Research article

Study of Farmers' use of Fertilizers and Methods of Application for Rice Cultivation in Central Myanmar

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Abstract Fertilizers play an important role in the maintenance of soil fertility for rice production. The correct application of fertilizers can alleviate declining soil fertility. To improve levels of rice production in central Myanmar, it is essential to assess the current practices used in the application of fertilizers. The aim of this study is to examine farmers' knowledge and attitudes to the use of fertilizers for rice production and examine the constraints they face. A survey was conducted using structured questionnaires to interview 164 farmers, randomly selected from three villages in central Myanmar. The survey data were analyzed using descriptive statistics. Based on the survey results, commonly used fertilizers were urea and compound fertilizers. It was clear that the majority of farmers used amounts below that recommended amount in their application of urea and levels of application of mineral fertilizer varied greatly. About 23% of respondents used cow-dung manure and 12% applied pulses residues as fertilizers for rice cultivation. Although the farmers' accept that fertilizer application is necessary for better rice growing, the majority of the farmers faced financial difficulties with any increased use of fertilizers. Also, this study shows that the sampled farmers' limited knowledge on fertilizer use and the lack of access to the information related to fertilizer management, is a constraint preventing appropriate use of available fertilizers. Thus, clear improvements to increase agricultural productivity and soil fertility levels would result from the improved application of organic and inorganic fertilizers.

Keywords rice cultivation, use of fertilizers, farmers

INTRODUCTION

In Myanmar the agriculture sector is the backbone of the economy. This sector contributes to 37.8 percent of gross domestic product (GDP), accounts for 25 to 30 percent of total export earnings and employs 70 percent of the labor force (FAO, 2018). Among the cereal crops, rice is the most important source of national prosperity. Rice is not only the staple food source but also an important export crop, so successful rice production is crucial. Correctly used, fertilizers can play an important role in ensuring successful rice production.

Although Myanmar has had a long history of low fertilizer use, the fertilizer market has expanded rapidly since 2008. However, current practices in fertilizer use have resulted in the unbalanced application of nutrients. One keyway to improve fertilizer use is to enhance farmers' knowledge of the specific crop and soil nutrient needs and the fertilizer products (nutrient grades/formulations) that will best ensure the supply of these needs. Choosing which fertilizer to use

is often one of the most important decisions a farmer has to make. However, Myanmar farmers have limited knowledge of modern agricultural technologies, including fertilizers (IFDC, 2018).

The Department of Agricultural Development and Planning, Myanmar, reports that there is a declining tendency in domestic use and demand for chemical fertilizers, and that many small holder farmers have not adopted technology that ensures best use of both organic and inorganic fertilizers application, nor were farmers fully abreast of the importance of their use (DADP, 2007). This is despite the advantages of using inorganic fertilizers in boosting production and previous efforts making these fertilizers more freely available to farmers. In contrast to chemical fertilizers, farmyard manure has been used long term by Myanmar farmers to restore soil fertility. However, because of the lengthy process in processing farmyard manure so that it is ready for use, and the limited availability of animals kept by small holders, the amount of farmyard manure produced and used has always been insufficient to needs.

Myanmar faces huge food supply challenges due to the increasing population, the limited opportunities to increase arable land, and the declining yields associated with continuously declining soil fertility. In order to improve the productivity of rice farming, particularly for small holder farms in central Myanmar, it is critical to assess the current practices for the use of fertilizers, and to explore the constraints encountered by farmers with respect to both the use of organic and inorganic fertilizers.

OBJECTIVES

The main objective is to study the current methods of fertilizer application for rice production in central Myanmar, and to ascertain any problems and constraints associated with the farmers' use of fertilizers.

METHODOLOGY

General Description of Study Area

Three villages were selected, with two from the Naypyitaw area (Kyee Inn and Thit Tat villages) and the third, Chiba (Shwebo Township) from the mid-north of Myanmar. Data were collected using a structured questionnaire, with the assistance of the village-head (Table 1).

Table 1 General description of Kyee Inn, Thit Tat and Chiba Villages

Variables	Unit	Kyee Inn	Thit Tat	Chiba
Population		2160	1522	2828
Sown acre	acre	1392	550	1750
Rice sown acre (Summer)	acre	-	550	1750
Rice sown acre (Monsoon)	acre	850	550	1750
Farmer population		1000	89	230
Water availability		Irrigated	Irrigated	Irrigated
Name of Dam		Nga-like Dam	Yezin Dam	Tha Phan Seit Dam
Cropping pattern		Rice-Pulses	Rice-Rice	Rice-Rice

Survey and Data Analysis

Interviews were conducted, and farmers taking part were selected using a simple random sampling method. A total number of 164 farmers (66 from Kyee Inn, 63 from Thit Tat, 35 from Chiba) were interviewed using questionnaires which included questions on gender, marital status, farmers' age, farming experience, location of residence, educational levels, and size of area cultivated for rice. Questions specific to fertilizer use related to quantity, time of application, and type of fertilizer used for rice cultivation. The survey also identified any problems and constraints faced by farmers in

obtaining fertilizers, and what methods of application were used. All data were analyzed by descriptive statistics with the *Statistix 8th* version.

