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Impact of Farming Practices on Productivity of Paddy Cultivation in Minor and Major Irrigation Schemes of Mahagirilla Agrarian Services Division of Kurunegala District in Sri Lanka

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Abstract: Food supply for ever growing population has become one of the challenges in Sri Lanka. Considering the paddy production statistics over 10 years period of *Maha* and *Yala* seasons, though the districts of Anuradhapura, Polonnaruwa and Ampara maintained higher average yield than national average yield, Kurunegala district had less average yield than national average yield during this period. Therefore, this study investigated the problems at farmers' level for low productivity of paddy and identified the extent of adaptation of modern technological practices to overcome prevailing problems in Mahagirilla Agrarian Services Division. Two hundred farmers engaged in paddy cultivation from 16 Grama Niladhari divisions were selected from major and minor irrigation schemes as of 100 in each using random sampling method including. Major scheme is irrigated under Deduru Oya irrigation Scheme. Minor scheme is irrigated by *wewa*/ surface storage systems. The study revealed that the yield is positively correlated with method of planting, method of fertilizer application, duration of land preparation and irrigation method. The majority (79%) of farmers are a risk avert cluster who hesitate to adapt new technological practices to overcome prevailing problems. It could be recommended to organize awareness campaigns, build the confidence of farmers through activity oriented and result oriented trials, create a competitive work environment throughout the paddy farming areas, promote paddy cultivation among young generation and consistently providing subsidiaries through the government and non government organizations to reduce the yield gap.

Keywords: Fertilizing technology, Water management, Yield gap

Introduction

Before six decades, the population of Sri Lanka had been six million and now it has exceeded twenty million. It has become a big challenge to supply enough food for the ever growing population (Datta, 1981; FAO, 2000). This problem can be addressed by increasing the total cultivating area and introducing improved rice varieties which have qualities like higher yield, disease resistance and suitable for most existing soil problems. But, land has become a limiting factor and increasing the cultivating area could not be further proceeded with ever growing population. Also, improved varieties have reached its highest

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potential yield in research fields but not in farmer's fields so far. However, rice production has to be increased in Sri Lanka to meet the food demand in the future. Literature review proves that there is a gap between potential yield and the farmers yield mainly due to poor nutrient and water management, but other factors too contribute (FAO, 2000; Khan *et al*., 2002). Therefore, reducing yield gap between potential yield and the farmers yield need to be considered to address this problem. It is known that management of water and fertilizer is important to reduce the above yield gap or to increase yield per unit area (Bandara *et al.,* 2006).

One way of increasing the productivity of unit land area can be done by efficient use of fertilizer. Over use of fertilizer leads to environmental pollution, on the other hand increase the cost of production. Climate change prediction using general circulation model have shown that there will be water shortage in dry and intermediate zone due to temperature increase (De Silva *et al.*, 2007). Therefore, understanding of constraints faced by the farmers of Mahagirilla agrarian services division in intermediate zone in relation to water and fertilizer along with other factors including new technologies in planting and seed varieties will help to introduce better management options to achieve the above task. Therefore, socio-economic survey can be used as a tool to find out the constraints faced by the farmers.

Methodology

Sample design

Target population was farmers who are engaged in paddy cultivation in Mahagirilla Agrarian service Division in Kurunegala District under major and minor irrigation systems and rainfed cultivation. This area is selected for this study to represent the Kurunegala District where the average yield is less than national average yield during the study period. There are 16 Grama Niladhari divisions which belong to two Agriculture Instructor divisions. According to Mahagirilla Agrarian Service Division, in farmers registered book, there were 3522 farmers who are engaged in paddy farming. Farmers were selected using random sampling method and 100 from major schemes and 100 from minor schemes. Data collected from the farmer's field during *maha* season of year 2016/2017. Hidogama and Hulawa are under major irrigations schemes and all other 14 GN divisions are under minor irrigation scheme.

