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ASSESSMENT OF FARMERS' FERTILIZER MANAGEMENT PRACTICES AND CROPPING PATTERNS IN TATKON TOWNSHIP, NAY PYI TAW UNION TERRITORY, MYANMAR

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Abstract

Face-to-face interviews (n = 48) were conducted at Kin Mun Tan village tract in Tatkon Township, Nay Pyi Taw Union territory, Myanmar to identify current status of cropping patterns in their farmland and to assess the currently used fertilizer management practices in the study area. Survey data indicated that there were twenty-four cropping practices and it could be categorized as three cropping patterns; double rice (38%), maize based (28%) and sunflower based (34%). In maize and sunflower based cropping patterns, farmers used to grow rotating with other crops such as chickpea, chili, cabbage, onion, parsley, spinach, tomato, watermelon, cotton and banana depending on the market demand. In the fertilizer management practices, they used to apply organic manure, compound, urea, T-super (Triple super phosphorus) and foliar fertilizers. The greater portion of respondents (81%) used organic manure with the average application rate of 4.82 cart per hector (2.42ton ha^{-1}) per year. The highest number of respondent (79%) used compound fertilizers, 85% used urea fertilizer, 2% used T-super and 69% used foliar fertilizers depending on cropping patterns. Concerned with soil fertility status, half of respondents answered that their farm had good fertility status without testing their soils. There were 94% of study area without soil test. It indicated that the study area was necessary to conduct soil analyses to improve soil fertility status. In summary, farm size, compound fertilizer usage, foliar application and year of fertilizer application were depending on diversified cropping patterns. Especially, a cropping pattern including pulses would be assessed with much application of foliar fertilizers.

Keywords: Cropping patterns, Fertilizer management practices

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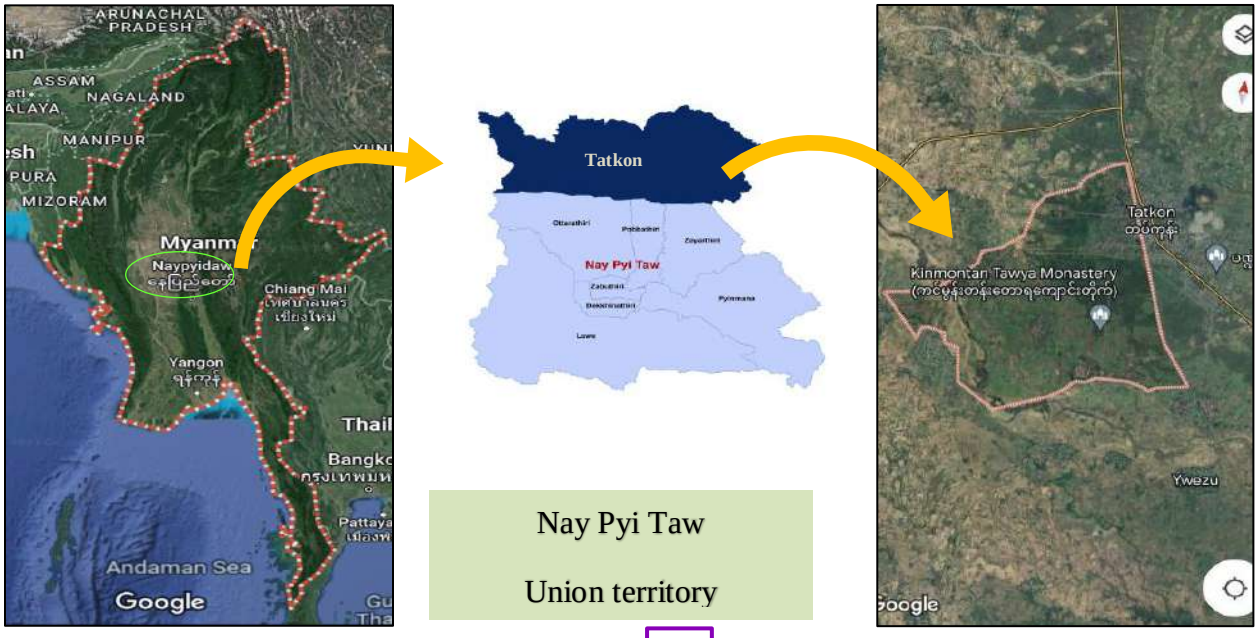
Introduction

About 70% of the population in Myanmar resides in rural area and agriculture is their mainly livelihood. While the agriculture sector contributes 30% of national GDP, that are gained from farming but the socio-economic status of farmers is extremely low (MOALI, 2023). The performance of Myanmar's Agriculture sector is highly dependent upon soil quality. Many years of poor agriculture and land management practices have led to serious land degradation issues. Land degradation can be attributed to inappropriate land use and management leading to unproductive farming (IFDC, 2018).

