The Importance of Seasonal Planning for Irrigation Water Productivity: Inginimitiya Experience

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Abstract

The principal tool in water management in a major scheme is the seasonal planning for water balance. Therefore, the respective officers of such schemes must have this knowledge. Cultivation failures frequently take place in schemes where this method is not adopted. In most of the cases, proper seasonal planning is not done due to lack of interest, knowledge or data. As a result, there are delays in cultivation and decreases in yield, which in turn have a negative impact on farmers' income and their living conditions.

Problems

At the moment, global-wise water usage for agriculture is 85 %. But in the near future it is expected to decrease to 75 % due to the increase in population. On the one hand, food production needs to be increased to meet the food requirements of the increased population but, on the other hand, the availability of fresh water for this purpose is decreasing day by day due to water pollution. Under these two contradictory circumstances, increasing the productivity of irrigation water is an essential requirement. This would be one of the biggest challenges the future world will have to face.

Seasonal Planning

In Sri Lanka, there are two cultivation seasons per year. The period from October to February is called the *maha* season, while the period from April to August is called the *yala* season. Seasonal planning involves the planning of all activities related to cultivation during any one of the aforementioned seasons. Such planning includes the calculation of water balance, determination of cultivation dates, arrangements for operation and maintenance (O&M) activities, arranging cultivation loan facilities, deciding what crops are to be cultivated and the pattern of cropping etc. But the major activity for seasonal planning is the calculation of the water balance equation for the whole season, and it is this aspect that this paper intends to cover and refers to when using the words ‘seasonal planning’.

Calculations Pertaining to Seasonal Planning

The following data are required for traditional seasonal planning or operation study:

1. Yield curves
2. Stream flow-data
3. Evaporation data close to the reservoir
4. Reservoir seepage and percolation data
5. Cultivation data
6. Evaporation data at cultivation area
7. Canal-flow data

Inflow to the reservoirs can be calculated using yield curves and rainfall data (Ponrajah 1984). More accurate results than those generated using this basis of calculation, can be obtained if daily stream flow data are available. When weekly or monthly pan evaporation data close to the reservoir is known, reservoir surface evaporation can be calculated using the following formulae.

(1) Evaporation loss = Evaporation factor x Water surface area of the reservoir

If permeability data for the reservoir bed and the dam are known, the percolation and seepage losses can be calculated. If soil permeability is not available, then seepage and evaporation loss is assumed to be 0.5 % of the monthly average storage. (Ponrajah 1984).

(2) Seepage and percolation loss = 0.5 % x Average monthly storage

Crop water requirements (ET_C) can be calculated using the pan evaporation data of the cultivation area (ET_0) and crop factors (k_c), while conveyance losses and canal efficiencies (E_a) can be calculated using canal flow data. Subsequently, daily, weekly or monthly irrigation requirements can be calculated using:

(3) Crop water requirement = $ET_C = ET_0 \times k_c$

(4) Field irrigation requirement = FIR = ET_C / E_a

(5) Irrigation requirement = IR = FIR / E_c

The water balance equation for the period of interest can be derived using:

(6) Storage at the end of previous day + inflow = Storage at the end of day + Irrigation requirement + Reservoir surface evaporation + Seepage and percolation loss

More accurate results can be obtained if calculations are done on a daily basis, which would however, require rather long calculations to be made, which make the work boring and difficult. If a monthly basis is considered, then calculations are easy but results are less accurate, given that the duration between data is long and as such, there may not be a sense of uniformity in the abovementioned components. This leaves the weekly calculations as the best method.

Seasonal Planning in Inginimitiya

Inginimitiya is a major irrigation system in the Mi Oya River basin. The reservoir is located in the Galgamuwa electorate in the Kurunegala District. The irrigation command area is situated in the Anamaduwa and Nawagattegama electorates in the Puttalam District. The total cultivation area is 2,650 ha. The average rainfall is 800 mm – 900 mm annually. Inginimitiya is considered to be a system that faces very serious levels of water scarcity. The average cropping intensity for the system before was 1.0 indicating that cultivation was done every other season. The author understood the need for improvement in the system and decided to change the method used in the seasonal planning that was practiced. This paper presents the author's experiences as the Irrigation Engineer for this system since the beginning of year 2000.