Questionnaire Survey

Data were collected by method of Pre-tested questionnaire filled by interviewee. Questionnaire was designed to get basic information about the farmer age, gender, educational level, socio-economic constraints regarding paddy farming, water management and fertilizer problems, adaptation of new technologies with reference to water management and fertilizer (use of leaf colour chart, soil testing, use of parachute technique and use of transplanter machine)

Both primary as well as secondary data were used for analysis. Secondary data were used to supplement the findings. Key Informant Discussions (KID) were used to strengthen the quantitative findings. Secondary data were collected using the publications of Sri Lanka Census and

Statistics Department, Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) and World Bank publications. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel 2007. Descriptive statistics along with frequency tables were used. Correlation tests were used for analysis of data. Results obtained from the quantitative analysis were supported by the qualitative data obtained through discussions, interviews and observations. When it comes to the data collection educational, psychological, economical levels of the farmers have not been considered.

Results and Discussion

Basic information about the farmers

Age distribution

Mahagirilla Agrarian service Division area belonged to rural, and dry climatic zone in Kurunegala District of Sri Lanka. It is shown that, out of the total number of respondents 45% represents were above the 61 age category, which reflects the reduction of new entries from young ages to the paddy cultivation (Figure 1).

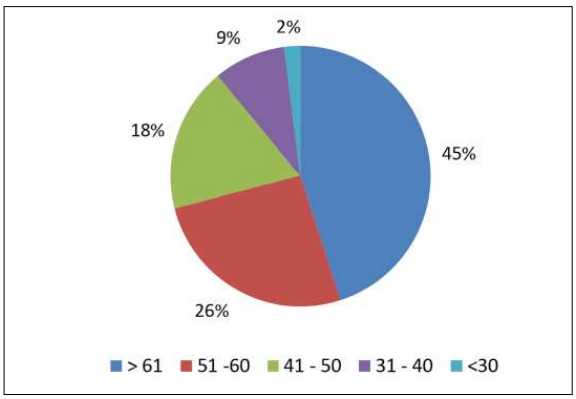

Figure 1: Age distribution

The age category of 41-50 years and 51-60 years were represented by 18% and 26%, respectively. The age category of 31-40 years and below 30 years was just 9% and 2%, respectively. It shows that the younger generation has not been involved in paddy cultivation in the study area.

Source of Income

The results show that, 93% of the correspondence Mahagirilla Agrarian service division depends on paddy farming (Figure 2). There are only 7% of farmers who are having alternative income sources such laborer in other paddy farms and or in shops.

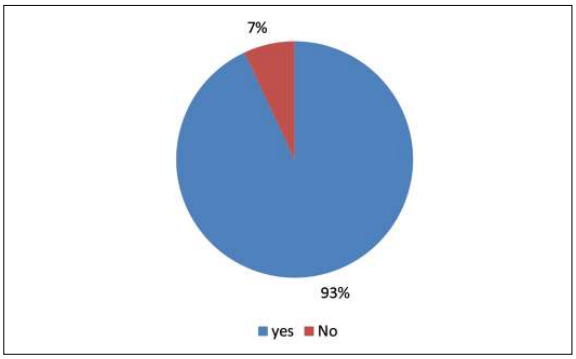

Figure 2: Source of income

Farming Practices

Planting methods

Out of the four planting methods, such as broadcasting, transplanting manually, transplanting using transplanter machine and transplanting by parachute method, only 13% of farmers have adapted transplanting by Transplanter machine and use of parachute technology in major and minor irrigation schemes which were considered as modern technological planting methods in use recently (Figure 3). It reflects that more than 75% of farmers are reluctant in practicing these planting methods although they have been made aware by the Department of Agriculture.