Cropping practices such as crop diversification, crop rotation and related agronomic practices used in agriculture impact soil health and quality (Vukicevich et al., 2016). In agro-ecosystems, anthropogenic activities, such as preferred cropping practices and land-use management practices including intensive tillage, fossil fuel consumption, wetland -drainage, adaptation of using heavy equipment in farming practices, fertilizer management, are factors that cause global agricultural soil degradation (Yang et al., 2020).

Soil fertility is crucial to determine soil health and fertility status for planning effective practices for precision farming (Parnes, 2013) (Velayutham and Bhattacharyya, 2000). It is also directly proportional to productivity although the soil has a dynamic natural property (Kavitha & Sujatha, 2015). The evaluation of the soil characteristics of an area is an important aspect to step the precision agriculture in sustainability (Singh & Mishra, 2012). Applying fertilizer with improper rates at the incorrect times of the year can lead to negative impacts, such as, lower yields, irregular fruit formation, increase in disease/pest pressure, nutrient loss, increase toxic soil and environment impacts. However, the level of fertilizer use in the crop production sector of Myanmar is far below the dangerous level (Than et al., 2017).

In Tatkon Township, most of farmers usually practice as an intensive cropping and use different fertilizer rates depending on the crops. Lack of scientific and economic information on efficient use of fertilizers and cropping patterns in Myanmar will hinder the step of foreign investment in sustainable crop productions. Therefore, the objectives of study were to identify current status of cropping patterns in their farmland and to assess the currently used fertilizer management practices in the selected area.



Methodology

Description of study area

This study was conducted in Kin Mun Tan village tract in Tatkon Township, Nay Pyi Taw, Myanmar. Geographically, it is located at 20° 09' 81" N latitude and 96° 19' 41" E longitude (Fig. 1) and the total study area of 60 ha. It lies in the middle region of Myanmar. The area had a mean annual rainfall of 74.83 mm, mean annual temperature of about 37.5°C and mean annual relative humidity of 68%.

Data collection and data analysis

Pilot survey was conducted in January, 2023 by meeting with the village administrator and local farmers to learn about the situation of the village. The required secondary data such as land history, real estate, weather data etc., were collected by consultation with village administrators and meeting with the township manager from Department of Agriculture. Using the purposive sampling method within to the grid point, 48 respondents for the study were selected. Face-to-face interview was conducted at Kin Mun Tan village tract during February 2023.

The structured questionnaire contained questions relating to the social-demographic characteristics of the respondents, fertilizer management practices, and crop management practices those were currently used by respondents. The data were analyzed with the help of SPSS statistical software 25. The socio-demographic characteristics of the sample respondents in the study were calculated using descriptive statistics and linear regression. The level of significance was taken as $p \leq 0.05$.

Results and Discussion

Crop management practices used in the survey area

Table 1 showed that there were twenty-four cropping practices which could be categorized as three groups; rice – rice, maize based cropping pattern and sunflower based cropping pattern. 38% of respondents were practiced double rice cropping pattern. 28% and 34% of respondents were practiced maize based and sunflower based cropping patterns, respectively.

Table 1. Cropping pattern practices by the respondents of the survey area

No.	Cropping Patterns	Percentage
1	**Rice - Rice**	**38.30**
	Maize Based cropping	**27.67**
2	Maize - Cabbage	4.26
3	Maize - Chili	4.26
4	Maize - Chili - Cotton	4.26
5	Maize - Chickpea - Chili	3.19
6	Maize - Chickpea	2.13
7	Maize - Chickpea - Onion	2.13

8	Maize - Parsley	2.13
9	Maize - Watermelon - Chili	2.13
10	Banana - Maize	1.06
11	Maize - Spinach	1.06
12	Maize - Tomato	1.06
	Sunflower Based cropping	**34.04**
13	Sunflower - Chickpea	11.70
14	Sunflower - Chickpea - Chili	4.26
15	Sunflower - Lablab bean	3.19
16	Sunflower - Chili	2.13
17	Sunflower - Sesame	2.13
18	Sunflower - Chili - Lablab bean	2.13
19	Sunflower - Green gram	2.13
20	Sunflower - Onion - Chili	2.13
21	Sunflower - Cotton	1.06
22	Sunflower - Cabbage	1.06
23	Sunflower - Black gram	1.06
24	Sunflower - Sunflower	1.06

