Research article

Seasonal Distribution Maps, Management Practices and Profitability Analysis of Vegetables in the Selected Area, Nay Pyi Taw

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Received 15 December 2018 Accepted 8 April 2019 (*Corresponding Author)

Abstract Detailed information on seasonal distribution of vegetable growing areas and comprehensive study on cultural practices of some commercial vegetables are still lacking in Myanmar. This study was done to produce seasonal distribution maps of vegetables for the selected area and to analyze crop management practices and profitability of the selected commercial vegetables. Kyee Inn village tract, Pyinmana Township, Nay Pyi Taw was selected and studied from May 2016 to December 2017. Total study area was 483 ha and DJI Phantom 4 drone, Lichi software, GPS device, pix 4D software and ArcGIS were used to draw the maps. A total of 50 vegetable farmers were interviewed to analyze crop management practices and profitability for selected five commercial vegetables; okra, chilli, yard long bean, cucumber and ridge gourd by using descriptive analysis and profit function. The result showed that 15 kinds of vegetable were distributed year-round and total vegetable production areas ranged from 3.69 acres (0.31%) to 17.61 acres (1.44%) of total cultivable land. Farmers used hybrid seeds except for chilli and practiced their preferable spacing, not following the recommended one provided by Department of Agricultural Research (DAR). Farmers commonly used high dosage of urea and some farmers used wrong pesticides to control green leaf hopper, leaf miner, powdery mildew and rust. Moreover, most farmers had no awareness on using pesticide. Okra production gives the highest Benefit Cost Ratio (BCR) of 2.5 if it was grown in less than average acre. But, in chilli and ridge gourd production, BCRs (2.7 and 3.7) were the highest in 'average growing acre'. Yard long bean and cucumber production give the highest BCRs (2.5 and 2.5) in 'above average growing acre'. In total cost of production, labor cost was the highest followed by fuel cost for irrigation.

Keywords vegetables, distribution maps, management practices, profitability

INTRODUCTION

Myanmar has rich sources of plant biodiversity and more than 100 kinds of vegetables are growing in Myanmar depending on suitable growing seasons (MOALI, 2014). Vegetables are the most important of crops because they are an excellent source of minerals, vitamin A, folic acid and beta-carotene. They play a key role in solving the problems of food production and providing a balance diet. Although many different vegetables are grown in Myanmar depending on the suitable growing seasons, the detailed information on their distribution for three seasons (summer, rainy and winter season) throughout the country is still lacking. In order to know the distribution of vegetables for an area, the new science tools such as Geographic Information System (GIS) and Global Positioning System (GPS) should be introduced with innovations and modern technologies based on satellite data. At present, the development and implementation of precision agriculture (planning, field mapping, soil sampling, crop scouting, variable rate applications, and yield mapping) has been possible by combining the GPS and GIS but has not being published.

Vegetable production is important not only for national economic development but also for rural household income generation. Therefore, vegetable growers must use cultural practices that optimize yields, maximize returns and profits, and minimize environmental impacts (Colquhoun et al., 2018). But there have been no detailed studies about the cultural practices of each vegetable in Myanmar.

OBJECTIVES

The study was carried out as a first step with the following objectives;

1. To create seasonal distribution maps of vegetables of the selected area in Nay Pyi Taw
2. To analyze crop management practices and profitability of the selected commercial vegetables in the study area

METHODOLOGY

Study Duration and selected area

The research was conducted from May 2016 to December 2017 at Kyee Inn Village, Pyinmana Township in Nay Pyi Taw of Myanmar. Total study area was 483 ha and vegetables covered about 7.28 ha (1.52% of cultivable land) in 2016.

