# ECONOMIC MODEL FOR KALAWEWA BASIN AREA TO OPTIMIZE THE PRODUCTIVITY OF WATER

By

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## DECLARATION

I declare that this presentation is carried out by me at the University of Sri Jayewardenepura under the supervision of Dr.(Mrs) Annista Wijayanayake – Senior Lecturer, at the Department of Industrial Management, University of Kelaniya, Dr.(Mrs) Menaka Liyanage – Senior Lecturer, at the Department of Mathematics and Dr.(Mrs) P.Kalukottege – Senior Lecturer, at the Department of Statistics and Computer Science, University of Sri Jayewardenepura and the report on this has not been submitted to any University for another degree/Diploma.

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# Abstract

Kalawewa basin area is situated in the Mahaweli System H, which lies in the dry zone. As a result of that water is a scare resource in this area. In Maha season, this area gets enough rain, and farmers do depend on rain water and cultivate paddy in a large scale and Other Field Crops (OFC) such as Chillie, B-onion, Soya bean, Cowpea, Maize, Black gram and etc. are cultivated in a very small scale. But in Yala (dry) season, this area experiences less rain fall and completely depends on the irrigated water. Therefore, Yala season has been selected to find a better water management. It is also important to find the best combination of paddy and OFCs to maximize the water productivity and the income of the farmers. Here we have discussed the initial step of developing an economic model for the Kalawewa basin area to optimize the water productivity.

Linear Programming (LP) has been widely used to find solutions to the problems with limited resources. In our study a LP model is being used to maximize the net return of the farmers with limited resources available including water.

We conducted numerical tests of this algorithm using the historical data of Kalawewa basin area from 1995 to 2000. We used 'TORA Optimization System' to analyze the data. It is significant that the proposed model optimally utilizes the total amount of water received for cultivation and earns a higher profit than the current system. Also water productivity has been increased significantly in the proposed system. The proposed model encourages cultivating more of OFCs of higher values with less amount of irrigated water, which yield high water productivity.

# Chapter –1

# Introduction

## 1.1 Mahaweli Development Programme

Mahaweli Programme is the largest development programme ever undertaken by the Government of Sri Lanka. This was started in 1970, after a decade of planning. System H is the first beneficiary of this project. The Government of Sri Lanka undertook it with aid from the World Bank. Polgolla diversion barrage and the dam at Bowatenna, which helps to divert Mahaweli, water to Kalawewa basin.

The main objective of the Master Plan was to develop the land by providing irrigation facilities. Development of infrastructure and providing facilities, such as educational, health and postal services are also included in this project. The Mahaweli programme also promotes inland fisheries and other industries. The settlement of this area has been completed.

The Resident Project Manager of System H, Mr. K. R. Neil Bandara [2], has identified five responsibilities of Mahaweli Authority of Sri Lanka (MASL), in order to improve the living standard of the settlers and achieve the objectives stipulated in the master plan. They are to improve:

(a) Water management and maintenance
(b) Agriculture and crop diversification
(c) Marketing and credit
(d) Strengthening of farmer organizations
(e) Enterprise development and employment creation

This research will be an initial step, which helps to improve the first two requirements.

## 1.1 Objectives of the study

The main objectives of this study are to;

- Find the best combination of paddy and other field crops (OFC).
- Optimize the water productivity.
- Increase the income of the farmers in this area and thereby upgrade their living standards.

## 1.2 Background

Sri Lanka experiences high seasonal and spatial variations in rainfall due to the bimonsoonal climatic pattern;

Northeast monsoon from October to March
Southwest monsoon from April to September

As a result of that it has two seasons;

Maha season ( wet season ) from October to March
Yala season ( dry season ) from April to September

In Maha season Kalawewa basin area gets enough rain. Hence farmers do not depend on water allocated from Kalawewa within this season. They cultivate paddy in a large amount of land ( more than 95% ) and other field crops are cultivated in a very small scale.

Barker and Samad have stated in their Economic journal that;

" Sri Lanka continues to have a comparative advantage in producing rice specially in the wet maha season where there is no suitable alternative."

But in Yala season they experience less rain (less than 1500mm) and totally depend on the water allocated from Kalawewa and face many problems due to the insufficient water management.. Therefore, Yala season has been selected for this research as it needs a better water management and has to have a specific crop pattern.