RESULTS AND DISCUSSION

Socioeconomic Background of Sampled Respondents

Agriculture is undertaken by an aging male population at all sites (80% in Kyee Inn, and 89% in Thit Tat and Chiba). This finding is in agreement with those of Lawal and Ayoola (2008). The results indicate that the majority of the farmers are about middle aged and according to Yunusa (1999) this is an economically active age for motivation and innovation.

Education facilitates the transfer and promotion of technologies meant to improve crop production (Lawal and Ayoola, 2008). The education status of the respondents in the survey areas varies greatly, with farmers who have no formal education to those who have tertiary education and university education (in this survey university education is given a separate category to education gained at other tertiary institutions). However, in general, the level of educational attainment is sufficient to support the adoption of technology through information sharing and written material. The percentage of farmers attaining a secondary education is highest in Kyee Inn (45%) followed by Chiba (43%). Thit Tat village had the highest percentage of farmers (41%), who had attained, at highest, primary education. These results correspond to those of Ifejika et al. (2008) who found that the majority of farmers had some formal education. There is a low percentage of farmers with tertiary education in all villages. A significant number of farmers with no formal education (14%) is found only in Thit Tat village. The results clearly indicate that the farmers in the surveyed villages can, in general, read extension leaflets, posters and magazines promoting innovative farming methods. Given the small percentage of illiterate farmers it can be expected that knowledge of new methods would be communicated widely in the farming community.

The amount of experience of farming relates as a key risk management factor, and Ridler and Hishamunda (2001) showed that new farmers were at a higher risk compared to experienced farmers. The survey identified five different levels of farming experience; from under 5 years, then 5 to 10 years, 10 to 15 years, 15 to 20 years and finally those with above 20 years of farming experience. Thit Tat village had the highest percentage of farmers with experience of more than 20 years, followed by Chiba and Kyee Inn. The data show that most farmers are very experienced and this would be expected to enhance effective fertilizer use.

The size of land holding of the respondents ranges from under 2 hectares, 2 to 6 hectares and above 6 hectares. However, Olayide et al. (1980) classified small-scale farmers as those having 0.1 to 5.99 hectares of farm size. Farm size determines the number of inputs, such as fertilizer, that can be purchased. Most of the respondent's farms can be classified as small scale, with this being attributable to land fragmentation with land acquisition among family members.

Types and Brand of Fertilizers used by Farmers in the Survey Area

The data show that the most common types of fertilizers used by the farmers are urea (85%, 95%, and 100%) and compound fertilizers (97%, 81%, and 71%) in the Kyee Inn, Thit Tat, and Chiba villages, respectively. This indicates that farmers in these areas have good knowledge in the use of these types of fertilizers, which can provide a greater rice yield than other types of fertilizers. However, there was little use or knowledge of other types of fertilizers such as the Phosphorus and Potash, in the surveyed villages. In respect to most popular brands, most farmers use a combination of brands with Armo brand used by 87%, followed by Awba (57%), China brand (46%), Myanmar brand (8%), while Tan Quen and Thailand brand have the same percentage use (5%), and Shwe Nagar (2%).

Methods and Time of Fertilizers Applications

According to the data in Table 2, broadcast fertilizer application methods are used by most farmers across the surveyed villages, and basal application methods are seldom used. The broadcasting method has a lower investment cost, and is popular as farmers lack the capital to invest in mechanization or even hire labor for alternate application methods. Most respondents used a top dressing application at the tillering and flowering stages. Some of the respondents from Thit Tat and Chiba, but very few from Kyee Inn, apply fertilizers after flowering.

Table 2 Methods and time of fertilizer application for rice crops

Method of application	Kyee Inn Frequency, (%)	Thit Tat Frequency, (%)	Chiba Frequency, (%)
Broadcast	57 (86)	50 (79)	34 (98)
Basal	0 (0)	13 (21)	1 (2)
Time of application			
Top dressing			
Tillering	63 (100)	59 (94)	35 (100)
Flowering	60 (95)	55 (87)	33 (94)
After flowering	3 (5)	45 (71)	22 (63)
Total amount of urea application (kg ha^{-1})	125.20	169.05	105.8

Urea Application at Different Farm Size and Education Levels

In Fig. 1, it is clear that farmers on smaller farms applied relatively low amounts of urea fertilizers in comparison to larger farms in the areas surveyed. This indicates that larger holdings relate definitely with higher use of urea. The Kyee Inn village in particular, shows this pattern, with vastly higher amounts of urea application for those areas greater than 6 hectares.

It can be seen that there is a visible progress in the amount of urea application with higher levels of education for farmers in the Nay Pyi Taw area. However, in the Chiba (Shwebo) area there is a quite difference. Here a relatively lower amount of urea is applied by those with a university level of education, while farmers who were educated to a primary level or by another tertiary institution applied high amounts of urea. In contrast, university educated farmers from Kyee Inn and Thit Tat villages apply higher amount of urea for their rice production. In Thit Tat village, farmers with no formal education or a primary level education applied the lowest amounts of urea (Fig 2.).

