IMPROVEMENTS TO THE RADELLA IRRIGATION SCHEME IN LAHUGALA DIVISIONAL SECRETARY AREA IN AMPARA DISTRICT

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INTRODUCTION

Tank irrigation systems contribute significantly to agricultural production in the dry zone of Sri Lanka. Tank irrigation has a long history and many currently used tanks were constructed in the *Anuradapura* and *Polonnaruwa* era. Four rainfall seasons can be clearly identified in Sri Lanka from which two consecutive rainy seasons make up the major growing seasons, namely *Maha* and *Yala*. *Maha* season is the major growing season while *Yala* is considered the minor growing season of the dry zone. Tank irrigation contributes mainly during *Yala* season where the farmers are unable to cultivate due to insufficient amount of water that they receive from rain in spite of the land availability.

The *Radella* scheme is situated very close to "*Heda Oya*" River in *Radella* village in *Lahugala* Divisional Secretary area in *Ampara* District in the Eastern Province. The left bank end of the main bund is defined by the co-ordinate (181925N, 308575E). This is an ancient tank built to accommodate drainage water from its own catchment. In 1995 the tank bund was breached due to heavy floods. In January 2000 the dam breached in three locations, once again due to heavy floods and overtopping of the bund. After restoration, presently 405 ha extent of land is under paddy cultivation in *Maha* season, where as the paddy cultivation varies according to the water availability (Figure 2).

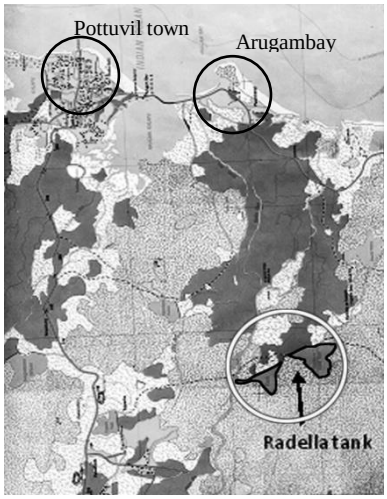

Figure 1 - Pottuvil area

In *Radella* scheme, most of the farmers cultivate only in *Maha* season due to the problem of getting sufficient water during the *Yala* season. Some farmers do not get sufficient water for the final stage of paddy cultivation even in *Maha* season. This eventually decreases the yield even in *Maha* season. The social and economic condition of the farmers in the scheme is extremely pathetic. Most of them have taken loans from either government banks or private institutions. The loans are repaid with the harvest that they get in *Maha* season, leaving them in a "no saved money" state once again. Two solutions can be adopted in solving the above problem; encouraging the farmers to cultivate in *Yala* & improving yield in *Maha*. This study mainly focuses on increasing the cropping intensity during *Yala* season facilitating the farmers to improve their economic and social conditions in the long run.

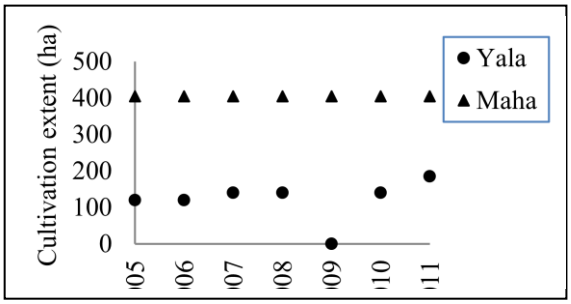

Figure 2 – Cultivation extent in hectares in *Yala & Maha*

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The main shortcoming of the scheme is that the tank water is not distributed to all the paddy fields in the *Radella* Irrigation scheme because the sluice of the tank is situated at a lower level than some of the paddy fields. These paddy fields are situated in such a manner that water cannot be taken from any other water source. Other reason leading to fewer yields is that the water capacity of the tank is insufficient for distribution among all the paddy fields. According to figure 2, an average extent of 140 ha of land has been cultivated in *Yala* season since year 2005 except for year 2009 where no cultivation was carried out due to the severe drought.

