Research Paper Engineering

Methodology for managing irrigation canal system with optimum irrigation scheduling for Meshwo irrigation Scheme

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ABSTRACT

Water is becoming a scarce resource as a result of the growing demand in various purposes. In North Gujarat the availability of water resources is limited in space and time, but with growing population the demand of water for various purposes is ever increasing. Other a systematic and scientific planning for its optimal utilization is high imperative. Use of modern techniques in irrigation will go a long way in economizing consumption and saving of water which will bring greater areas under command and will ultimately result in more agricultural yield.

Keywords : Meshwo reservoir, Penman-Monteith equation, Evaporation, Transpiration

1. INTRODUCTION

The scarcity of water, regarded as the most important factor in crop production, is usually a limiting factor in the development of irrigation scheme particularly in semi arid regions. Irrigation Scheduling is the process of supplying the needed amount of water for crops at the most appropriate time so that soil water content never falls below the management allowable depletion (MAD) level at the crop stress is avoided, thus maximizing the yield. Another important objective of Irrigation Scheduling is to maximize irrigation efficiency by minimizing runoff and percolation losses and in turn, saving water and energy. Economy in use of water and proper application necessitates measures for limiting supply of water to individual field to that which is required for optimum growth of the crop. It further necessitates measures for enforcing discipline and minimizing the excessive water use.

2. NEED TO STUDY

There are different systems of distribution prevailing in different part of the country. In old system cultivator has to submit an application indicating the area of a crop which he wants to grow and for which he require water. The sanction to individual application follows the matching of area applied for and the availability of water. The flow in individual channel is not of fixed duration.

The need to reverse this trend has been recognized. Economy in use of water and proper application necessitates measures for limiting supply of water to individual field to that which is required for optimum growth of the crop. It further necessitates measures for enforcing discipline and minimizing the excessive water use. Assurance regarding supply has built up confidence of cultivators by virtue of which implementation of Irrigation Scheduling is made possible in all irrigated areas.

3. SPECIFIC OBJECTIVES OF STUDY

1. To study and evaluate the various irrigation options and suggests appropriate option for optimizing Net Irrigation Requirement and Irrigation Demand for the cropping pattern of Meshwo Irrigation Scheme situated in Sabarkantha District of North-Gujarat.

2. To suggest suitable canal operation scheduling to match with the seasonal Irrigation Demand.

3. To explore the possibility of “CROPWAT” windows version 8.0 model as management tool in irrigation management.

4. STUDY AREA

Meshwo reservoir is located across river Machhan. Meshwo Irrigation Scheme is a medium project for irrigation and drinking water. It is benefited for Modasa, Bhiloda and Dhansura taluka of Sabarkantha district of Gujarat state. The total Culturable command area of the entire project is about 28369 hectares. The project is on Meshwo the river with gross command area of about 34763 hectares Meshwo (a tributary of Sabarmati river), near village Shamalaji of Bhiloda taluka in Sabarkantha district, Gujarat state, India. Meshwo reservoir is situated at a longitude of 73^0 26’ East and latitude of 23^0 41’ North. At Altitude of 190.0 meter Type of Meshwo dam is earthen dam.

Table: 01

Particular	Direct Command in Hector	Indirect Command in Hector	Total Command in Hector
G.C.A	21975	12788	34763
C.C.A	16269	12100	28369
I.C.A.	6880	10320	17200

5. DATA COLLECTION AND ANALYSIS

The regional climatologically a data are used to estimate crop evapotranspiration, Irrigation scheduling, monthly crop water requirement for Meshwo Irrigation Scheme and ON/OFF schedule for canal operation.

CLIMATOLOGICALLY DATA

The climatologically data of Modasa representing Meshwo Irrigation Scheme command have been collected from Meteorological station, Shamalaji which are recorded by the A State Water Date Center, sector-8, Gandhinagar. It includes the daily values of temperature (maximum and minimum), humidity, wind speed, bright sunshine hours, and rainfall for 10 years (2001-2010). The daily climatologically data are converted into mean value over the monthly and then averaged

over the period of 10 years to arrive at the monthly

Rainfall
The daily data are transferred into fortnightly rainfall and monthly rainfall from this the 50% probable value of rainfall over each of the fortnightly and monthly are calculated by arranging the each fortnightly rainfall and monthly rainfall value in descending order. Rainfall value based on 50% probability is included in monthly

Cropping Pattern of Study Area
The data on project cropping pattern and existing cropping pattern are collected from Meshwo Irrigation Sub Division; Modasa.The existing cropping pattern is shown in below.

The three distinct seasons are considered as:

Kharif - (1 July to 30 November)
Rabi - (10 November to 10 March)
Two Seasonal - (9 February to 10 June)

Soil Types and Soil Moisture Variation
Total Available Soil Moisture (TAM)
TAM defined as the difference in soil moisture content between field capacity and wilting point soil, expressed in mm/meter. Indicative values for different texture class are:

Soil: Coarse Sandy Loamy Clayey
TAM (mm/m): 60 100 140 180

Considering the extent and variation in soil type (i.e. Sandy loam to Sandy clayey loam), total available moisture is considered to be 150 mm/m.