Data Collection

The primary data collection was done from November 2016 to December 2017. Coordinate points of each vegetable growing field were collected depending on the crop changes and drone flying above the study area was done to draw the seasonal distribution map. All kinds of vegetables scattered year-round were studied. Five most commercially grown vegetables (okra, chilli, yard long bean, cucumber and ridge gourd) were selected based on high growing percentage, year-round production and high benefit according to the preliminary survey. All farmers who grow vegetables in the study area (50 persons) were interviewed with structured questionnaire sets to analyze crop management practices and profitability of five selected commercial vegetables. The secondary data comprising field base map hard copy, weather data, total crop growing area and total population were obtained from Township Administration Office, Department of Agriculture (DoA) and Department of Agricultural Land Management and Statistics (DALMS), Pyinmana Township in Nay Pyi Taw.

Data Analysis Methods

DJI Phantom 4 drone manufactured from SZ DJI Technology Co. Ltd, Shenzhen, Guangdong in China was programmed to fly at a constant altitude of 120 meters above the ground to get the ground images of the study area. For drone flying, DJI Phantom 4 drone supplied from SkyLink Company, Japan and Lichi software were used. Location coordinates of each vegetable growing field were recorded with GPS device (GARMAN, GPSMAP 62). Drone photos were consolidated and prepared for digitizing and analyzing with pix 4D software to provide digital base map of the study area. Mapping for spatial distribution of crops were provided using ArcGIS Desktop (software) from Environmental Systems Research Institute (ESRI). The collected crop management data were entered to Excel program. Means and percentages were calculated to know the management practices comprising seed type, spacing, fertilizer application and pesticide usage. The concept of enterprise budget was used to compare the profitability of different vegetables. Gross return was calculated by multiplying the total volume of production of an enterprise by the average prices of that product in the harvesting period (Dillon and Hardaker 1980). Variable costs of production included cost for land preparation, seeds, fertilizers, fuel, pesticides, poles and labors. Return of vegetable production was based on average yield and sale at average current price of

vegetable during that period. Profitability measures were calculated by using the following formula:

Benefit Cost Ratio (BCR) = Total Gross Benefit (GB) / Total Variable Cost (TVC)

RESULTS AND DISCUSSION

In the study area, 15 kinds of vegetable were produced year-round, and vegetable fields cover about 0.31 - 1.44% of total cultivable land (Table 1). They were okra, chilli, yard long bean, cucumber, ridge gourd, water convolvulus, mustard, French bean, onion, coriander, rosella, bitter gourd, mint, kai-lan and Asiatic pennywort. In the summer season, 11 kinds of vegetable were grown, and the production area ranged from 15.1 to 17.06 acres covering 1.27% - 1.43% of total cultivable land. In the rainy season, the production area of vegetables (11 kinds) declined to 3.69 - 13.37 acres. This is because most farmers grew monsoon rice in this season. In the winter season, 7 kinds of fruit vegetables, 6 kinds of leafy vegetables, one kind of bulb and herb vegetable were grown. Kinds of leafy vegetables increased because of winter season crops such as mustard, kai-lan and coriander. Figure 1 shows the sample distribution map of vegetables in the winter season in which 15 kinds of vegetables were produced. This kind of distribution map can be used to compare species distribution and location changes of vegetables from season to season and year to year. Since maps can show the accurate positions of vegetable growing areas, they can be useful for the future study of scientists and vegetable production data are also essential for effective planning assessment.

Table 1 Distribution of vegetables from November 2016 to December 2017

Items	Summer	Rainy	Winter
Fruit vegetables	Okra	Okra	Okra
	Chilli	Chilli	Chilli
	Yard long bean	Yard long bean	Yard long bean
	Cucumber	Cucumber	Cucumber
	Ridge gourd	Ridge gourd	Ridge gourd
	Bitter gourd		Bitter gourd
	French bean		French bean
Leafy vegetables	Water convolvulus	Water convolvulus	Water convolvulus
	Rosella	Rosella	Rosella
			Mustard
			Kai-lan
Bulb vegetables	Onion	Onion	Onion
Herb vegetables	Mint	Mint	Mint
		Coriander	Coriander
		Asiatic pennywort	Asiatic pennywort
Total growing acre	**15.1 - 17.06**	**3.69 - 13.37**	**3.94 - 17.16**

