DEVELOPMENT OF AN INDEX TO ASSESS THE WATER REGIME OF PADDY FIELD ECO SYSTEM: A CASE STUDY IN AWLEGAMA, WARIYAPOLA

G.W.R.W.M.R.M.W.K Kirinde[1], M.I.M Mowjood[2] and N.D.K Dayawansa[2]

[1]PostGraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.
Email: 1986mayuri@gmail.com
[2]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Sri Lanka.
Email: mowjood2010@gmail.com, dammid@pdn.ac.lk

ABSTRACT

Rice is cultivated in rain-fed lowland, deep water, upland and tidal wetlands based on water regime, drainage, soil type and topography. Based on the water regime, rice fields in Sri Lanka can be classified into three major categories; major irrigation, minor irrigation and rainfed rice lands. Irrigated rice lands are usually lowland areas and are supplied with adequate water. However, these rice fields are defined as fresh water bodies that experience a recurrent dry phases of varying lengths that are predictable according to their time of onset and duration. Primary producers and the derived food chain are based on the prevailing water regime. This study aims to develop an index to assess the water regime in order to elaborate the respective ecosystem. A study was carried out in minor irrigation system in Awlegama, Wariyapola. Factors that directly and indirectly affect to determine the water regime of rice fields were identified through literature and preliminary survey. Then a questionnaire survey was conducted among the randomly selected farmer group in the study area to assess wet and dry conditions through information of water management in the field. Each factor that contributes to the wet and dry condition was quantified with a ranking system to different levels. High numerical value was given to the wet conditions and lower value was given to the dry conditions. Then total values were calculated for each farmer to determine the wet and dry conditions of their fields.

Six factors were identified as the key factors in deciding the wet and dry conditions of the field. Water availability factor, distance factor (distance from the water source), farming factor, irrigation scheduling factor, enthusiasm factor (willingness to Involve in farming) and farming dependency were considered as the main components of the index. First four were considered as the directly affecting components and last two as the indirectly affecting components. Out of these components, water availability factor and distance factors directly define the wet and dry conditions of the field. Total water regime index was higher for the farmers who cultivate the paddy in the upper part of the channel. It was found that the fields in the end of the channel are in medium wet conditions. With respect to the total index values, none of the fields were in the extreme dry conditions in the study area. Sixty (60) % of the farmers in Awlegama have wet paddy fields with good water management system according to the developed Index. This Index can be developed further to apply to any area to assess the water management system in the paddy field ecosystems.

***Key words*:** Water management system, Paddy field Ecosystem, Index

1. INTRODUCTION

Rice is mainly classified as a tropical and sub tropical plant and it is the most important cereal crop especially in developing countries [1]. In Sri Lanka, rice is the predominant crop in term of land use and dietary importance. Rice growing environments significantly vary within countries. There are five categories of rice cultivation: Irrigated environments, Rain-fed lowland environments, Deep water environments, Upland environments and Tidal wetlands. These categories are based on water regime, drainage, soil type and topography.

Based on the water regime, rice fields in Sri Lanka can be classified into three major categories; rice land under major irrigation, rice land under minor irrigation and rainfed rice lands. Not like rainfed rice lands, irrigated rice lands are usually lowland areas and are supplied with adequate water [2] therefore irrigated or flooded rice fields are described as agronomically managed marshes, characterized by seasonal standing water bodies. Conversely these rice

fields are defined as fresh water bodies that experience a recurrent dry phases of varying lengths that are predictable for their time of onset and duration. Hence the hydrological regime is the initial determinant of the marshland ecosystems, and in the same way, the hydrological regime associated with the irrigated rice fields play the main component that controls the manmade rice field ecosystem [3].

The source and regular supplying of water are the main attributes of the hydrologic regime of the rice fields. Though the rice field ecosystem is considered as a monoculture agro ecosystem, it undergoes three major ecological phases as aquatic, semi aquatic and terrestrial dry in a single paddy cultivation period [4]. The duration of these periods vary greatly from site to site especially within the aquatic phase.

Consequently, the aquatic (wet and dry) conditions of the irrigated rice fields are decided by the hydrological water regime. Ultimately, it influences the flood water chemistry, soil fertility and the composition of the aquatic biota such as plants, animals and micro organisms.

This study aims to develop an index to assess the water regime in paddy fields in Awlegama in Wariyapola, Sri Lanka.

2. METHODOLOGY

Study was carried out in a minor irrigation system in Awlegama Agrarian service area in Wariyapola Divisional Secretariat. Bayawa is the selected tank (Latitude 7° 69‘N; Longitude 80° 20’E) with 96 acres of command area [5] and 128 farmers.

Factors that directly and indirectly affect the water regime of rice fields were identified through literature and preliminary survey. Then a questionnaire survey was conducted during August to September in 2014 among the randomly selected thirty farmers in the study area.

According to the collected data from the survey, the index to assess water regime of the paddy fields was developed. Water availability, distance from the water source, Farming, irrigation scheduling, enthusiasms and farming Dependency are the main factors that were identified as contributors to the wet and dry condition of an eco system. Then the factors were quantified with a ranking system to different levels [6]. High numerical score was given to the wet conditions and lower score was given to the dry conditions.

