. It is much more difficult to regulate flow through a breach in an earthen ditch than through siphon tubes or pipe gates. Furrow irrigation requires lower capital investment, less technical knowledge and greater labor than most other irrigation systems. Fields can be irrigated without leveling or grading because water flows in furrows. Furrow irrigation is not well suited to automation because water flow rate must be adjusted for each furrow for each irrigation.

Sprinkler Irrigation: Sprinkler irrigation applies water to soil by spraying or sprinkling water through the air on to the soil surface. Water is pressurized and delivered to the irrigation system by a mainline pipe, which is often buried so it does not interfere with farming operations. Three main categories of sprinkler irrigation systems are solid-set, set-move and moving. Sprinkler irrigation is used for a wide variety of plants including field crops, vegetables, orchards, turf and pastures. Sprinkler systems are also installed for applying wastewater, protecting plants from frost, and dust control in confined animal operations. Solid-set systems may be installed for a single season for certain field crops or permanently for turf, orchards or permanent crops. Set-move systems are manually or mechanically moved to another part of the field after the irrigation set is complete in the present location. Moving systems, such as center pivots or traveling guns, apply water as the system slowly travels through the field. Sprinkler irrigation is often more efficient than surface irrigation because water application is more controlled. In hot and/or windy areas, however, sprinkler irrigation can have significant water losses to evaporation and wind drift. Maintenance is also important for efficient sprinkler irrigation; worn nozzles and leaking pipe connections reduce application uniformity and system efficiency.

Basin and Border Irrigation: Basin and border irrigation systems are similar in that both involve a uniform sheet of water flowing over the soil. The general difference is that basin irrigation involves applying water to a nearly level field and may include ponding for extended time periods. With border irrigation, water flows between dikes that divide a sloping field into rectangular strips with free drainage at the end. The purpose of the dikes is to contain water as it flows across the field, unlike basin irrigation where the dikes pond the water. Basins can be as small as a few square meters for a single tree or as large as several hectares with >100 L s1 inflow rates. Basin size is a balance of soil infiltration rate, slope and water supply. Water depth in basins varies from about 5 to 20 cm, with typical depths of 10–15 cm. Efficient basin irrigation requires a level soil surface with uniform soil texture and adequate water supply so the basin is quickly and uniformly covered with water. If the basin is not level, the higher elevation areas will receive less water than the low areas. If the basin inflow rate is inadequate, water will slowly advance, causing large differences in infiltration opportunity time within the basin (Fangmeier et al., 1999). A special type of basin irrigation is a drain-back level basin. Drain-back level basins have a series of parallel basins that receive inflow from a shallow, 5–10 m wide ditch. After the first basin is filled, a gate opens to start filling the adjacent basin, which is at a lower elevation. Water near the inflow end of the first basin drains back to the inflow ditch and flows to the next basin. This procedure is repeated until every basin has been irrigated. The drain-back phase improves uniformity by reducing the amount of water that infiltrates near the inflow end and initially increases the inflow rate to the next basin, which increases the advance rate. Border irrigation systems are better suited for sloping fields than basin systems because water flows between dikes rather than ponded within basins. The irrigated areas between dikes may be 3–30 m wide and up to 400 m long. The field slope between dikes (perpendicular to water flow direction) should be nearly level so water flows uniformly down the field.

4. Methods of Irrigation

Irrigation can be carried out by two different methods:

- Traditional Methods
- Modern Methods

Traditional Methods of Irrigation

In this method, irrigation is done manually. Here, a farmer pulls out water from wells or canals by himself or using cattle and carries to farming fields. This method can vary in different regions.

The main advantage of this method is that it is cheap. But its efficiency is poor because of the uneven distribution of water. Also, the chances of water loss are very high.

Some examples of the traditional system are pulley system, lever system, chain pump. Among these, the pump system is the most common and used widely.

Modern Methods of Irrigation

The modern method compensates the disadvantages of traditional methods and thus helps in the proper way of water usage.

The modern method involves two systems:

- Sprinkler system
- Drip system

Sprinkler System

A sprinkler system, as its name suggests, sprinkles water over the crop and helps in an even distribution of water. This method is much advisable in areas facing water scarcity.

Here a pump is connected to pipes which generate pressure and water is sprinkled through nozzles of pipes.

Drip System

In the drip system, water supply is done drop by drop exactly at roots using a hose or pipe. This method can also be used in regions where water availability is less.

