DISTRIBUTION AND MANAGEMENT OF IRRIGATION WATER IN MAHAWEI PROJECT SYSTEM H.

By

R. T. C. Peiris and L. V. Talagala

1. Introduction

Sri Lanka is a tropical country encompassed by the latitudes 6° - 10° North and Longitudes 80° - 89° East. It has an area of 65,000 Sq. km. and is populated by 14 million people. All the major rivers in the Island radiate from the mountain range and are characterised by sustained and heavy discharges throughout the year, due to the influence of North East and South West monsoons. Dry zone of Sri Lanka covering over 60% of land, with gentle relief, well drained soils and dry climate is the most promising area for irrigated agriculture. One of the largest rivers which flows across the Wet and Dry zones is the Mahaweli Ganga. It has its origin in the area where rainfall is over 2,500 mm. and drains an area of 10,000 Sq.km. Mean annual runoff is 8,900 million M³. The problem of providing an assured supply of water to the Dry Zone can thus be solved by using Mahaweli Ganga as the promising source.

The Master Plan provides for the construction of Diversion Dams and a Cascade of reservoirs on the Mahaweli Ganga and its tributaries and distribute the regulated yield to thirteen Dry Zone river basins along a Network of waterbasin tunnels and canals (Fig. 1). 3,500 million M³ of regulated water is delivered from Mahaweli Ganga to the Dry Zone, and together with its local yield of nearly 1,150 million M³ will meet the necessary water requirements for the full development of 360,000 ha. of land. In addition, combined use of reservoirs and canal Dams will permit the development of about 810 MW of installed electrical generating capacity and an average annual energy output of 2,610 million kilowatt hours.

2. Description of Project Area

With the construction of Polgolla and Bowatenna Complexes the Mahaweli Water is diverted to the Kala Oya Basin. With the improvements to Kalawewa and the construction of Dambulu Oya Reservoir it is possible to develop 29,000 ha. of farm area in System H. The total project area covering 550 Sq. km. is located between Kandalama Reservoir (uppermost) and Rajanganaya Reservoir (lowermost) with reservoirs Kalawewa and Dambulu Oya forming the main storage components in the development. The project area includes about 6,500 ha. of existing, paddy fields rainfed or irrigated from village tanks. The irrigation plan provides for the supply of water to the new areas by the construction of new canal network and the ancient canal system after improvements. The new areas are dotted with numerous village tanks and ancient schemes varying in size from a few to about 50 ha.

2.1 Climatological Data

The annual rainfall in the project area is about 1,500 mm. of which over 70% occurs during the North East monsoon period (Maha season) October through March, while the period (Yala season) May through September is characterised by low and erratic rainfall and dry winds from South West direction (Table 1).

2.2 Topography, Land Classification and Soils

The project lies within the first peneplain of Sri Lanka. Small size catchments from a gently undulating relief with successive wide and flat valleys. The slopes average 0 to 3 percent. Land classes 2 and 4 R amount to 90% of the irrigable area. Reddish Brown Earth Soils (RBE) cover about 60% of the area. Low Humic Gley Soils (LHG) 35%, the remainder being Alluvial Soils, (Fig. 2). Leaching conditions of the soil prevail during the Wet Season. Surface sheet erosion occur during storms.

RBE soils (1-2 percent slopes) moderately deep to deep, moderately fine textured, well drained occupy the crests and mid slopes. These are reddish in colour, have a narrow range of available moisture between 8-12 percent by weight. The average infiltration is between 35-60 mm/hr. Bulk densities are about 1.0 g/cc at the surface and 1.7 g/cc in the sub soil.

The LHG soils (0.1 percent slopes) moderately deep to deep, moderately fine textured, poorly drained occupy the valley bottom positions. These are greyish and brownish. Available water holding capacities are about 10-15 cm/m of soil. The average infiltration is between 5-10 mm/hr. Bulk densities are about 1.6 g/cc in the surface and subsoil.

Deep Alluvial Soils (AL) of variable texture and drainage (0-2 percent slopes) occur adjacent to streams. These are imperfectly to poorly drained, dark brownish or greyish, sandy, loamy or clayey structureless soils with variable consistencies.