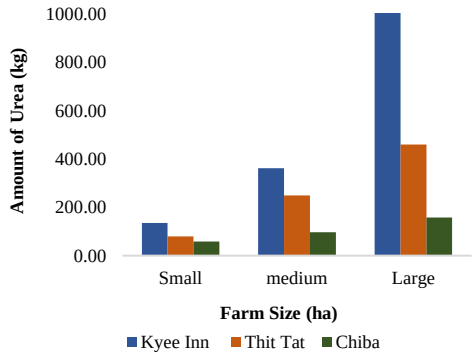

Fig. 1 Urea application and farm size

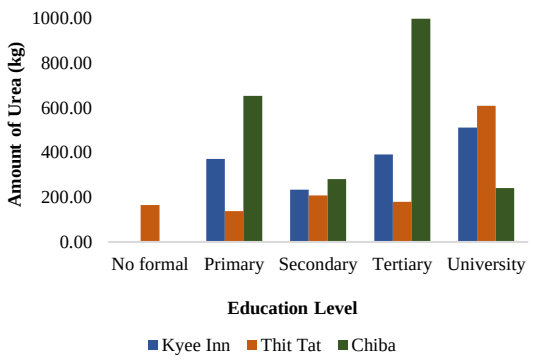

Fig. 2 Urea application and education levels

Problems and Constraints Faced by Respondents in Rice Cultivation

Farmers face many problems in growing rice. The main problem is insufficient water, followed by inadequate credit facilities, pest infestation, and problems related to seed and soil in the Nay Pyi Taw

area (that is Kyee Inn and Thit Tat villages). However, poor soil and pest infestation are clearly the main problems faced by Chiba village in their rice production (Fig 3.).

Farmers in the survey area encounter many common shared constraints in their use of fertilizers for rice production (Fig 4.). While farmers of Kyee Inn village are mainly constrained by high cost of fertilizers, lack of capital, less in weight and poor quality fertilizer, the farmers in Chiba village are more constrained by lack of capital, the high cost of fertilizers, lack of organic fertilizers, and non-availability of fertilizers for timely application. Finally, in the Thit Tat area, the major constraints on rice production are high cost of fertilizers and replacement of organic fertilizers.

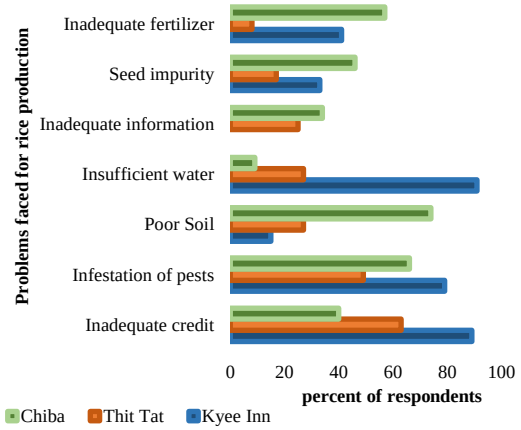

Fig. 3 Problems faced by respondents for rice production

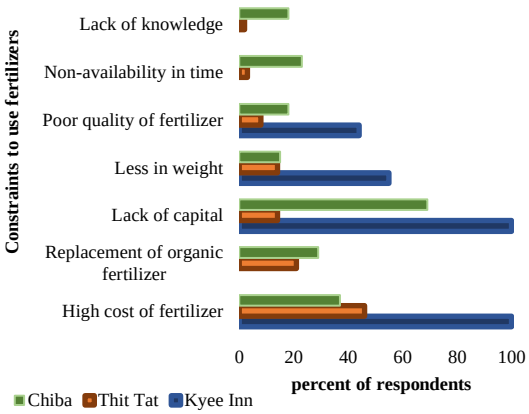

Fig. 4 Constraints on the use fertilizer for rice production

CONCLUSION

According to these results, respondents in Kyee Inn have the highest appreciation of the benefits of using fertilizers. They believe fertilizers are necessary for the crop to do well and can double yields. To a lesser extent, Thit Tat village has similar attitudes regarding the use of fertilizers, but farmers from Chiba village do not value fertilizers as much in rice production. Most farmers applied urea with two to three times of split application to be more efficient for rice production. A majority of farmers use amounts of urea below those recommended (276 kg ha^{-1} for monsoon season and 414 kg ha^{-1} for summer). In spite of the role that fertilizers play in improving rice production, lack of access to information about fertilizer management, high prices and lack of capital constrain their usage. This study shows that manure or organic fertilizer cannot be relied on to increase rice production and sustain agricultural productivity. Manure is scarce and transportation costs are high. As a result, the quantity of manure applied is likely to be low. Due to the lack of proper storage facilities the quality of manure applied is likely to be very low in terms of nutrient supply. Lack of proper management of fertilizers by farmers increases the cost of production and excessive application will probably have adverse effects on aquatic and terrestrial ecosystems. Greater education on fertilizer use and management through agricultural extension services, the media, and at the point of sale are recommended to improve sustainable use of fertilizers for rice production in Myanmar.

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