In rice – rice cropping pattern, the respondents were grown Thai Hnan Kauk, Sin Thu Kha, Manaw Thu Kha rice variety in both monsoon and summer seasons. Only Ayeyar Min variety was grown in monsoon. Rice was cultivated as an early-season crop from February-April to May-July and as a late-season crop from June-July to October-November. In maize based cropping pattern, the farmers were mainly grown with maize and other crops such as chickpea, chili, cabbage, onion, parsley, spinach, tomato, watermelon, cotton, sunflower and banana grown depending on the local market demand. In sunflower based cropping pattern, the farmers were mainly grown with sunflower and other crops such as chickpea, black gram, green gram, Lablab bean, sesame, chili, onion and cotton depending on the local market demand.

Table 2 described that the respondents were used the seed rate of 17-26 kg ha^{-1} for rice, 1-3 kg ha^{-1} for maize, 8.98 kg ha^{-1} for sunflower, 0.8-1.0 kg ha^{-1} for sesame. The seed rates for pulses crop such as chickpea, black gram, green gram, lablab bean were 11-19 kg ha^{-1}, 5-13 kg ha^{-1}, 3.2 kg ha^{-1}, 4-7 kg ha^{-1}, respectively. The seed rates for transplanted crops were 1 kg ha^{-1} for onion and 0.12 kg ha^{-1} for cabbage. The respondents were used draught animals and machines for land preparation. All farmers harvested rice with machines and other crops manually. The time of sowing and harvesting for each crop were described in table 2.

Farmers' fertilizer management practices in the survey area

Fig. 2 illustrated the percentage of the type's fertilizer used by respondents in the study area. There were five kinds of fertilizers which utilized by farmers. These were organic manure, compound, urea, T-super (Triple super phosphorus) and foliar. According to the results, 81.3% of

the respondents applied organic manure, 79.2 % of the respondents used compound fertilizer, 85.4 % of the respondents used urea fertilizer, only 2.1 % of the respondents used T-super fertilizer, 68.8% of the respondents applied foliar. No farmer used potash fertilizer in study area.

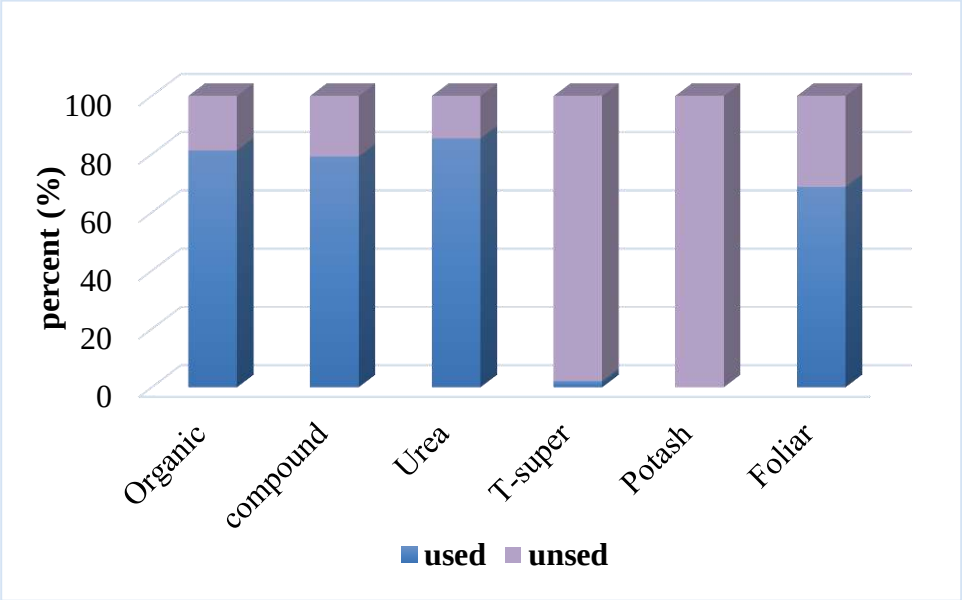


Fig. 2. Percentage of respondents' utilization of fertilizer in the study area

Table 2. Crop and fertilizer management practices used by sample respondents (N=48)