3. Cropping Patterns, Intensities and Field Water Requirements

Cropping patterns and water requirements have been based on data evaluated from trials made at Maha Iluppalam. In order to minimise percolation losses in RBE soils and to make maximum use of rainfall cropping patterns have been selected as shown below.
TABLE 1
MEAN MONTHLY AVERAGES OF CLIMATOLOGICAL DATA FOR MAHA ILLUPALLAMA

(Latitude 8° 67' N; Longitude 80° 8' E; Altitude 137 meters)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Rainfall</td>
<td>mm</td>
<td>105</td>
<td>51</td>
<td>87</td>
<td>186</td>
<td>82</td>
<td>21</td>
<td>32</td>
<td>46</td>
<td>76</td>
<td>258</td>
<td>206</td>
<td>255</td>
<td>1467</td>
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<tr>
<td>Relative Humidity</td>
<td>%</td>
<td>75</td>
<td>68</td>
<td>70</td>
<td>67</td>
<td>64</td>
<td>63</td>
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<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>Pan Evaporation</td>
<td>mm</td>
<td>97</td>
<td>101</td>
<td>164</td>
<td>130</td>
<td>154</td>
<td>192</td>
<td>215</td>
<td>249</td>
<td>258</td>
<td>154</td>
<td>72</td>
<td>71</td>
<td>1818</td>
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<tr>
<td>Evapotranspiration (Mod. Penman)</td>
<td>mm</td>
<td>132</td>
<td>143</td>
<td>180</td>
<td>180</td>
<td>162</td>
<td>165</td>
<td>183</td>
<td>158</td>
<td>183</td>
<td>123</td>
<td>124</td>
<td>1920</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>%</td>
<td>28.9</td>
<td>30.5</td>
<td>32.3</td>
<td>33.6</td>
<td>32.2</td>
<td>31.9</td>
<td>32.6</td>
<td>33.1</td>
<td>33.3</td>
<td>32.2</td>
<td>29.7</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td>Mean Maximum</td>
<td></td>
<td>29.2</td>
<td>18.8</td>
<td>21.1</td>
<td>22.8</td>
<td>23.8</td>
<td>24.0</td>
<td>23.7</td>
<td>23.7</td>
<td>23.7</td>
<td>21.7</td>
<td>21.7</td>
<td>20.0</td>
<td></td>
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<tr>
<td>Mean Minimum</td>
<td></td>
<td>24.6</td>
<td>25.5</td>
<td>27.2</td>
<td>28.2</td>
<td>28.6</td>
<td>27.9</td>
<td>28.1</td>
<td>28.4</td>
<td>28.4</td>
<td>27.3</td>
<td>28.7</td>
<td>26.0</td>
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<tr>
<td>Wind Velocity</td>
<td>km/day</td>
<td>2 m</td>
<td>88</td>
<td>94</td>
<td>67</td>
<td>60</td>
<td>128</td>
<td>241</td>
<td>209</td>
<td>212</td>
<td>229</td>
<td>122</td>
<td>61</td>
<td>65</td>
</tr>
<tr>
<td>Day-Night Wind Ratio</td>
<td></td>
<td>3.7</td>
<td>3.2</td>
<td>3.0</td>
<td>2.4</td>
<td>1.8</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>2.2</td>
<td>2.0</td>
<td>3.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Sunshine</td>
<td>hr/day</td>
<td>7.6</td>
<td>8.9</td>
<td>9.2</td>
<td>9.5</td>
<td>9.1</td>
<td>8.7</td>
<td>8.2</td>
<td>9.0</td>
<td>8.0</td>
<td>7.6</td>
<td>6.5</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>Cloudiness</td>
<td>cot</td>
<td>4.9</td>
<td>4.1</td>
<td>3.9</td>
<td>5.0</td>
<td>5.9</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>6.8</td>
<td>6.0</td>
<td>8.8</td>
<td>5.7</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2
Monthly Average Discharge Per ha. for Upland and Lowland