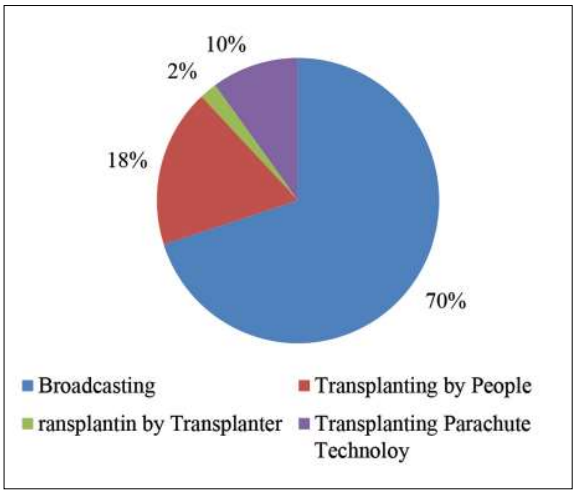

Figure 3: Planting methods used by farmers in percentage

Though broadcasting method requires more seeds than other methods, highest number of farmers tends to use broadcasting as it is the easiest method. Besides that, water requirement of rice crop varies with the method of crop establishment, and water has been identified as a scare resource in Mahagirilla Agrarian Services Division. But, these analyzed data showed that farmers did not get the benefit of practicing transplanting by machine and parachute methods which have the ability of saving water because the farmers consider the broadcasting was the easiest and low cost method compared to transplanting.

Selection of Seed variety

Although Bg300 has the potential yield of obtaining 100-150 bushels per acre, farmers tend to use this variety more than the other varieties. It is tragic that there are 6% of farmers; they do not have knowledge or not even aware of the variety, but they are using different varieties (Figure 4). Though the farmers who use major irrigation system have the ability to cultivate four or four and a half months varieties such as BG401, BG403, BG405 and BG450 which give higher yield, but farmers are reluctant to cultivate it because they think about short time benefits and the uncertainty of the availability of irrigation water.

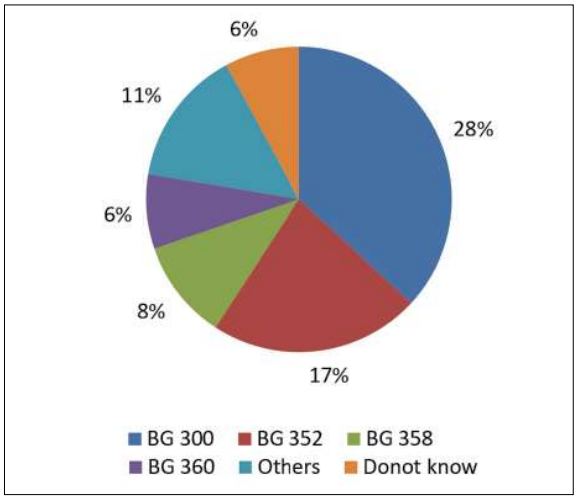

Figure 4: Selection of Seed variety

Duration of land preparation

The prevailing cultural practices shows that the majority (67%) of farmers are not following the standard land preparation times due to various reasons. This was because farmers have waited until filling the tanks/*wewa* with water completely to start cultivation and limited time was remained to allocate land preparation. But, filling of tanks entirely depend on rainfall pattern, which is also uncertain due to the prevailing climate change impacts. Only one third (33%) of farmer group has been following 21 days land preparation time, which is recommended by the Department of Agriculture.

Fertilizer Application

All the farmers in the major and minor irrigation schemes use the inorganic fertilizers recommended by the Department of Agriculture. As per the Table 1,

Table 1: Average yield per farmer (Bushel/Ac) against method of fertilizer usages

	Average yield per farmer (Bushel/Ac)		
	Major Irrigation Scheme	**Minor Irrigation Scheme**	**Rain fed**
Inorganic and organic fertilizer	108.64	98.74	58.26
Only inorganic fertilizer	87.48	74.48	44.78

comparison between the average yields of minor and major irrigation systems, both schemes shows almost the same average yield. It is obvious that the farmers who use major irrigation system get higher average yield, because there is no water shortage.

However, the reason for yield in minor irrigation scheme is because almost 80% of the farmers in minor irrigation scheme use of both organic and department recommended rates of inorganic fertilizer which gave yield almost similar to the major irrigation scheme. These results of this study agree with the findings of Premaratne and Sanggakkara (2014). As it takes about 3 months to make compost, farmers did not concern about pre preparation of compost which is enough for the next season. Though there is enough material available for compost preparation, farmers do not use it as farmers do not consider the advantage of it. Compost contributes to nutrient supply as well as moisture conservation (Premaratne and Sanggakkara, 2014) and the farmers use organic fertilizers in addition to the department recommended inorganic fertilizers have obtained higher yield.