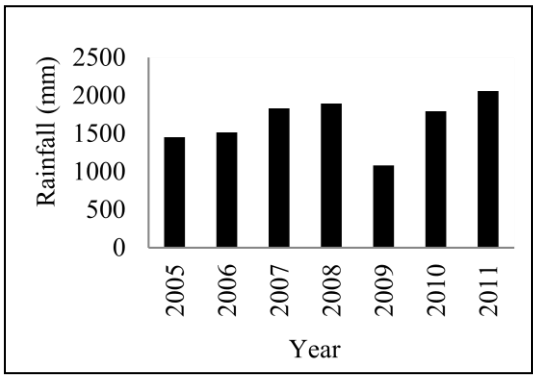

Figure 3 – Rainfall data in *Radella* tank

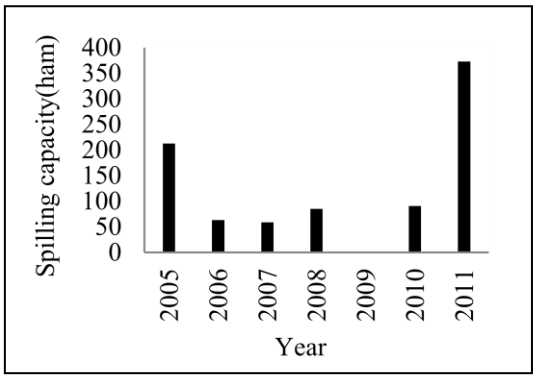

Figure 4 – Spilling capacity data in *Radella* tank

It can be observed from figures 3 & 4 that the tank spills annually as a consequence of heavy rains in the months of December and January except for year 2009.

AIM

The aim is to redesign the Radella tank bund and the spill in view of increasing the cropping intensity of the Radella Irrigation Scheme.

OBJECTIVES

Perform an operation study and redesign the tank bund

- Raise the sill level of the sluice.
- Perform a flood study and redesign the spill.

METHODOLOGY

Operation Study

An operation study was carried out to determine the optimum water capacity of *Radella* tank and possible irrigable land with paddy in *Maha* and paddy and other desired crops in *Yala*. The study is started by assuming a nominal storage and proposed extent of cultivation area. A pre-determined cropping pattern and intensity were decided at the beginning of the study.

"Water balance equation" shown below is the basis of the operation study.

Storage at the beginning of the month	+ Inflow – losses –Demand – Spillage =	Storage at the end of the

The procedure in carrying out an operation study is given in the block diagram shown in Figure 5.

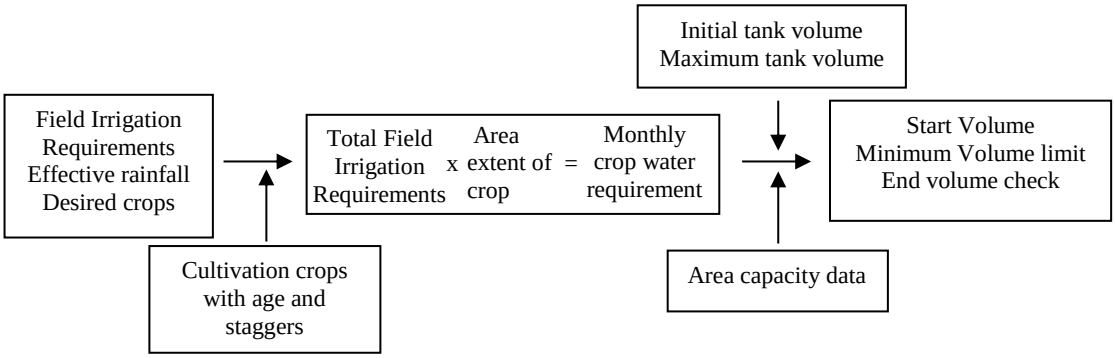

Figure 5 – Block diagram for operation study

Flood study

Intensity- Duration – Frequency curves have been derived for the 6 hydrological zones into which Sri Lanka is divided. These curves could be obtained using equation 1 (Ponrajah,1984).

$$I = XD^{-Y} \quad (1)$$

where I = The rainfall intensity in mm per hour, D = Duration in minutes, X , Y = Constant for each curve. The rainfall intensity is obtained considering that *Radella* tank is situated in hydrological zone 6 (Ponrajah, 1984).

The peak run-off from a catchment which has no undue retention or detention occurs when the storm is of duration equal to the time of concentration of the catchment and the run – off can be obtained by the Rational formula given in equation 2 (Ponrajah,1984).

$$Q = RICA \quad (2)$$

where, Q = Peak runoff in meter cube per second, R = Coefficient dependent on the units used, C = The runoff coefficient, I = The rainfall intensity in mm per hour, A= The catchment area in hectares.

Time of concentration can be can be calculated using equation 3 (Ponrajah,1984).

$$T_C = \frac{L}{60V} + 15\ minutes \quad (3)$$

where, T_c = Time of concentration in minutes, L = Longest watercourse in meter, V = Average velocity in meter per second.

Capacity of spilling (Qo) and Duration of spilling (Ds)

Capacity and duration of spilling can be obtained using Figure 6.