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Upland</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Water Requirement (No Rainfall)</td>
<td>mm</td>
<td>110</td>
<td>55</td>
<td>185</td>
<td>224</td>
<td>231</td>
<td>188</td>
<td>211</td>
<td>190</td>
<td>102</td>
<td>147</td>
<td>106</td>
<td>103</td>
<td>2022</td>
</tr>
<tr>
<td>Effective Rainfall</td>
<td>mm</td>
<td>43</td>
<td>18</td>
<td>20</td>
<td>90</td>
<td>63</td>
<td>55</td>
<td>15</td>
<td>15</td>
<td>18</td>
<td>70</td>
<td>61</td>
<td>66</td>
<td>661</td>
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<tr>
<td>Field Water Requirement</td>
<td>mm</td>
<td>97</td>
<td>37</td>
<td>165</td>
<td>125</td>
<td>107</td>
<td>153</td>
<td>196</td>
<td>172</td>
<td>82</td>
<td>94</td>
<td>127</td>
<td>1401</td>
<td></td>
</tr>
<tr>
<td>Average discharge per ha. with effective rainfall</td>
<td>Litre/sec</td>
<td>0.25</td>
<td>0.16</td>
<td>0.03</td>
<td>0.53</td>
<td>0.33</td>
<td>0.60</td>
<td>0.74</td>
<td>0.65</td>
<td>0.32</td>
<td>0.25</td>
<td>0.37</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Lowland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Water Requirement (No Rainfall)</td>
<td>mm</td>
<td>290</td>
<td>127</td>
<td>220*</td>
<td>297</td>
<td>271</td>
<td>269</td>
<td>213</td>
<td>122</td>
<td>294*</td>
<td>257</td>
<td>210</td>
<td>203</td>
<td>2092</td>
</tr>
<tr>
<td>Effective Rainfall at Maha Illappallama</td>
<td>mm</td>
<td>64</td>
<td>25</td>
<td>38</td>
<td>101</td>
<td>38</td>
<td>10</td>
<td>18</td>
<td>20</td>
<td>33</td>
<td>127</td>
<td>140</td>
<td>149</td>
<td>754</td>
</tr>
<tr>
<td>Field Water Requirement</td>
<td>mm</td>
<td>136</td>
<td>102</td>
<td>182</td>
<td>196</td>
<td>233</td>
<td>259</td>
<td>196</td>
<td>102</td>
<td>251</td>
<td>140</td>
<td>70</td>
<td>38</td>
<td>1038</td>
</tr>
<tr>
<td>Average Discharge per ha. with effective rainfall</td>
<td>Litre/sec</td>
<td>0.62</td>
<td>0.43</td>
<td>0.69</td>
<td>0.76</td>
<td>0.88</td>
<td>1.01</td>
<td>0.74</td>
<td>0.38</td>
<td>0.98</td>
<td>0.52</td>
<td>0.53</td>
<td>0.23</td>
<td></td>
</tr>
</tbody>
</table>

1/ Effective rainfall figures for the cropping pattern used, calculated on the basis given in FAO/Irrigation and Drainage paper No. 26 using Maha Illappallama Data.
2/ Allowing for Effective Rainfall.
* Main Puddling Period.
3.1 Cropping Pattern Rotation

<table>
<thead>
<tr>
<th>Rotation Percent</th>
<th>Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>of Land</td>
<td></td>
</tr>
<tr>
<td>UPLAND</td>
<td></td>
</tr>
<tr>
<td>1 4</td>
<td>Paddy/ Vegetables/ Nurseries</td>
</tr>
<tr>
<td>2 4</td>
<td>Onions/Chillies/ Pulses</td>
</tr>
<tr>
<td>3 15</td>
<td>Paddy/Chillies</td>
</tr>
<tr>
<td>4 47</td>
<td>Paddy/Groundnut/ Pulses</td>
</tr>
<tr>
<td>5 30</td>
<td>Paddy/Cotton</td>
</tr>
<tr>
<td>LOWLAND</td>
<td></td>
</tr>
<tr>
<td>1 75</td>
<td>Paddy/Paddy (Both 135 days each)</td>
</tr>
<tr>
<td>2 25</td>
<td>Paddy/Paddy/ Paddy (all 100 days each)</td>
</tr>
</tbody>
</table>

3.2 Upland Crops

(a) An irrigation of 40 mm is given before land preparation of Upland (assumed 15 days before sowing or transplanting).

