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MODELLING AND ANALYSIS ON WATER PRODUCTIVITY IN TANK IRRIGATED SYSTEM USING HYDROLOGICAL MODEL

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ABSTRACT

As a limited and essential natural resource, water has played a significant role in the advancement of human civilisation. Agricultural production systems need it as a critical input to produce both food and fibre. By 2025, the world's population will have surpassed the two billion mark, and the domestic food grain consumption is expected to be between 241 and 245 million tonne. The amount of water that can be withdrawn from river basins to supply the rising demand for food is limited, as the maximum withdrawal has already been reached. Irrigated agriculture will be affected by the need to supply water for the home, industrial and environmental needs. In order to continue producing food for the future, more water must be drained from natural resources. Agricultural output must therefore focus on increasing water efficiency.

Keywords: Natural resource, Water, Food, Fibre, Agricultural production, Environmental and Water efficiency.

1. INTRODUCTION

1.1 GENERAL

Food production, economic growth, and overall well-being all depend on water to some degree. It cannot be substituted for most of its functions, is difficult to purify, is expensive to carry, and is truly a gift from nature to mankind. Water can be diverted, transported, stored, and recycled, making it one of the most controlled natural resources. Water has a wide range of uses for humans because of these characteristics.

In 2000, India's population surpassed 100 million, and in 2011 it stands at 121 million. A total of 4000 km3 of precipitation falls on India each year, which includes snowfall. As a result, the annual monsoon rainfall totals around 3000 km3 (2007). Indian rainfall is influenced by the monsoons, shallow cyclonic depressions, and local storms, all of which are influenced by the weather patterns in India. Between June and September, the majority of it occurs under the influence of the south-west monsoon, except in Tamil Nadu, where it occurs during the north-east monsoon in October and December. More than 20 significant rivers and their tributaries may be found in India. Some of these rivers are year-round, while others are only present for a short time each year.

IRRIGATION AND FOOD

Irrigation has been practised for millennia, but the enormous development in irrigated area mostly took place in the 20th century, with irrigation becoming the primary water usage in many countries, particularly in developing nations. A whopping 85% of all water used in the country is now attributed to agriculture, making it the biggest user of freshwater (2010). The expansion of irrigated land and the consequent increase in agricultural output was a given before the late 1970s, when intensive irrigation development could be found on every continent. Irrigated areas grew at a slower rate in developed as well as developing countries in the 1980s. Soil salinization due to inadequate drainage, the depletion of irrigation water supply sources, and environmental issues are the primary causes of the problem. The area of irrigated land has stabilised or even decreased in many affluent countries. Irrigation currently covers around 15% of all arable land.

2. LITERATURE REVIEW

It has been shown that water resources can be accounted for and productively used by Molden (1997); Molden and Sakthivadivel (1999). Improved understanding of current water consumption and suggestions for implementing improvements in integrated water resource management systems are provided by this water accounting methodology. Outflows are classified into numerous categories based on the water balance technique, which provides information on the amount of water depleted by various applications and the amount that remains available for further use. Various levels of analysis, from the micro to the macro, can make use of this technique. Indicators for water resource productivity are clearly outlined in this study work.

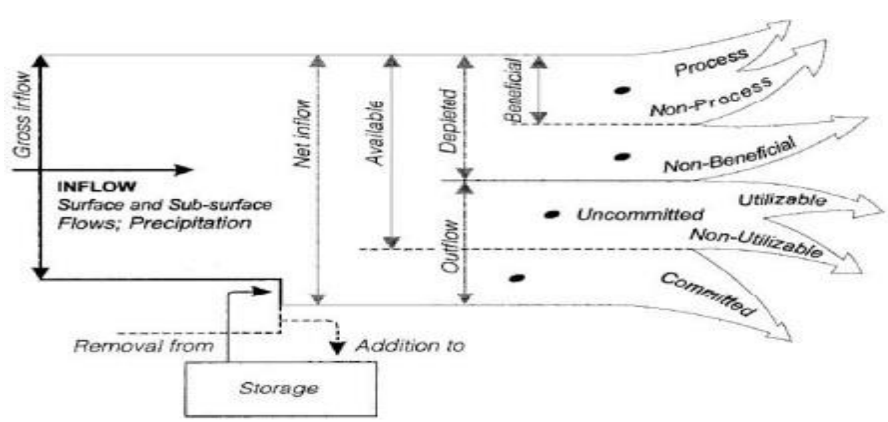

Figure 2.1 Water Accounting

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An important part of water accounting is the classification of water balance components into the many water-use categories that represent the effects of human activity on the hydrologic cycle. Water accounting combines information on water balance with a conceptual representation of how water is used. There are a variety of use categories for inflows into the domain as outlined below (Figure 2.1).