## 1.3 Water issue system

Kalawewa is the main reservoir in the Mahaweli System H. It has a gross storage capacity of 123 million cubic meters. Water is issued through three main canals; Right Bank canal, Left Bank canal and Yoda Ela canal. According to the water distribution, the area can be divided into three parts.

| Canal | Block | Area ( ha ) ('000) |
|---|---|---|
| Right Bank | Eppawala | 3.80 |
| | Thambuttegama | 3.05 |
| | Talawa | 3.32 |
| | Nochchiyagama | 3.40 |
| **Sub total** | | **13.57** |
| Left Bank | Galnewa | 3.93 |
| | Meegalewa | 2.17 |
| **Sub total** | | **6.10** |
| Yoda Ela | H3 Area | 4.70 |
| **Total Area** | | **24.37** |

Figure 1.3

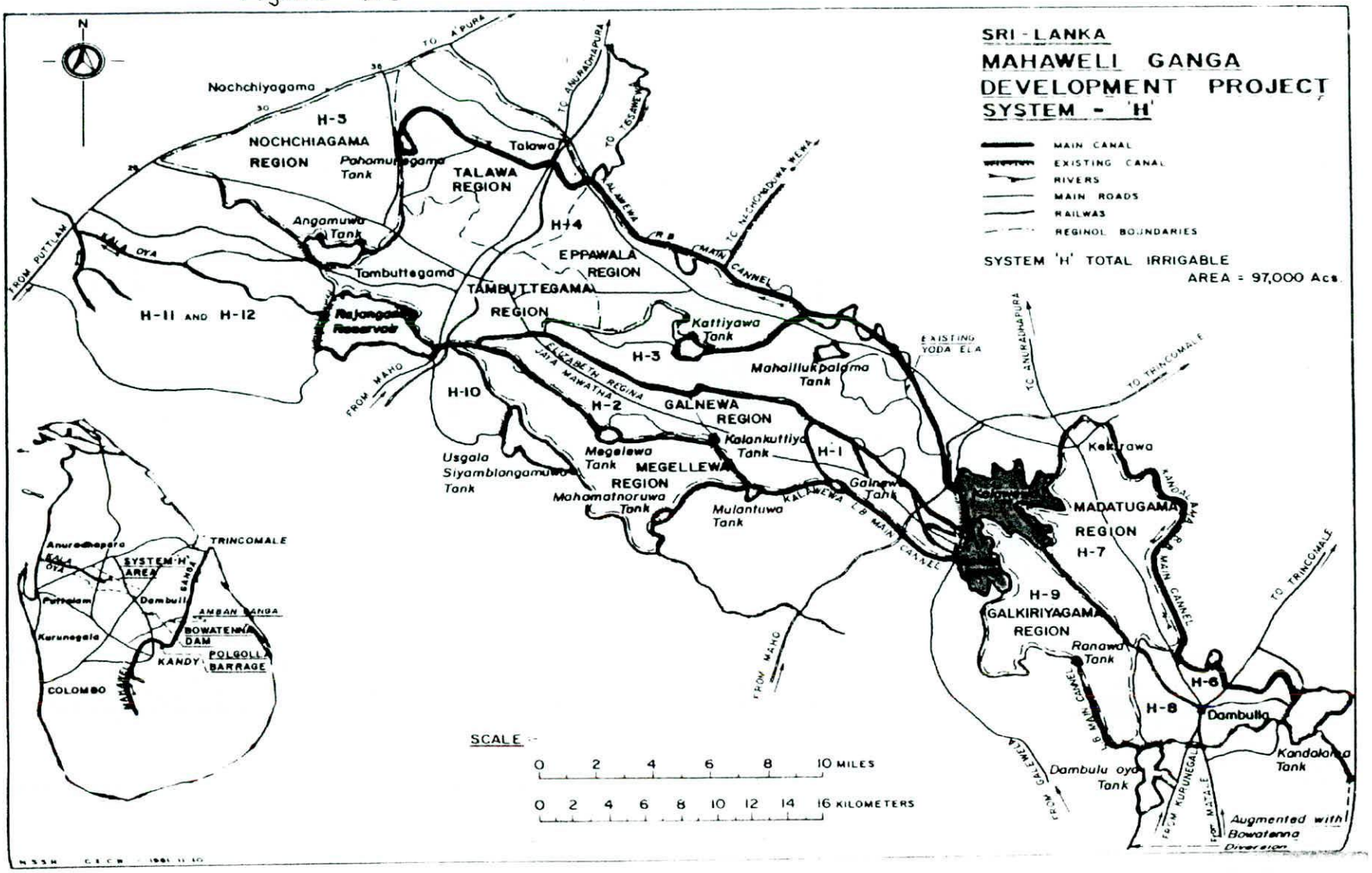
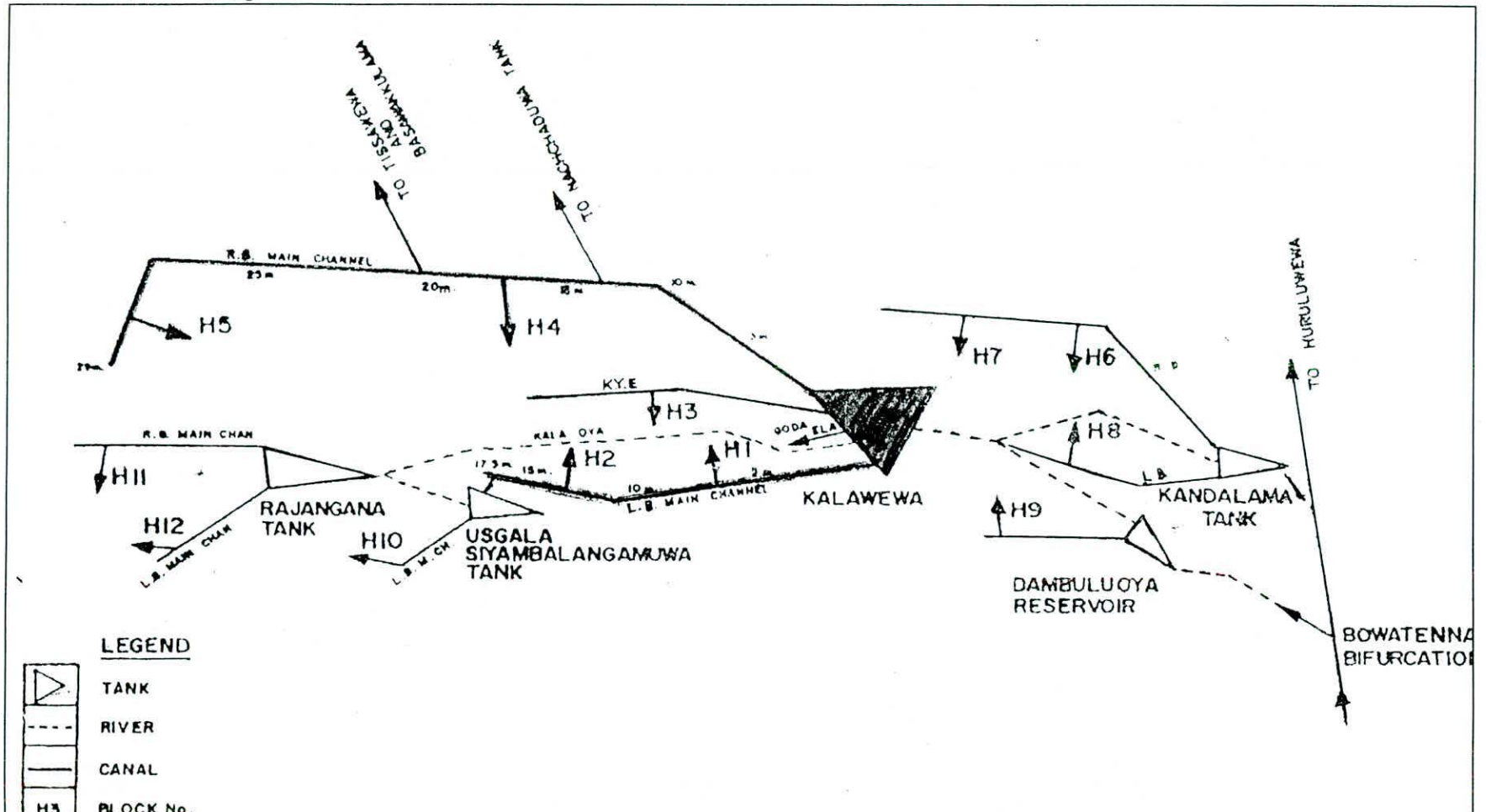