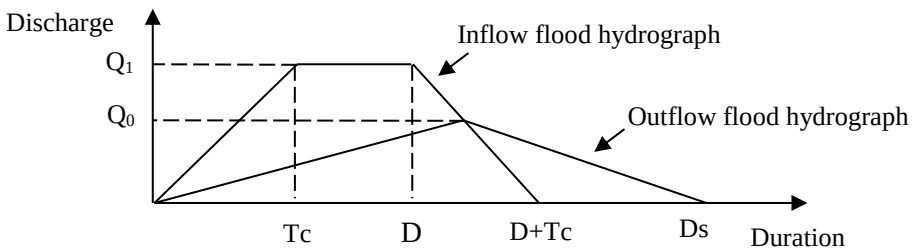

Figure 6 – Inflow & outflow flood hydrographs

when D = Tc

$$Q_O = Q_I - \frac{Q_D}{0.36T_C} \quad (4)$$

when D > Tc

$$Q_O = \frac{2DQ_I}{(D+T_C)} - \frac{2Q_D}{0.36(D+T_C)} \quad (5)$$

$$D_S = 2T_C + \frac{2Q_D}{0.36T_C} \quad (6)$$

Where Q_I = Maximum run off in meter cub per second, Q_o = Critical out flow in meter cub per second, T_c = Time of concentration in hour, D= Duration of rainfall in hour, D_s = Duration of spilling in hour, Q_D = Detention capacity in hectare meter

Length of the spill

Length of the Clear overfall spill was obtained using equation 7 (Ponrajah, 1984).

$$Q = 1.83\, L\, H^{1.5} \quad (7)$$

where, Q = Critical out flow in hectare meter, L= Length of the Clear overfall spill in meter,

H = Afflux in meter.

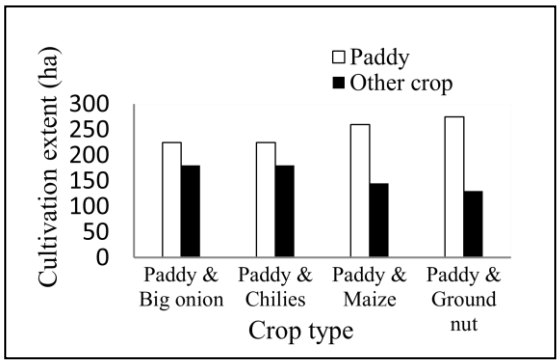

Figure 7- Cultivation extent Vs crop variety in *Yala* season

Soil sampling and analyzing

Soil was sampled from several locations of the paddy fields in *Radella* scheme and tested using sieve analysis and hygrometer tests to check the suitability of soil for cultivation.

Survey work

Radella tank was surveyed in several aspects to obtain necessary technical data. Survey work included leveling of the tank bund, bed contour survey, identifying the longest fetch and taking levels in the paddy fields in the vicinity of the tank.

RESULTS AND DISCUSSION

From the Operation study the tank capacity was found to be 490 ham. Using elevation-area-capacity data of the *Radella* tank, it can be suggested that the tank full supply level be increased by 1.5 m to accommodate the increased water capacity. Consequently, crest level of the spill should be raised by 1.5 m. Using the levels obtained via survey work carried out in the *Radella* tank, it was determined that the sill level of the tank sluice should also be raised by 0.9 m to facilitate distribution of water for all the paddy fields in the *Radella* Irrigation scheme. Therefore the dead storage must be increased from 13 ham to 50 ham. Spill length is increased from 30 m to 36 m. The extent of area that can be cultivated in *Maha* and *Yala* seasons are 405 ha and 325 ha respectively after adopting the suggested improvements.

By introducing new variety of crops with low water consumption (*eg: maize, chilies…*), the paddy extent can be reduced, facilitating cultivation of whole 405 ha even in the *Yala* season (Figure 7).

CONCLUSIONS

The increased water capacity in the *Radella* tank can be used to irrigate more paddy lands in *Radella* irrigation scheme during *Yala* season. As the sill level of the sluice is raised to the maximum ground level of the paddy lands, all the paddy fields will get water both in *Maha* and *Yala* seasons. The extent of area that can be used for paddy cultivation in *Maha* and *Yala* seasons are 405 ha and 325 ha respectively, after adopting the suggested improvements. By introducing new variety of crops with low water consumption, all culturable land in *Radella* Irrigation scheme can be cultivated even in *Yala* season. The chances of depletion of *Radella* tank is minimized due to the increase of dead storage.

REFERENCES

Design of small dams (1987). A water resources technical publication, United States Department of the Interior, Bureau of Reclamation, New York University Press, U.S.

Ponrajah, A.J.P. (1984). Design of Irrigation Head works for small catchment: Irrigation Department, Colombo.