By the year 2000, rainfall and cultivation data for 15 years and inflow data for 7 years were available. I (the author of this paper) analyzed this data in a simple way. Abnormal cases were removed and afterwards, the average inflow for each month of the year was obtained using the balance data. I also understood that precipitation from convectional and inter-monsoon rains during March to May are higher than the north-east monsoon. Therefore, I took a risk without any doubt to analyze the database available for periods mentioned above.

Standard practice of the Irrigation Department is to consider 7 ft. (2.13 m) as the water duty in the *yala* season cultivation planning (Ponrajah 1988). But considering past duties and in a rational analysis, it was assumed that 5.5 ft. (1.68 m) is the overall duty for the whole season. Here, crop water requirements, field irrigation requirements or irrigation requirements were not calculated; instead the assumed total seasonal duty was divided based on the growth stages of the crop so as to calculate the irrigation requirement for the total cultivation area.

Pan evaporation data for either the area close to the reservoir or in the cultivation area was not available in the office. As such, water surface evaporation was calculated based on the evaporation factors of the Tabbowa evaporation station in the same river basin. Based on Ponrajah (1988), monthly seepage and percolation loss was assumed to be at 0.5 % of the monthly average storage. The above water balance equation was thereafter, applied using an 'Excel' worksheet. For storages at the end of each week, the respective water levels were decided using the area-capacity curve. The relevant data was plotted against respective weeks on an A4 size paper. This was used as the tool for the main reservoir water level operation for the whole season.

I (the author of this paper) submitted this plan to the Kanne meeting, which was chaired by the District Secretary, Puttalam. He was very pleased with the plan. I explained the plan at the Kanne meeting in very simple terms, so that farmers could understand. Farmers were encouraged to use rainwater as much as possible. The ancient farmers' water saving techniques were introduced in a new approach.

Implementation and Monitoring

After commencing the water issues for the season, the reservoir water level was measured everyday using the installed gauge and the actual water levels were plotted in the same sheet. To know the problems in the field, I (the author of this paper) introduced field log books to each farmer organization. Departmental irrigators referred these books daily and reported to my office on the same day, which helped to make the necessary flow adjustments expediently. I visited the field with relevant field staff fortnightly. The problems in the field were solved in the field itself. The runoff water, which flowed through the cultivation area, was diverted to the left bank and right bank main canals in two places. This practice reduced water discharges from the main reservoir (sluice discharges) to a great extent and the water level could be monitored easily.

Results

By using this method I (the author of this paper) obtained the following results:

1. 2002 *yala* duty was 4.2 ft. (1.28 m).
2. In 2002 and 2003 the cropping intensity was 2.0 (200 %).
3. I could persuade farmers that my calculations and analyses were correct, which in turn helped me to win the trust and confidence of the farmers, and thereby minimizing the incidence of troubles and unnecessary problems.
4. Farmers' income was increased as the cropping intensity increased.
5. The department was given recognition and considered to be credible.
6. I was commended by farmers and the District Secretary Puttalam.
7. The next season could be started even with a small storage in the reservoir, but expecting a prospective inflow.

Discussion

The forecast I (the author of this paper) made was more than 90 % accurate, even though very advanced theories and complex analyses were not used. The main reasons for this success were,

1. Accurate forecast of components in the water balance equation.
2. Establishing trust among farmers.
3. Integrated approach to water management, taken by Irrigation Engineer's office, Project Manager's office and Farmer Organizations

4. My keen interest on water management.

5. My close monitoring.

I applied the same method for the Kaudulla scheme in Medirigiriya from 2004 to 2006, there again I was able to generate very good results.

Conclusion

It is the author's belief that this method is not specific to the Inginimitiya and Kaudulla schemes; rather it can be applied for all other major schemes as well. This method can even be applied for small schemes as well. If however, it is applied for small schemes, a greater effort will have to be expended to account for the fact that farmers in small schemes are relatively poorer than those who are in major schemes. However, very good water productivity can be obtained even in the small schemes if this method is effectively applied.

References

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