In Table 2, most of the farmers (76%) used local variety for chilli production because of market demand and high price but all the farmers used the hybrid seeds in okra, yard long bean, cucumber and ridge gourd production. Moreover, farmers used the F_1 population seeds (i.e., seeds come from the hybrid seed at the first season) obtained from their fields because hybrid seeds were very expensive and they could save money by using them. The most commonly used spacing of okra, chilli, yard long bean, cucumber and ridge gourd were 3' x 0.5', 3' x 1.5', 4.5' x 3', 3.5' x 1.5' and 4' x 3'. The spacing of okra, chilli, yard long bean, cucumber and ridge gourd recommended by DAR (Department of Agricultural Research) were 3' x 1', 2' x 2', 3.5' x 0.7', 4' x 1' and 20' x 2',

respectively. In fertilizer usage, most farmers used more urea fertilizer rate than the recommended one in all selected vegetables. Although farmers did not use the recommended spacings and fertilizer rates provided by DAR, they got the profits. However, extension workers should share the knowledge on the application methods and time of fertilizer usage to be more effective.

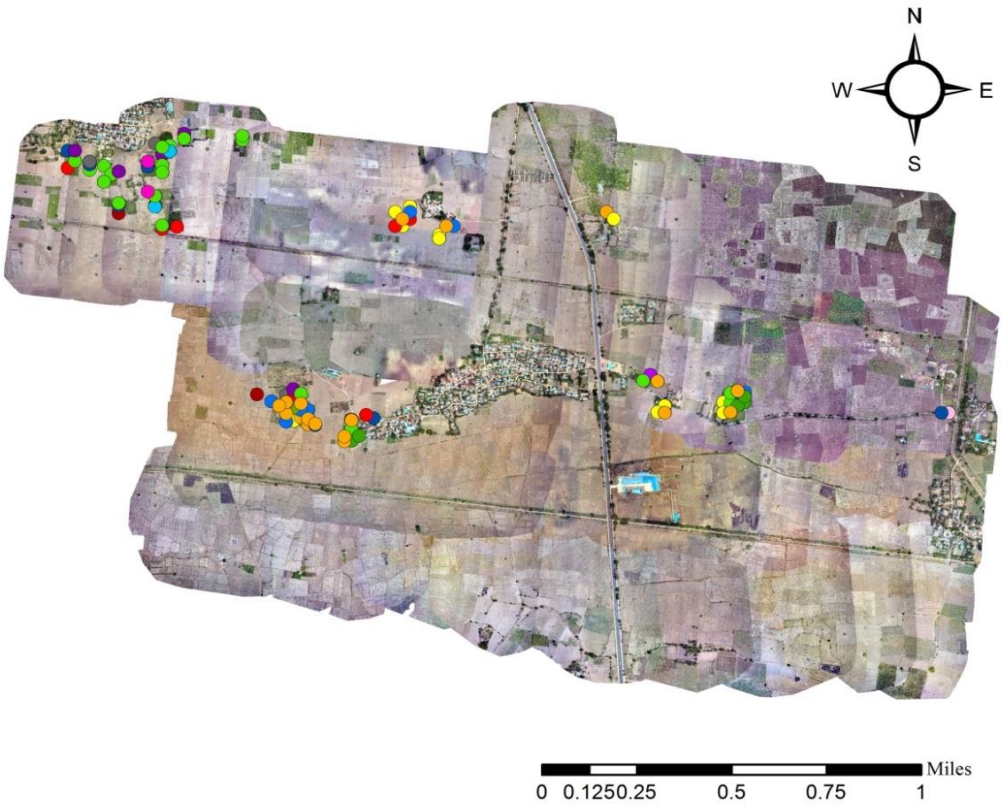

Fig. 1 Distribution of vegetables in the winter season, 2017

Table 2 Comparison of seed type, spacing and fertilizers between farmers'practices and recommended ones by DAR