	Crop Management Practices	Agronomy Crops									Horticultural Crops					
		Rice	Maize	Sunflower	Sesame	Green Gram	Black Gram	Chick pea	Lablab Bean	Cotton	Chili	Cabbage	Onion	Spinach	Water melon	Banana
1	**Seed Source**															
	Farm saved seed				▲	▲	▲	▲	▲							
	Company seed	▲	▲	▲										▲		
	Broker	▲	▲					▲		▲	▲				▲	▲
	DOA office				▲											
	Exchange seed between farmer				▲	▲	▲		▲			▲	▲			
2	**Seed Rate ($kg\ ha^{-1}$)**	17 - 26	1 - 3	8.98	0.8 - 1	3.2	5 - 13	11 -19	4 - 7	2 - 3	0.08	0.12	1	2	3.5	485 plts
3	**Land preparation**	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine	animal + Machine
4	**Sowing Method**	Brocasting/ transplant	Brocasting/ line sowing	Line sowing	Brocasting/ Line sowing	Line sowing	Brocasting/ Line sowing	Brocasting/ Line sowing	Line sowing	Line sowing	transplant	transplant	transplant	Line sowing	transplant	transplant
5	**Time of Sowing**	June - July Feb - March	April - June	April - June Sep - Nov	May - June	April - May	May-July April - March	Sep -Dec	May	May	Feb - May	Oct - Nov	Feb	Nov	Nov	May
6	**Fertilizers application ($kg\ ha^{-1}$)**															
	NPK compound	62	124	124	124					247	124	247	124	124	247	
	Urea	247	247	62						124	124	124	124	124		
	T-super															
	foliar				2-4 times	2-4 times	2-4 times	2-4 times	2-4 times							
7	**Pesticide**		Apply as need							Apply as need	Combined with foliar	15 – 20 times			Apply as need	
8	**Weeding**	weedicide	animal+ Manual	Manual	Manual	Manual	Manual	Manual	animal+ Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual
9	**Time of Harvesting**	Oct - Nov May - July	June - Oct	June - Aug Nov - Jan	Aug - Oct	July - Aug	July - Aug May	Feb -March	Sep	Nov	June - Oct	Feb - March	April	Jun	March	
10	**Method of Harvesting**	Machine	Manual	Machine	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual

Based on the survey data of sample farmers, most of the respondents applied organic manure with average application rate of 4.84 cart per hector (2.42ton ha^{-1}) per year. Compound fertilizers were applied 62 kg ha^{-1} for rice, 247 kg ha^{-1} for cotton, cabbage, watermelon and 124 kg ha^{-1} for other crop (Table 2). And application of urea was used 247 kg ha^{-1} for rice and maize; 62 kg ha^{-1} for sunflower; 124 kg ha^{-1} for other crops (Table 2). T-super was only used by two farmers with 62 kg ha^{-1} in maize. Foliar fertilizer was applied 2-4 times in pulses crops. Compound and urea fertilizer was applied by splitting from one to three times. No farmers were used potash fertilizer because they assumed that crop requiring potassium obtained from compound fertilizer application. In general, the decisions of fertilizer application rate and time were depended on type of crops, fertilizer price, their farming experience and local knowledge

The opinion of respondents for soil fertility status was described as fig. 3. 50% of respondents accepted their farm had good soil fertility status. 48% of respondents answered medium soil fertility status and 2% of respondents answered as poor. According to findings, only 4% of the respondents did soil testing, other 96% did not test the soil (Fig. 4). Therefore, their opinion on soil fertility status were not based on soil test and it was only on their personal judgment.

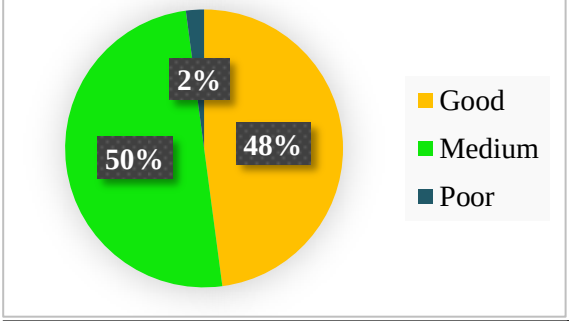


Fig. 3. Percentages of respondents' opinion for their soil fertility status

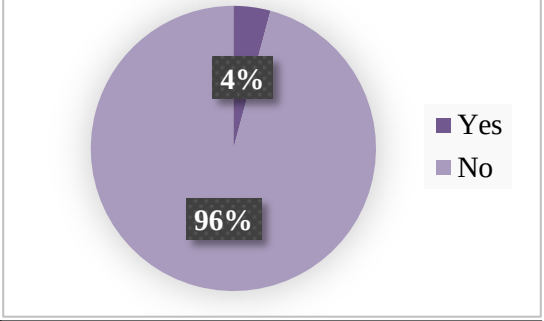


Fig. 4. Percentages of respondents who did soil testing

Socio-demographic information of sample respondents

The demographic characteristics of 48 respondents from the study area described in Table 3. The age of the respondents ranged from 34 to 70, with a 49-year average. Most of the respondents had middle school level. The respondents possessed different farm sizes. These ranged from 0.73 to 3.24 ha, with the average farm size of 1.80 ha. The results showed that farm experience of respondents were ranging from 8 to 50 years with the average of 27 years.