Use of leaf colour chart

According to Khan *et al.* (2002) the use of leaf colour chart limits the excess usage of urea, by working as an indicator of applying the sufficient amount of urea. In this study, only 9.7% of respondents used the leaf colour chart as an indicator for urea application. Therefore, this is evidence that farmers show slow movement of adapting new technological practices to overcome prevailing problems. The average yield of farmers who used leaf colour chart was higher than the average yield obtained by the farmers who did not use leaf colour chart in both major and minor irrigation schemes.

Water Shortage

As shown in Figure 5, 16% of the considered sample in minor irrigation scheme faced the problem of water shortage at the flowering stage of their cultivation which was highly

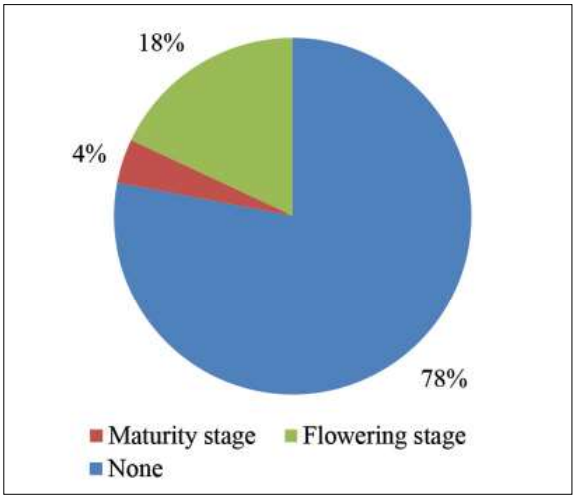

Figure 5: Farmers perception on shortage of water during different growth stages.

affected by the reduction of panicle number and potential spikelet number which in turn negatively affected the yield as suggest by Khan *et al.* (2002). About 8% of the respondents faced the water shortage problem at maturity stage which might have resulted in increase in unfilled spikelet as reported by Tuong and Bouman (2003).

Water supply method

In minor irrigation scheme when the available water was not sufficient, only 16% of the sample population overcame the water shortage problem by having alternative water storing sources like rain water harvesting ponds and agro wells (Figure 6). Unfortunately, 5% of farmers of the considered sample had to abandon their cultivation due to heavy water shortage. However, 79% of the sample population did not do any water supply method and received very low yields.

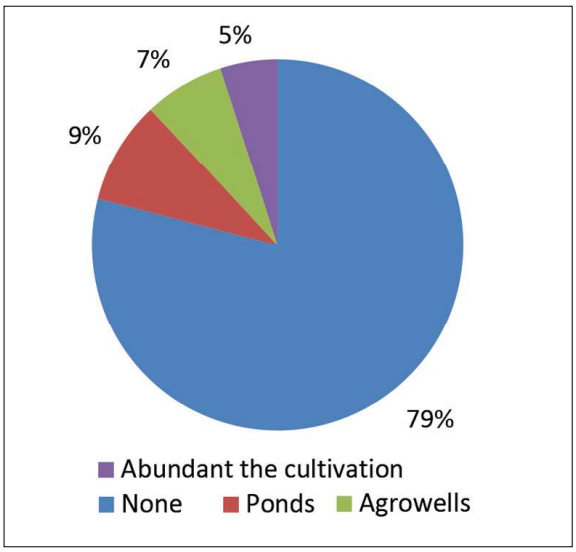

Figure 6: Water supply method when the available water is not sufficient in minor irrigation scheme.

Other problems identified in paddy cultivation

Salinity has been identified in 8% of the farmer's field in Minor irrigation scheme of Mahagirrilla Agrarian Services division, but farmers did not know how to reduce salinity from the soil. In addition they do not know about the use of liquid fertilizer to supply nutrient through leaves because it is difficult to absorb nutrients from the soil (Figure 7). Though some farmers do not know that there is salinity problem in their fields because they have not tested the soil samples through Department of agriculture prior to cultivation, they tend to use urea instead of using liquid fertilizer. Nearly, 5% of the farmers indicated the iron toxicity and 18% of the farmers indicated the drought as the problem. Almost 75% of the farmers do not know what the problems in soil or paddy cultivation are as they have never tested their soils through Department of Agriculture service.