SRI - LANKA
MAHAWELI GANGA
DEVELOPMENT PROJECT
SYSTEM - 'H'
MAIN CANAL
EXISTING CANAL
RIVERS
MAIN ROADS
RAILWAS
REGINOL BOUNDARIES
SYSTEM 'H' TOTAL IRRIGABLE AREA = 97,000 Acs.
N
H-5 NOCHCHIAGAMA REGION
Nochchiyagama
Pahamunagama Tank
TALAWA REGION
Talawa
H-14
EPPAWALA REGION
TAMBUTTEGAMA REGION
Tambuttegama
Angamuwa Tank
Rajangana Reservoir
H-11 AND H-12
KALA OYA
FROM PUTTLAM
TO ANURADHAPURA
TO TISSAWEWA
TO NOCHCHIYAGAMA WEWA
TALAWEWA L.B. MAIN CANNEL
Kattiyawa Tank
H-3
Mahaillukpalama Tank
EXISTING YODA ELA
TO ANURADHAPURA
TO TRINCOMALE
H-10
H-2
GALNEWA REGION
Kalankuttiya Tank
Megalewa Tank
MEGELLEWA REGION
Usgala Siyamblangamuwa Tank
Mahamatnoruwa Tank
Mulantuwa Tank
H-1
Galnewa Tank
KALAWEWA L.B. MAIN CANNEL
Kekirawa
MADATUGAMA REGION H-7
H-9 GALKIRIYAGAMA REGION
Ranawa Tank
H-6
H-8
Dambulla
Kandakadiya Tank
Dambulu oya Tank
FROM GALEWELA
FROM KURUNEGALA
FROM MATALE
Augmented with Bowatenna Diversion
FROM MAHO
TO TRINCOMALE
KANDALAMA L.B. MAIN CANNEL
TRINCOMALE
Anuradhapura
KALA OYA
SYSTEM 'H' AREA
Puttalam
Dambulla
AMBAN GANGA
BOWATENNA DAM
Kurunegala
KANDY
POLGOLLA BARRAGE
COLOMBO
MAHAWELI GANGA
SCALE :-
0 2 4 6 8 10 MILES
0 2 4 6 8 10 12 14 16 KILOMETERS

Figure 1.4




SYSTEM H & 1(H)

SCHEMATIC LAYOUT OF WATER ISSUE SYSTEM

# Chapter – 2

## Crop Diversification

### 2.1 Introduction

Improvements in rice growing technologies and in the development of new lands for irrigation during the last two decades have resulted in near self-sufficiency in rice production in Sri Lanka. Therefore, policies are now shifting towards maximizing the economic utilization of land and water resources and income of farmers, particularly by growing non-rice crops in irrigated areas.

Most of the farmers do not like to grow non-paddy crops which are high risk venture where cash and labour inputs can be three or four times as those of paddy. Therefore it is an essential thing to motivate them to grow high valued crops.

### 2.2 The need for crop diversification

1. Increase economic returns to farmers.
2. Effective utilization of available irrigation water.
3. Low efficiency of irrigation water use with paddy.
4. Inadequate water storage in reservoirs during Yala season for rice cultivation.
5. Decline in world market demand and price for rice.
6. Select and match crops for different topographical land classes to optimize water use efficiencies.

## 2.3 Crops grown in the area

### 2.3.1 Paddy

Rice is the most important cereal since it is the staple food of Sri Lankans. It contributes a considerable amount of the total calorie and protein requirements of Sri Lankans. Paddy is grown in regions of high temperature and prolonged sunshine. Although it is cultivated in a wide range of soils, the preferable PH value for heavy soils is 5.5 – 6.5.

Paddy (*Oriza sativa* ) is a seasonal crop. The bulk of the production comes from Maha season, which represents 65% of the total production and 63% of the extent cultivated. The main reason for this seasonal bias in production is that most of the paddy producing areas are located in the dry zone where its cultivation activities mainly depend on rain in Maha season. A limited extent of paddy is also cultivated in Yala season, but with irrigated water.

In terms of employments, paddy cultivation is the main source in the rural sector and it accounts for more than half of the rural employment. Further, paddy farming is more related with the culture and social life, especially of the rural sector of the country. Majority of farmers cultivate rice for consumption purposes, but the surplus is sold.

Sri Lanka produces 2.6 million metric tons (125 million bushels) of paddy (1.8 million metric tons of rice) per year [4], which accounts for 95% of the requirements. For a longer period, rice has been imported mainly from Vietnam, Pakistan and India followed by Burma and Thailand.

The marketing system of paddy:

Producer → Collector → Processor → Wholesaler → Retailer → Consumer