Rather than referring to efficiency, physical indicators are reported in the form of depleted and processed fractions (Jensen, 1993; Willardson et al., 1994). A system's characteristics are more important than the system's actual performance.

A study published in 1990 by Howell et al. ties mass production to transpiration. As a water accounting tool, productivity of water can be applied to a wide range of crops, as well as to non-agricultural applications. In Sakthivadivel et al., gross value of crop yield per unit ET is used to compare irrigation systems (1999). When it comes to different applications of water, we can come up with a phrase that takes that into account. When calculating water productivity, it's important to take into account the sum of the net benefits derived from various uses of water.

3. STUDY AREA AND METHODOLOGY

3.1 GENERAL

At Anna University's Centre for Water Resources (CWR), an experimental study was done to calibrate crop growth parameters and estimate water productivity for rice and groundnut crops at field scale under controlled conditions. An accurate model was employed to calculate tank irrigated system water usage and accounting for the second stage.

3.2 METHODOLOGY

The first stage of the research involves experiments in the Field Lab of the Centre for Water Resources at Anna University, while the second stage takes place in a tank system in the Thiruvannamalai district's Thenkarumabalur Village. For groundnut and paddy trials, soil data was collected to better understand the movement of water in the field. Soil samples were taken at the beginning, middle, and end of the sluice 1 and sluice 2 of the tank system. In studies with paddy and peanuts, crop growth indicators were collected on a regular basis. Crop growth parameters were gathered for paddy crop on both sluices from the sample fields in the tank system primarily because it is the primary crop. Experiment and tank research flowchart, shown in Figure 3.1.

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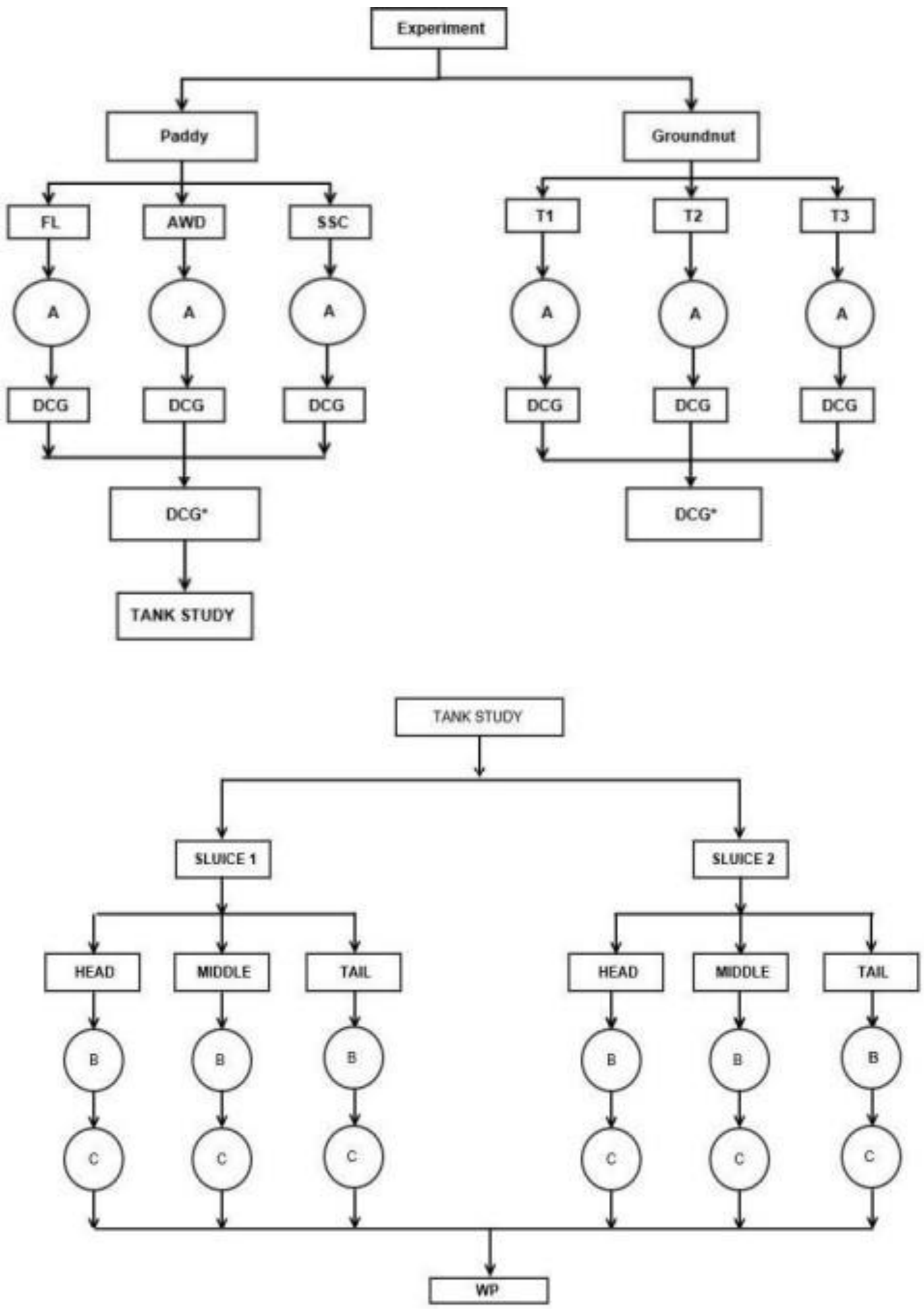