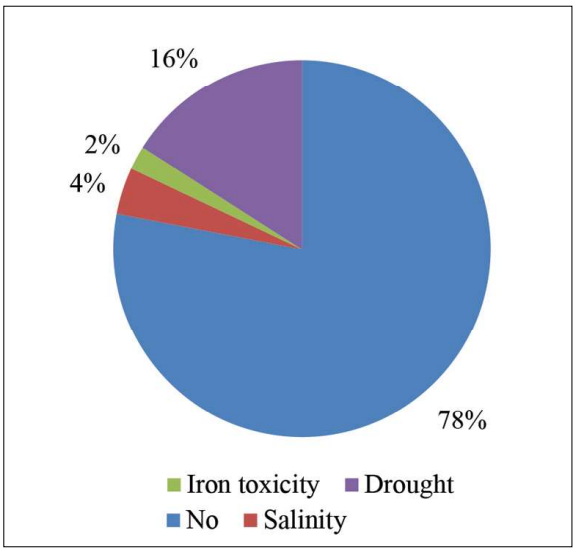

Figure 7: Other problems identified in the farmer's field

Table 2: GN Division of the study area and the average yield during the year 2016/2017.

GN Division	Average yield (bussel/Ac)	GN Division	Average yield (bussel/Ac)
Paluus *wewa*	62.66	Nagala	67.5
Galkadawala	68.23	Hulawa	93.88
Mewellewa	64.11	Sirisethagama	71.66
Mahagirilla	74.5	Dodangollegama	54.66
Hidogama	84.61	Ethewa	70
Yakadapotha	68.84	Diwllepitiya	69.95
Elagammillawa	68.24	Mahakirinda A	72.4
Nawana	69.41	Mahakirinda B	63.5

Table 3: Correlation between cultural practices and the farmer's yield

Cultural practices	**Pearson correlation**	**Sig. (2-tailed)**	**N**
Planting method	0.501**	0.00	300
Duration of land preparation	0.179**	0.002	300
Fertilizer application	0.208**	0.00	300
Water supply method when the available water is not sufficient	0.435**	0.00	300
Way of supplying water	0.737**	0.00	300

***. Correlation is significant at the 0.01 level (2-tailed).*

The average yield in minor irrigation scheme of Mahagirilla Agrarian services division in 2015/16 *Maha* season was 75.35 bushel/Ac (Paddy Statistics, 2015). In this study, only Hidogama and Hulawa GN divisions belong to major irrigation scheme therefore exceed the average yield of Mahagirilla Agrarian services division, indicating that scarcity of water had been one of the major problems of minor irrigation schemes to cause low productivity (Table 2).

Correlations were sought using Pearson`s correlation factor. Table 3 indicates significant correlations between cultural practices done and the yield. Planting method, water supply method when available water is not sufficient and way of supplying water were strongly correlated

with obtained yield. Fertilizer application also influences the yield with correlation coefficient of 0.208. Further, there is a significant difference between duration of land preparation and farmer's yield, because farmers do not follow proper land preparation due to various factors such as financial constraints and labour availability (Table 3).

Conclusions and recommendations

Yield of paddy is significantly correlated with method of planting, method of fertilizer application, duration of land preparation done and the way of water supplying. As far as the Mahagirlla Agrarian division concerns, 93% of the farmers are fully depend on the paddy farming which indicate that the most influencing socio economic factor is paddy farming. Age distribution showed a declining trend of involvement into the agricultural occupations by the new generation of below 30 age category, which is only 2% of the sample farmer population. The above argument is strengthened by the fact that in the age category above 61 years represents almost half of the sample population. By representation only 13% of the farmers are adapting new technologies such as transplanting using transplanter machine and parachute planting for the paddy cultivation. It is identified that majority (79%) of farmers are a risk averters who have planted three months varieties although there is the opportunity of having more yield by planting four months varieties.

Finally, it was revealed that the inefficient cultural practices related to transplanting, fertilizing and water management in the paddy cultivation have contributed to the low productivity of Mahagirilla Agrarian Service division. Further, the prevailing cultural practices are being practiced without any developments with respect to new innovations. It has been proved that the trend of newcomers for joining the paddy farming is less which could be a negative sign to the future of the industry.

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