Crops	Seed type			Plant spacing (ft)		Fertilizer usage (kg/ac)							
	Hybrid	F_1 popu;	Local	RP*	FP**	Urea		T-super		Potash		Cowdung manure	
						RP*	FP**	RP*	FP**	RP*	FP**	RP*	FP**
Okra	44	56	-	3 x 1	3 x 0.5	50	426	50	23	50	30	1000	235
Chilli	14	10	76	2 x 2	3 x 1.5	100	286	50	15	50	20	3000	208
Yard long bean	53	47	-	3.5 x 0.7	4.5 x 3	50	328	25	52	25	67	1000	310
Cucumber	100	-	-	4 x 1	3.5 x 1.5	50	465	50	56	50	73	1000	262
Ridge gourd	100	-	-	20 x 2	4 x 3	50	658	50	150	50	96	1000	750

** = Recommended practice, ** = Farmers' practice*

The most common pests and diseases in the selected vegetables were green leaf hopper, white fly, pod borer, leaf miner, powdery mildew and rust (Fig. 2). In the controlling of green leaf hopper, 80% of farmers used various insecticides correctly. For the control of white fly and pod borer, all farmers (100%) used the insecticides correctly. Also, in controlling of leaf miner, 92% of farmers used correct insecticides. Though 74% of farmers used the fungicides correctly to control powdery mildew, 100% of them used the insecticide incorrectly instead of fungicide to control rust.

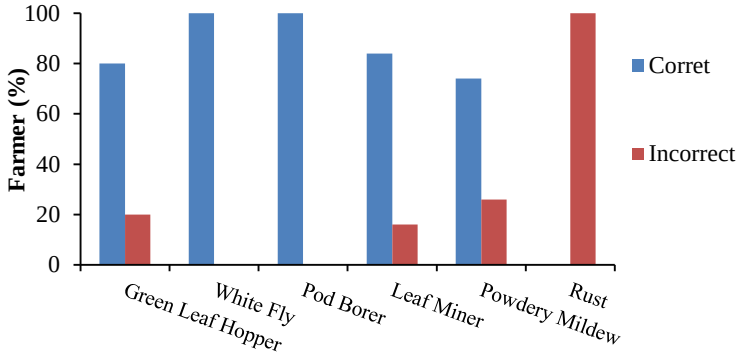

Fig. 2 Pest and disease incidence and pesticide usage in the selected vegetables

In Fig. 3, most of the farmers harvested all selected vegetables except chilli only one day after pesticide application; 100% in okra, 94% in yard long bean, 77% in ridge gourd and 95% in cucumber. In chilli production, all farmers harvested the crop seven to ten days interval after pesticide application. Therefore, most vegetable farmers did not follow the pre-harvest waiting period and they applied the pesticides near harvesting time. Misuse of pesticides can cause poisoning, human and environmental hazard. So, farmers should imply the pre-harvest waiting period instructed on pesticide package accurately during pesticide handling.

Figure 4 shows the results of personal protective equipment used by the farmers such as long sleeves (34%) and boots (8%) and gloves (2%). But all vegetable farmers did not use masks during pesticide handling and spraying that can maximize exposure and increase the risk of pesticide poisoning. Pesticide poisoning has been a major problem worldwide, but the estimates vary among the reports. Rajendran (2003) mentioned that nearly 500,000 illnesses and 20,000 deaths can be attributed annually to chemical pesticides worldwide. Likewise, World Health Organization (WHO) data showed that each year 3,000,000 cases of pesticide poisoning including 220,000 deaths are reported across the globe (Down to Earth, 2001). To solve the pesticide usage problems, educating the village pesticide retailers and farmers on knowledge of pest and pest management, proper pesticide handling and safety measures is needed.