Initial Soil Moisture Depletion (% TAM)
Initial Soil Moisture Depletion indicating the dryness of the soil at the start of the growing season. The initial soil moisture is expressed as a depletion percentage from field capacity. For the analysis works, 40% initial soil moisture depletion is considered.

Maximum Rooting Depth
Maximum rooting depth although in most cases the genetic characteristics of the crop will determine the rooting depth, in some cases the soil and certain disturbing soil depth

Maximum Rain Infiltration Rate
Maximum rain infiltration rate, to allow an estimate of the surface runoff for the effective rain calculation, the maximum rain infiltration rate expressed in mm/day .For the analysis works, 80 mm/day maximum rain infiltration rates have been used.

Irrigation Performance
The following data on Irrigation performance are collected from the Meshwo Irrigation Sub Division, Modasa.

Crop water requirement, irrigation requirement and irrigation schedules

Calculations of crop water requirements and irrigation requirements from climatic and crop data are done by 'CROPWAT windows version 8.0, a computer programme for irrigation planning and management. The programme allows the development schedules for different management conditions and the calculations of scheme water supply for varying cropping patterns. It also helps in the development of recommendations for improved irrigation practices and planning of irrigation schedules under varying water supply conditions.

Calculation of Reference Crop Evapotranspiration
Using required climatic data for Penman-Monteith Method, the reference crop evapotranspiration were computed in mm/day for the monthly calculated.

Development of Crop Coefficient Curve
The growing season of each of the crop is divided into four stages (1) Initial Stage, (2) Development Stage, (3) Mid Season Stage, (4) Late Season Stage.

NET IRRIGATION UNDER DIFFERENT OPTIONS (For proposed cropping pattern)
In order to optimize Irrigation Demand based Irrigation Scheduling options for efficient canal operations, the 'CRPOPWAT' model with required information pertaining to monthly value of climatological elements, soil factors, and crop factors and rainfall. The model was operated and results of this under different options are as under.

6. METHODOLOGY

NET IRRIGATION UNDER DIFFERENT OPTIONS (FOR PROPOSED CROPPING PATTERN)
In order to optimize Irrigation Demand based Irrigation Scheduling options for efficient canal operations, the 'CRPOPWAT' model with required information pertaining to monthly value of climatological elements, soil factors, and crop factors and rainfall. The model was operated and result of this under different options areas under.

The model is operated for all given crops in Kharif, Rabi and Two seasonal

Net Irrigation Under Option-1
This Option is characterized by the application of water when 100% of the readily soil moisture depletion occurs for application timing and refill to 100% readily available soil moisture as application depth criteria.

Net Irrigation Under Option-2
This Option is characterized by the application of water on every 10 days for application timing and refill to 100% of readily available soil moisture as a application depth criterion.

Net Irrigation Under Option-3
This Option is characterized by the application of water when 100% of the readily soil moisture depletion occurs for application timing to irrigate when 50 mm of soil moisture depletion occurs.

Net Irrigation Under Option-4
This Option is characterized by the application of water when fixed depth of 50 mm each for application timing to irrigate when 50 mm of soil moisture depletion occurs as application timing criterion.

Net Irrigation Under Option-5
This Option is characterized by the application of when fixed depth 50 mm each for application timing to irrigation each 10 days as an application criterion.

7. ANALYSIS

The steps of this method are as below:

- Ø Compute monthly value of climatic elements of Shamalaji weather station.
- Ø Decide soil factor of command required for irrigation scheduling.
- Ø Compute crop factor used in irrigation scheduling for all given crops in Kharif, Rabi and Two seasonal
- Ø Compute average monthly rainfall & effective rainfall
  - ➢ Compute crop water requirement and corresponding values of field irrigation requirement and water supply at canal level
  - ➢ Compute irrigation scheduling report for different crops as per planting date and decided irrigation efficiency and crop water requirement (ETm) for available soil moisture under different irrigation options.

8. CONCLUSION

Canal system management for delivering required amount of irrigation water at right time is very much depending upon suitable Irrigation Scheduling matching with constraint and flexibility of the canal system. The performances of this system depend on preparation of realistic canal operation plan

and its implementation. An effort has been made to study the important feature of Meshwo Irrigation Scheme. In order to judge suitability of Irrigation Scheduling options, five options are selected and studied in respect of reference evapotranspiration of various crops in different seasons thereby working out crop water management, Net Irrigation Requirement and Irrigation Demand with canal running time.

Crop yield and C.C.A will increase with optimum Irrigation Scheduling also saving water.

CROPWAT is a strong tool for Irrigation Scheduling. It is a computer interactive and handling of database is very much smooth.

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