(b) Efficiency of irrigation is related to irrigation frequency and following figures are assumed.

   - Onions and upland paddy: 50%
   - Chillies during the 1st month: 50%
   - Chillies after one month: 60%
   - Other crops: 70%

(c) Irrigation is stopped 15 days before the final harvest.

3.3 Lowland Paddy

(a) The first and second flooding for land preparation requires a total of 180 mm over a period of 15 days (Fig. 2).

(b) Evapotranspiration and losses require irrigation till 15 days before harvest.

(c) Percolation losses are assumed to be 100 mm per month during the entire period standing water on the field.

Water requirement based on the above is given in Table 2.

3.4 Water Distribution and Control

Water distribution is done in three stages:

- Along the Field Canal
- Along the Distributary Canal
- Along the Field Canal

The turnout area is delivered with a field canal of capacity 28.3 1/s to irrigate about 14 farms of 1 ha each. The details of the irrigation and drainage network are given in Fig. 3.

Two farms inside a turnout area will receive the entire field canal discharge for a specified time to deliver simultaneously the required quantity of water. After irrigating the first two farms the field canal discharge is turned into the second pair of farms. During the peak period of this procedure is continued till all farms within the turnout receive the required quantity of water. Other periods the field canal discharge can be reduced accordingly. When the required discharge falls below one half of the design discharge, instead of reducing the field canal discharge, two turnovers are combined for purpose of rotation.

The issue to the turnout areas is done from the distributary canal. The distributary is designed to supply the peak requirement of all the turnovers simultaneously. The control structure at the head of the distributary canal will be used to regulate the varying demands.

The main canal feeds a large number of distributaries where the discharge varies according to, monthly and seasonal variations due to climate and cropping pattern changes, and daily variations due to the change in application times for upland crops and paddy. Main canal has large hydraulic capacity making it less responsive to the sudden changes. It is not possible to adjust the control at the intake sluice everytime to suit the varying demands due to responsive time. Thus the main canal is routed through the larger village tanks. The operation and regulation is improved as the demand variations will then be confined to several sections of the main canal. The control structures at the head of each reach of the main canal are operated to replenish the village tanks from time to time.

4. WATER ISSUES AND CROPS CULTIVATED

4.1 Water Use

Up to Maha 1977/78 almost all the area was cultivated with paddy, and the water issues are summarised below in mm.
4.2 Estimated Efficiencies

Water conveyance efficiency  

\[ \eta_s = \frac{\text{Quantity of water issued to the farm } h_f}{\text{Quantity of water issued from Shieco } h_s} \]

Farm efficiency  

\[ \eta_f = \frac{\text{Qty. of water applied to root zone of Soil } h_n}{\text{Qty. of water issued to the farm } h_f} \]

Overall efficiency  

\[ \eta_p = \frac{\text{Quantity of water applied to the root zone } h_n}{\text{Quantity of water issued from the Shieco } h_s} = \eta_s \times \eta_f \]

4.2 Estimated Efficiencies

<table>
<thead>
<tr>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>0.68</td>
<td>0.78</td>
</tr>
<tr>
<td>0.46</td>
<td>0.38</td>
<td>0.50</td>
</tr>
<tr>
<td>0.34</td>
<td>0.25</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Thus, there are two major factors that require serious considerations, viz. The crop diversification and overall efficiency of water use.

5. REASONS FOR THE ABSENCE OF CROP DIVERSIFICATION AND LOW EFFICIENCY IN WATER USE

5.1 Traditional Practices — Background

Traditional Dry Zone farmer in addition to 0.3 to 0.6 ha. of paddy land below the village tanks has a small rainfed homestead plot and also operates several hectares of Chenna cultivation. The irrigated land grows only paddy and thus provides the staple food for the family. Homestead plot supports mainly tree crops, the Chenna provides pulses, vegetables and perhaps a small area of rainfed paddy. Although wasteful when looked at solely in terms of irrigation efficiency, this traditional system has several advantages for the farmer. It minimizes the cash resources and provides a diversity of annual crops. It also balances the risk of farming since the condition unfavourable for Chenna Cultivation—prolonged heavy Maha Rain—ensure a plentiful supply of impounded water for paddy while more moderate and well spaced storms although they fill the village tanks only slowly, will maximise yield on chenna. Farming to the Dry Zone farmer is a way of life rather than an economic venture with profit motive. His consideration for the leisure time to be spent with his family and neighbours prohibits him from spending long hours in the farm.