2.1. Calculation of the Index

The scores of each factor were then combined through a formula as given in eq. (01). Each factor was assigned a score according to Table 01.

$$\text{Index}=1/6*\{0.25W_{AF}+0.3W_{DF+}0.2W_{FF}+0.1W_{IS}+ 0.25W_{En}+0.125W_{FD}\} \quad (01)$$

AF = Availability Factor (Water Availability and source)

DF = Distance Factor (Distance from the water source)

FF = Farming Factor

IS = Irrigation Scheduling Factor

En = Enthusiasm Factor (willingness to involve in farming)

FD = Farming Dependency (Main Occupation)

Table 01: Ranks given to the factors affecting water regime associated with paddy field ecosystem

a).Water Availability Factor

Water source	**score**
Rainfall only	1
Rainfall + natural sources	2
Rainfall + Agro well	3

b). Distance Factor

Distance from field to channel	**score**
End of the channel	1
Middle of the channel	2
Head of the channel	3

c). Farming factor

Method of water managing	**score**
Traditional permanent water ponding	1
Intermittent wet ponding and dry techniques	2
Dry cultivating/ no ponding	3

d). Irrigation Scheduling Factor

Scheduling of irrigation	score
No proper schedule	1
Have a proper schedule	2

e). Enthusiasm Factor

Enthusiasm for farming	score
Less enthusiastic	1
enthusiastic	2

f). Farming Dependency Factor

Engagement of farming	score
Farming + other jobs	1
Farming + Chena cultivation	2
Only Farming	3

First four components were considered as the directly affecting components and last two as the indirectly affecting components.

As an example, wetness and dryness of the field are varied with the location of the field. When it is closer to the water source, it tends to be wetter. As the Bayawa tank have the capability to provide enough water to the total cultivating lands, most of the fields preserve wet conditions.

3. RESULTS AND DISCUSSION

According to the developed Index, mainly six factors were identified as the key factors that decide the wet and dry conditions of the field. Out of these five factors, water source and Distance factors directly define the wet and dry conditions of the field.

Figure 1 illustrates that among the selected farmer group, 33% of individual farmers maintain intermittent wet and dry conditions in their fields and 40% of individual farmers maintain wet conditions of their fields. None of the farmers' have dry conditions in their fields.

Highest index value was computed for the fields which are located the upper part of the channel. This illustrates that fields in the head end of the channel are in wet conditions with a proper water management regime. Fields with moderate wet conditions are mostly cultivating in According to the analyzed data, most of the farmers practice intermittent wet and dry ponding techniques in their fields. Flooding is the permanent ponding of fields and farmers in Awlegama are not practicing this water management system in their farming practices and this leads to avoid the permanent drying of fields.

Water source play a critical role in determining the ecosystem in paddy fields. Especially in Yala season, although there is a scarcely in rainfall and lack of water in the irrigation system farmers maintain the wet conditions in the fields by abstraction ground water sources.

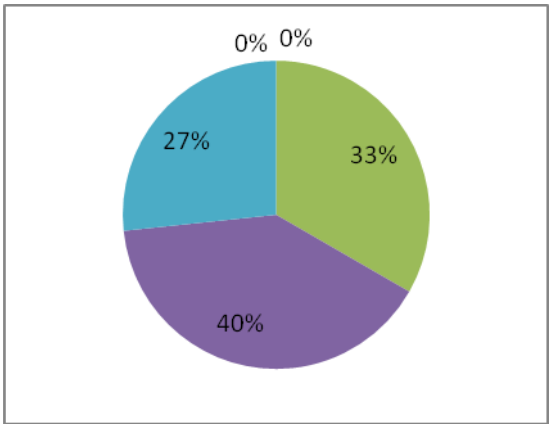

Figure 1: Percentage of total index scores of individual farmers in Bayawa minor tank system

4. CONCLUSIONS

60% of the individual farmers in Awlegama have wet paddy fields with good water management system according to the developed Index. The ecosystem of the fields located in head end of the channel certainly vary with that of the fields located in the tail end because of the disparity of wet and dry conditions in the fields. It can be concluded that the Bayawa tank has the capability to provide as much as necessary water to have sustain paddy field. The amount of water in the fields certainly defines the ecosystem and it affects to the sustainability of the paddy ecosystem.

5. ACKNOWLEDGEMENTS

This work was carried out with the aid of a grant from the International Development Research Center, Ottawa, Canada. Their financial support is greatly appreciated.

6. REFERENCES

[1] G. G. K. P. S. Kumari, H. G. A. Udyani, D. A. N. Dharmasena, and J. mannapperuma, "*Effect of water recirculation, aeration and pH of soaking*

water on moisture absorption rate of paddy during soaking", In: SAITM Research Symposium on Engineering Advancements (SAITM–RSEA2014), pp30-32, 2014.

[2]C. N. B. Bambaradeniya, and F. P. Amarasinghe, "*Biodiversity associated with the rice field agro-ecosystem in Asian countries: A brief review"*, working paper 63, Colombo, Sri Lanka, IWMI, pp. 1-5, 2003.

[3] J. G. Gosselink, and R. E. Turner, "*The role of hydrology in freshwater wetland ecosystems*", In: Freshwater Ecosystem eds. R.E Good D.F. Whigham and R.L Simpson. Academic Press. UK. Pp63-78, 1978.

[4] C. N. B. Bambaradeniya, K. T. Fonscka, and C. L. Ambagahawatte, (1988). "*A preliminary study of fauna and flora of a rice field in Kandy,Sri Lanka*" , Cey.J. Sci. (Bio. Sci.) Vol. 25. Pp 2-22, 1988.

[5] R. P. S. P. Chandrasiri, G. M. P Kumara, G. W. R. W. M. R. M. W. K. Kirinde, L. W Galgedara, and M. I. M. Mowjood, "*Water sharing practices and the conflicts rising among the farmers in a minor tank system in Yala season: A case of Bayawa tank, Awlegama, Sri Lanka*", In: Symposium Proceeding of The Water Professionals' Day, pp 115-121, 2014.

[6] H. M. D. D. Herath, M. I. M. Mowjood, and T. Sivananthawerl, "Development of an index to assess accessibility to safe drinking water in dry zone of Sri Lanka: A case study in Medirigiriya DS division", In: Symposium Proceeding of the Water Professionals' Day, pp. 71-83.