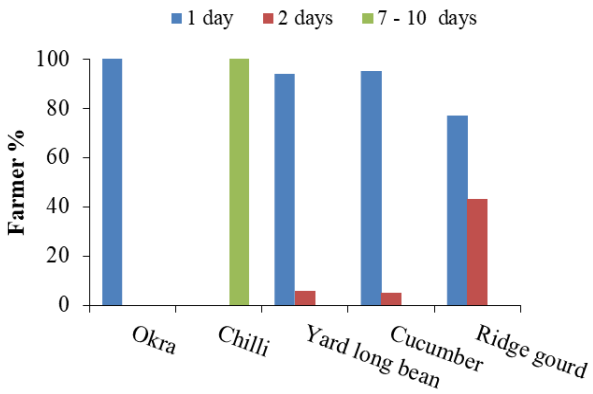

Fig. 3 Pre-harvest waiting period (days) after pesticide application

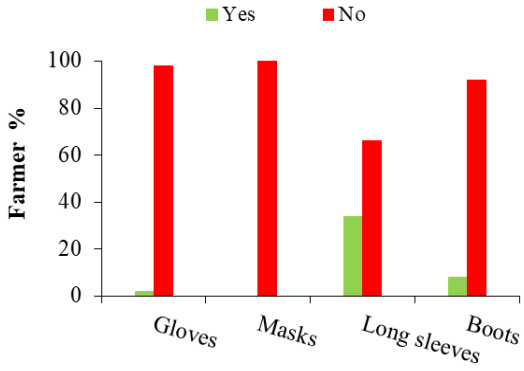

Fig. 4 Protective equipment usage

Cost and return analysis were calculated depending on average, below average and above average growing area (Table 3). The average growing areas of okra, chilli, yard long bean, cucumber and ridge gourd production were 0.30 acre, 0.40 acre, 0.15 acre, 0.10 acre and 0.10 acre respectively in the study area. Okra production gives the highest BCR (2.5) if it was grown in less than 'average acre'. But, in chilli and ridge gourd production, BCRs (2.7 and 3.7) were the highest in 'average growing acre'. And then, yard long bean and cucumber production give the highest

BCRs (2.5 and 2.5) if they were grown in above 'average growing area'. In the cost of inputs and labor as a percentage of total vegetable production cost, labor cost share was the highest among other cost share followed by fuel cost.

Table 3 Benefit cost ratio and cost share analysis of selected vegetables production

Crops	Benefit cost ratio (BCR)			Cost share of inputs and labor (%)						
	< Average	Average	> Average	Seed	Fertilizer	Pesticide	Land pre;	Labor	Fuel	Pole
Okra	2.5	1.8	1.7	6.10	8.55	7.91	13.37	47.06	17.01	0.00
Chilli	2.5	2.7	1.8	4.64	2.76	2.08	6.66	61.15	22.80	0.00
Yard long bean	2	1.8	2.5	5.55	7.90	13.68	6.74	41.44	10.01	14.68
Cucumber	2.2	2.4	2.5	7.18	9.62	7.66	8.38	38.47	6.27	22.42
Ridge gourd	2.2	3.7	3.2	9.03	4.44	12.43	9.46	38.48	10.54	15.61

CONCLUSION

Distribution maps can be used to compare species distribution and location changes of vegetables from season to season and year to year for the selected area. Since mapping can show the accurate position of vegetable growing areas, it can be useful for scientists and planners in the future. Therefore, this kind of research should be extended.

In fertilizer application, farmers used higher amount of urea fertilizer than the recommended rate. In pesticide application, the farmers used pesticide incorrectly to control green leaf hopper, leaf miner, powdery mildew and rust. Most of the farmers harvested the crops at one day interval after pesticide application in okra, yard long bean, cucumber and ridge gourd production. Moreover, most farmers did not use the personal protective equipment during pesticide handling and application.

ACKNOWLEDGEMENTS

We would like to thank the generous financial and technical training support of Japan International Cooperation Agency (JICA) Project for Capacity Development of YAU. Our special thanks are also extended to respondent farmers for their patience during survey and valuable answers to the survey questionnaires and the authorized persons from Department of Agriculture (DoA) and Department of Agricultural Land Management and Statistics (DALMS) for data provision.

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