5. Importance of Irrigation

Irrigation is the process through which controlled amount of water can be supplied through artificial means such as pipes, ditches, sprinklers etc. the main objectives of irrigation systems is to help agricultural crop growth, landscape maintenance, reduce the effect of inadequate rainfall etc. Therefore, the importance of irrigation systems is very high. The importance of irrigation can be explained in the following points:

1. Insufficient and uncertain rainfall adversely affects agriculture. Droughts and famines are caused due to low rainfall. Irrigation helps to increase productivity even in low rainfall.
2. The productivity on irrigated land is higher as compared to the un-irrigated land.
3. Multiple cropping is not possible in India because the rainy season is specific in most of the regions. However, the climate supports cultivation throughout the year. Irrigation facilities make it possible to grow more than one crop in most of the areas of the country.
4. Irrigation has helped to bring most of the fallow land under cultivation.
5. Irrigation has stabilized the output and yield levels.
6. Irrigation increases the availability of water supply, which in turn increases the income of the farmers.
7. Irrigation should be optimum because even over-irrigation can spoil the crop production. Excess water leads to waterlogging, hinder germination, increased salt concentration and uprooting because roots can't withstand standing water. Thus the proper method is to be used for the best cultivation.
8. Agriculture is often greatly hampered due to irregular, insufficient or uncertain rain. Proper irrigation systems can secure uninterrupted agriculture.
9. The productivity of irrigated land is more than the un-irrigated land. Crop yields everywhere in the developing world are consistently higher in irrigated areas than in rainfed areas[1].
10. Seeds cannot grow in dry soil as moisture is necessary for the germination of seeds. With the help of irrigation supply, the required moisture content of soil for the growth of seed can be ensured.
11. Multiple cropping in a year is possible through irrigation. This will enhance production & productivity. In many areas of India, two or three crops in a year are cultivated with irrigation facilities.
12. Through the irrigation, it is possible to supply the required amount of hydrogen & oxygen, which is important for the proper development of plant root.
13. A plant can absorb mineral nutrients from the irrigated soil. Thus irrigation is essential for the general growth of the plant.
14. Bringing more land under cultivation is possible through irrigation.
15. Insufficient rain may also cause drought & famines. Irrigation can play a protective role during the period of drought & famines.
16. Irrigation contributes to the economic growth and poverty reduction. As income and employment are closely related to output and irrigation increases production, substantial increase in income is achieved in the countryside

Conclusion:

At the forefront of current problems in the world comes the planning and effective use of water management, which is a triggering factor for water use and productivity in agricultural production. Recent studies have emphasized the need of addressing water sources with an integrated management approach that includes social, economic and environmental factors in order to achieve sustainability of water resources –which is a natural resource without an alternative–, identify issues that threaten water resources, and establish necessary strategies. The need for effective water management policies have also been globally acknowledge and accepted. The inputs used for agricultural production are very important in terms of sustainability. Irrigation affects the use and quality of all inputs when evaluated for other uses. In this study, ratio of irrigated cropland in the world and in Turkey according to product groups and distribution of product groups among countries were examined, and the importance of irrigation was discussed. Irrigation plays an important role in increasing yield and productivity in agricultural production. Based on the data evaluated in this study, it was determined that wheat yield in dry conditions was 245.5 kg per decare in 2017 and 424 kg in irrigated conditions. Likewise, barley production in dry conditions was 268 kg while the yield was determined as 466 kg in irrigated conditions. On average, the yield in irrigated conditions is about 73% higher than dry conditions for all products. At this point, while irrigation creates significant yield increases, it is also rapidly consumed as a resource without an alternative. At this point, the need for realization of sustainable agriculture, the most efficient use of resources to meet unlimited human needs, and the need to maintain water for long-term use become evident. Taking all these into consideration, the importance of irrigation in feeding the world population and contributing to the conservation of resources in dry farming is crystal clear. According to the results of this study; planning water management and water use and increasing irrigation efficiency through new practices and planning are needed. Increasing demand for food in parallel with the population increase, and the efforts to increase productivity and yield with irrigation results in excessive use of water. However, there is no need to use water so intensively in agricultural production. Realization of efficient distribution of water to fields, determination of water need according to the product and making product-based irrigation plans will contribute to efficient use of water. The creation of irrigation schemes by cooperatives and unions according to product, level of technology usage and land size should also contribute to the efficient and sustainable use of water along with irrigation techniques being used by farmers as well as training provided on the relationship of water and cost. Irrigation quotas for farmers should be determined based on crops and products, charging policies and penal sanctions should be enforced on farmers that exceed these quotas. Marketing channels of the products and priority products in terms of productivity/yield should be determined and reclamation activities should be organized to increase product yields where dry farming is performed.

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8/17/2022