Table 3. demographic characteristic of sample respondents (N=48)

Item	Unit	Minimum	Maximum	SD
Age of respondent	year	34	70	9.19
Education level		1	4	1.07
Farm size	ha	0.73	3.24	0.74
Farm experience	year	8	50	9.65
No. of years of fertilizer application	year	10	46	9.63

SD = Standard Deviation, Education level (1= graduated, 2= high school, 3= middle school, 4= primary school)

Correlation between demographic characters of farmers with cropping patterns and types of fertilizer in the study area

Farm size, compound fertilizer usage, foliar application and year of fertilizer application had significance relationship with cropping pattern (Table 3). As described in Table 3, the R^2 is 0.797, which indicates that 80% of the variance in the cropping patterns along with fertilizer usage by farmer can be explained by the selected demographic characteristics of farmers in the model. Foliar application (p = 0.000) and farm size (p = 0.005) were significant positive relationships than other variables. Foliar application (β = 0.778) shows the highest relative strength in predicting the cropping pattern. And, it was followed by farm size (β = 0.272), education level (β = 0.240), year of fertilizer application (β = 0.170), compound fertilizer utilization (β = 0.047), farm experience (β = 0.028), and age (β = −0.061), organic manure usage (β = −0.124), urea (β = −0.185), and phosphorus usage (β = −0.193), respectively. Foliar application made the highest contribution to explain the cropping pattern. The results revealed that farmers with a large farm size have to be depending more on diversified cropping patterns with frequent foliar fertilizer application especially for pulses cultivation. The farm size, farm experience and compound fertilizer application have positive relation to explain the cropping pattern. This result indicates that the larger farm size and the more farm experience, the higher possibility of predicting diversified cropping pattern that have to be necessary more compound and foliar fertilizers. Age of the farmers; phosphorus usage, urea usage and organic manure usage were no contribution to cropping pattern in the study.

Table 3. Linear regression model showing coefficients of demographic characters of farmers with cropping patterns and fertilizer usage

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.049	1.092		-0.045	0.964
	Organic manure usage	-0.556	0.426	-0.124	-1.304	0.200
	Compound usage	0.203	0.379	0.047	0.534	0.596
	Urea usage	-0.918	0.416	-0.185	-2.205	0.034
	Phosphorus usage	-2.361	1.014	-0.193	-2.328	0.025
	Foliar usage	2.938	0.324	0.778	9.058	0.000
	Age	-0.012	0.022	-0.061	-0.543	0.590
	Education level	0.397	0.147	0.240	2.694	0.011
	Farm size	0.633	0.215	0.272	2.950	0.005
	Farm experience	0.005	0.023	0.028	0.221	0.826
	Year of fertilizer application	0.031	0.018	0.170	1.700	0.098

R= 0.892, R^2=0.797, Adjusted R^2= 0.742, Std. Error of the Estimate=0.899, Sig.=0.000

Conclusion

The survey results revealed that there were twenty-four cropping practices and it could be categorized as three cropping patterns; double rice (38%), maize based (28%) and sunflower based (34%). In maize and sunflower based cropping patterns, farmers used to grow rotating with other crops such as chickpea, chili, cabbage, onion, parsley, spinach, tomato, watermelon, cotton and banana depending on the market demand. In the fertilizer management practices, they used to apply organic manure, compound, urea, T-super (Triple super phosphorus) and foliar fertilizers. The greater portion of respondents (81%) used organic manure with the average application rate of 4.82 cart per hector (2.42ton ha^{-1}) per year. The highest number of respondent (79%) used compound fertilizers, 85% used urea fertilizer, 2% used T-super and 69% used foliar fertilizers depending on cropping patterns. Concerned with soil fertility status, half of respondents answered that their farm had good fertility status without testing their soils. There were 94% of study area without soil testing. It indicated that the study area was necessary to conduct soil analyses to improve soil fertility status. In summary, farm size, compound fertilizer usage, foliar application and year of fertilizer application were depending on diversified cropping patterns. Especially, a cropping pattern including pulses was done with much application of foliar fertilizers.

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