5.2 Inputs and other Facilities

As large amount of water is made available, it is used as a substitute for purchased inputs (e.g. herbicides), draught power and labour. Average family labour available is about 2.8 units for full time farm work. The actual requirement having peak with land preparation and harvest is about 40%, more. To make maximum use of rainfall and to meet the planting dates, there is a serious shortage of draught power. The present and future draught power estimated on the basis of

- One 4 wheel 35 HP tractor — 50 ha/season
- One 2 wheel 7 HP tractor — 10 ha/season
- One pair of Buffaloes — 4 ha/season
- One mamboty/ man — 0.3 ha/season
are as follows a/  

<table>
<thead>
<tr>
<th>Make</th>
<th>Present (Unit)</th>
<th>Proposed (Unit)</th>
<th>Shortfall (Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Wheel Tractor</td>
<td>...</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>2 Wheel Tractor</td>
<td>...</td>
<td>60</td>
<td>250</td>
</tr>
<tr>
<td>Buffaloes (Pairs) b/</td>
<td>...</td>
<td>250</td>
<td>250</td>
</tr>
</tbody>
</table>

a/ For LB Area only 1973 January estimate

b/ Reduced output assumed — poor condition due to inadequate fodder supplies during the preceding period.

To provide family subsistence needs, paddy for wages in kind, seed, marketed surplus to finance the next season, pay the debts and prepare the land for the next season, the paddy crop needs to be threshed quickly. The threshing power available is hardly sufficient to meet the requirements.

5.3 Other Reasons

The other reasons which contribute to the above are high inputs and comparatively low income from upland crops, credit, agricultural extension, agro-chemicals, increased risk, increased cash commitments, market for the produce and the lack of technical knowledge of the farmer. The delay in planting dates due to inefficient distribution of inputs, or tractor spares, or small relaxation in the field of water economy due to neglect or interference of political pressure, may stretch the irrigation season to 5 to 6 months despite a 4 month paddy variety being grown by all farmers. In these instances, timely planting to take advantage of rains will not be possible.

The most important factor is the lack of co-ordination between agricultural, co-operative banking, irrigation and other agencies in the process of giving of the know-how and supplies required by the agriculturists to convert their dry-farm economy into an irrigation economy.

6. EXISTING IRRIGATION SYSTEM AND WATER DISTRIBUTION: AND MANAGEMENT PRACTICES

6.1 Layout

The present irrigation system is similar to that shown in Fig. 3. Although the farm is located between the field canal and the drainage canal, the water which enters from the uncontrolled farm outlet drains towards the farm No. 2. There is seepage through liyadda ridges due to soil conditions as well as crab holes. As the upper liyadda is flooded in order to get water, more water escapes towards farm No. 2 than what goes into lower liyaddas of farm No. 1. The tendency for the farmer No. 1 would be to draw off more and more water to his farm in order to irrigate the lower portion of his farm, thereby causing more and more wastage. To avoid this and incorporate shortcomings into the supply system, it is proposed to block out the land as shown in Fig. 4. In this method the water from the field canal to the supply-cum-drainage ditch will be issued only if there is not sufficient amount of drainage water in the supply-cum-drainage ditch due to the over irrigation of upper farms.

6.2 Other controlling Factors

- Operation of field channel 24 hours a day throughout the cultivation season.
- Absence of measuring devices at field turnout level.
- Absence of an organization among farmers for water distribution within the turnout.
- Seepage from the unlined channel system in the upper reaches of the land slope makes these farms too wet for dry food crops.
- Requirement of more mechanical power for grading of land for upland crops. If upland crops are grown in Yala in the levelled basins cultivated with paddy during Maha, the slopes will be inadequate for unprecedented storms in the dry season.
- Little or no effect taken in adjusting water issues with rainfall.