Figure 3.1 Flow chart of the experiment and tank study

Experimental Setup

Paddy and groundnut crops were tested in the field at the Field Laboratory (N13o E 80o India). The ADT 36 cultivar was utilised in the paddy crop; the nursery was raised on February 11th,

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2003, transplanted on March 11th, and harvested on May 30th, 2003. It was sowed on March 28th, 2003 and harvested on July 10th, 2003 for the groundnut crop. A total of 65.0 mm of rain fell on 8 wet days throughout the experiment, with 35 mm of that rain falling on the 9th and 10th of July 2003, respectively. On 20th May, a temperature of 42 degrees Celsius was recorded, while on 21st February, a temperature of 24 degrees Celsius was recorded. Plots were 3 metres by 3 metres in this experiment.

Model Description

Estimating water productivity begins with an understanding of water movement in the field. The first step in determining water productivity is to calculate the water balance components. Continuous development of SWAP began after Feddes et al (1978) wrote the initial version of the model. Van Dam et al. 1997 reported the SWAP 2.0 version used in this work. According to Droogers et al (2000), SWAP is the best model for water accounting on a field scale, but it demands a high level of physical information. This data requirement and spatial scale applicability of models are shown in Figure 3.2.

4. RESULT AND DISCUSSION

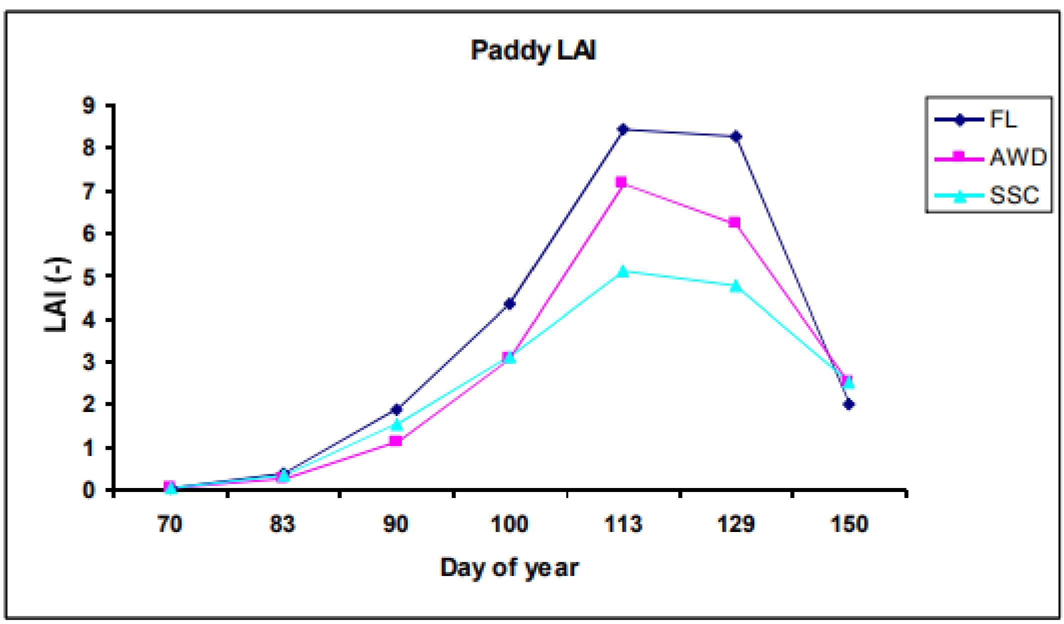

Figure 4.1 Leaf area index vs day of year of the paddy experiment

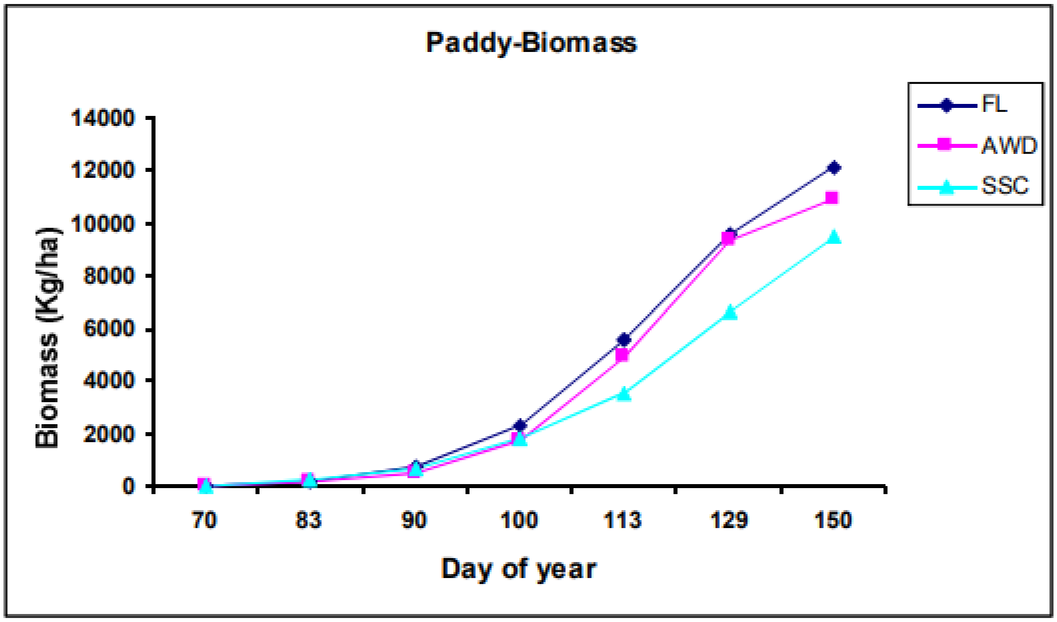

Figure 4.2 Dry biomass in the Paddy experiment

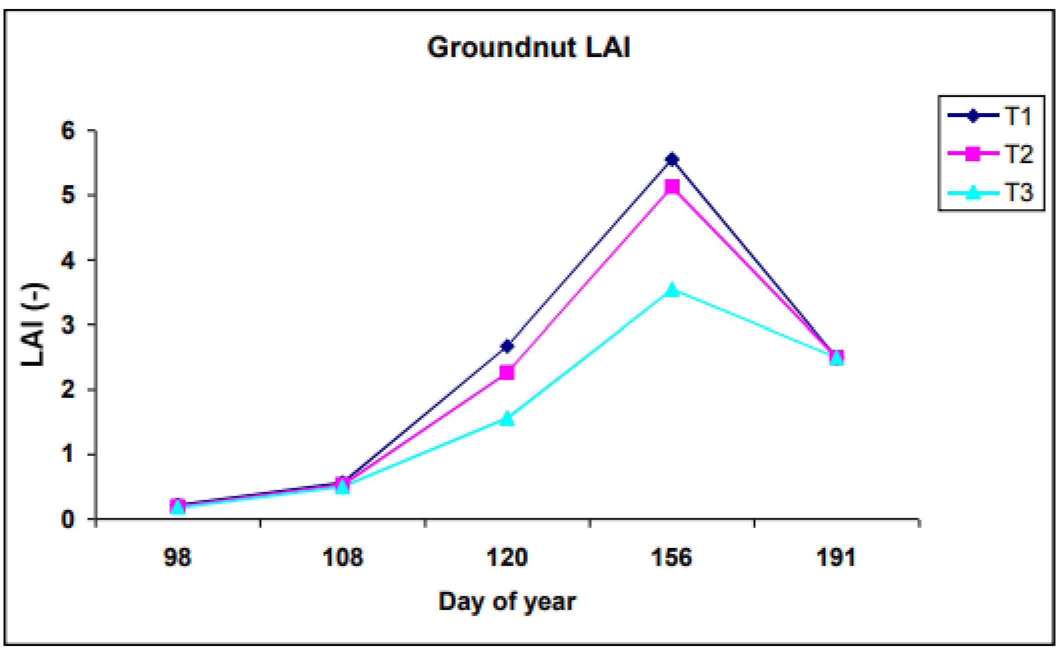

Figure 4.3 Leaf area index of the Groundnut experiment

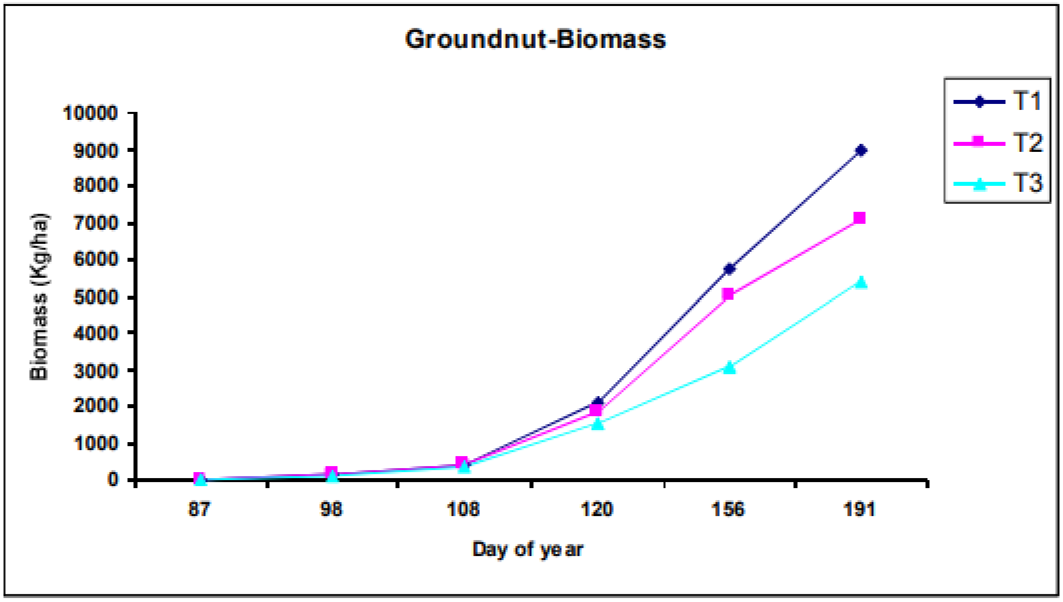

Figure 4.4 Dry biomass in the Groundnut experiment

CONCLUSION

Despite India's rapid growth, there has been no rise in the supply of natural resources available. Water is a precious and limited natural resource. All needs must be met with the water that is now available. Irrigation accounts for the majority of the water that is available. Thus, even a tiny amount of water saved in irrigation can be used to meet the needs of other sectors. The current state of tank irrigated agriculture and potential improvements to water productivity are the focus of this research. During the first phase of this research, the experiment was carried out at the Field Lab, Center for Water Resources, Anna University. Thenkarumbalur tank system, which is located in Thenkarumbalur hamlet in Sathanur left bank command in Thiruvannamalai district of Tamil Nadu, was used as the second component of the study.

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