6.3 When to Irrigate and How much to Apply

Four major considerations influence the time of irrigation and how much water should be added.

- Water needs of the crops
- Availability of water with which to irrigate
- Capacity of the root zone soil to store water
- Climatic conditions.

Removal of water from the soil by plant roots causes the soil to become dry and finally a condition is
reached where water is held so tightly by the soil that roots cannot absorb it at sufficiently rapid rate to prevent leaves from permanently wilting. The rate of crop growth in relation to moisture content of the soil is similar to that shown in Fig. 2.

Upland Crop

Arbitrary water scheduling leads to inefficiency of water use and results in decreased production. The water holding capacities shall be taken into consideration in determining the depth of water to be applied. The best criteria is based on the moisture available in the root zone. For most dry food crops irrigation is recommended when 50 - 60% depletion of available moisture.

Lowland Paddy

Continuous stagnation of water in rice field is not at all necessary to get the maximum yield as intermittent wetting and drying at a suitable interval can give more yields. The concept of intermittent submergence of variable depths at different stages of growth and intermittent drainage may be more appropriate than the usual moisture regime. If chemicals are used for weed control, lot of water could be saved.

7. MEANS OF IMPROVEMENT

Practising irrigated agriculture involves change over by the farmer in his agricultural habits and it is recommended to use the following means to hasten the process of change over from extensive irrigation to intensive irrigation.

(a) More scientific approach for the design and lay out of field channels and their proper management.

(b) Wherever possible channels must be lined and in any case action must be taken to see that rodents, crab, cat tracks and other damaging forces do not affect and divert water in the channels and the farm wastefully.

(c) Establishing research and demonstration plots along-side farmers' plots as no amount of persuasion will convince the farmer until a clear cut profit margin is shown with minimum risks.

(d) Setting up of farmers' organizations for water distribution on a rotational schedule and close down of irrigation system when rainfall is sufficient for crop growth.

(e) Liberalisation of credit facilities by Banks as the land owned and tilled by the farmer is the only security he possesses.

(f) Imparting training in Agro-Irrigation aspects to the Engineer.

(g) Proper co-ordination between the State agencies concerned in the agricultural production and a suitable organization for operation and maintenance.

(h) Separate organizational set-up for field management of irrigation supplies including farm machinery.

(i) Reforms in existing rules and simplifying procedures.

(j) Simultaneous construction of the distribution system with the construction of headworks.

7.1 Conclusion

- With only sufficient irrigation water given along with all the other inputs and avenues of marketing the produce, the farmers will ignore the traditional practices. There is evidence that the farmers will accept the changes if the State agencies involved meet all the obligations placed upon them but there is only a low probability of acceptance if they do not.

- The tradition of only concentrating on the building up an irrigation project and handing over the responsibility of utilizing the irrigation potential created should, not only be modified, but abandoned. Along with the construction work, co-ordinated and integrated functioning of other agencies in the field of supplies and credit, soil science, agronomy and plant protection, marketing, farm machinery, water utilization committees should be ensured to achieve the maximum utilization of irrigation potential created for agricultural production in attaining self sufficiency within the shortest period of time and sustaining the same.

- Utilization of irrigation water for the maximum production according to the nature of the soil and subsoil, climatic conditions, nature and age of crops, nature of fertilizers and availability of water in the particular period along with other necessary supplies and operations is a skilful procedure requiring care and attention. With the view t that this skill should go to each and every individual farmer, there must be an ideal, power and efficient organizational set up in the field for efficient management of all supplies and operations required right from the ploughing of the field till the harvest and sale of the produce. Any shortcomings in any step will jeopardize the aim of maximum production, however small and unnoticed the short-coming may be.

- Water management plays an extremely important role in the above, and the funds, energy, organization and re-thinking that are required in this behalf must not be stinted by Engineers or by State at any time. Any neglect in this matter will increase our dependence on other nations for our very sustenance.
References:

1. "The Mahaweli Ganga Stage II Feasibility Report" by Sogreah/MDB.


6. Project Reports and Records of Resident Project Manager Kalawewa, MDB.