The Effect of Availability of Water Sources on Summer Paddy Cultivation in Maubin Township, Ayeyarwady Region

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Abstract

The study area, Maubin Township is located in Ayeyarwady Region, Myanmar. The main aim of this research is to analyze the summer paddy cultivation in Maubin Township. Most of the factors are favorable for increasing the summer paddy cultivation in this study area. One of the factors is that the available water changes the cropping pattern of summer paddy cultivation. As the study area is part of the Ayeyarwady deltaic region, it has vast fertile alluvial soil which is suitable for growing various crops. Most people in Maubin Township practice the crop cultivation and fishery. Summer paddy cultivation is an important sector in the study area and it is favorable for local and foreign market. The conditions of summer paddy cultivation vary spatially and temporally. In this study, kinds of paddy seeds, practice and production are analyzed from the geographical point of view.

Keywords: summer paddy cultivation, cropping pattern, foreign market

INTRODUCTION

Agriculture, in any period, remains important especially for the developing countries. The economy of Myanmar is based on agriculture practices. About 70 percent of its national population (51.4 million in 2014) lives in rural areas and depends on agriculture, livestock, forestry, and fishery for livelihoods (FAO, 2016). Likewise, the economy of Maubin Township largely depends on the agriculture sector. Most of the farms are for summer paddy cultivation and monsoon paddy cultivation. Most areas are favorable for rice cultivation while some are prone to floods in the monsoon. After harvest of monsoon paddy, summer paddy and other pulses are grown in the fields.

Maubin Township, located in the Ayeyarwady delta of the lower part of Myanmar. Many rivers, creeks, embankments and streams are mostly found in this study area. Pulses and other vegetables crops are grown depending on the available water. But, in cultivated system for summer paddy cultivations, water is more used. Water is available from most of the existing creeks, depending on tides after rainy season and they cannot serve for irrigated farming in summer paddy cultivation period. The availability of sufficient water basic is essential for successful growing of crops in the summer period. Thus, this research work focuses on the influencing factors on availability of water and summer paddy cultivation in the study area.

Farmers have become aware that summer paddy gives high yield because of high sunshine intensity and summer paddy cultivation is of less risk. Moreover the cultivation period is free from untimely rain and it is cultivated in dry period with the help of irrigation. One of the most important requirements related to summer paddy cultivation is irrigation ((Panuju et al., 2012). Being the part of the Deltaic area, Ayeyarwady Region is known as rice granary of Myanmar, and Maubin Township is one of the townships of Ayeyarwady Region.

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Summer paddy cultivated areas occupied 90 percent of the total rainfed paddy cultivated areas, and yield per unit area of summer paddy is higher than that of monsoon paddy. Farmers extensively cultivate summer paddy, but farming practices differ from one another. Three farming practices in summer paddy cultivation are found and their returns are also different. Ramachandra and Nagarathna (2000) said that agriculture requires three major resources: land, water and energy. Being resources, agricultural productivity could be linked directly to the availability of water (rain or irrigation) and energy inputs.

Research Problem

The research work tries to examine the factors influencing on the summer paddy cultivation in Maubin Township.

AIM AND OBJECTIVES

The main aim of this research is to highlight the availability of water effect on summer paddy cultivation in Maubin Township.

The objectives are

- To examine the influencing factors on the conditions of summer paddy cultivation
- To identify the irrigated areas for further intensification of summer paddy cultivation

MATERIALS AND METHODS

Primary data and secondary data were used to observe the conditions of summer paddy cultivation in Maubin Township. To acquire the primary data, field observation and informal talks with local farmers were conducted. Secondary data were also applied to present spatial distribution of summer paddy cultivated area and these data were obtained from Agriculture Department. The climatic data were obtained from Meteorology and Hydrology Department in Maubin Township. The data of the types of land use and cultivated areas were collected from Department of Agricultural Land Management and Statistics, and soil types and properties were obtainted from Soil Department of Yangon.

Based on the data acquired from the field survey, descriptive method was used for conducting the research. The conditions of stream network and correlation method between summer paddy cultivation and using the surface water pumps are examined in study area. The information about stream network of Maubin Township area is obtained from the Ayeyarwady Digital Elevation Model (30-meters resolution) in 2018.

Study Area

Maubin Township is located in the eastern part of Ayeyarwady Region. It lies between north latitude 16º 30′ and 16º 56′ and between longitudes 95º 24′ and 95º 53′. The area of township is 1,334.828 square kilometers (515.38 square miles). It comprises 12 wards in the urban area and 76 village tracts in the rural areas. The township is bounded by Pantanaw Township on the north, Twantay Township on the east, Kyaiklat Township on the south and Wakema Township on the west (Figure 1).

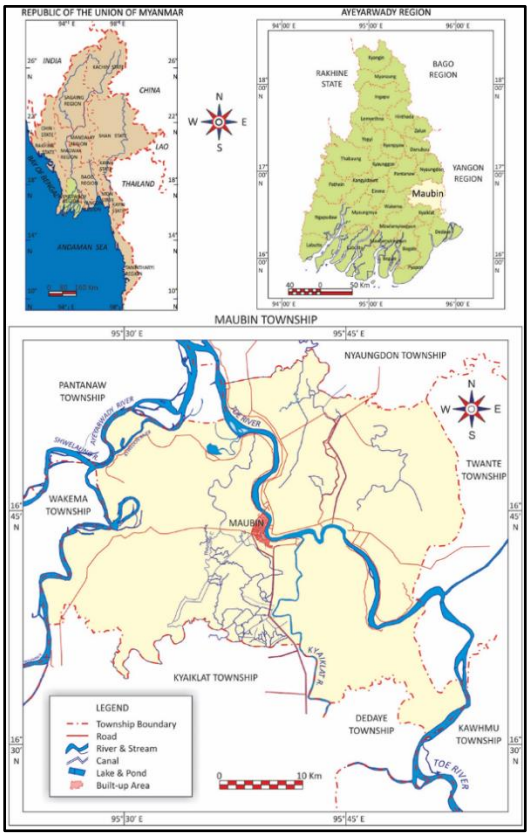


Figure (1) Location of Maubin Township
Source: General Administrative Department, Maubin

Types of Cultivated Crop in Maubin Township

According to the data of Department of Agricultural Land Management and Statistics**,** there are 64 types of crops in Myanmar, varying greatly from place to pace depending on relief, climate and soil types. In Maubin Township, 6 major crops are usually grown, including paddy, pulses, oilseed crops, maize, chilli and vegetables as shown in Table (1). Double cropping and mixed cropping are also practiced.

Table 1. Types of Cultivated Crop in Maubin Township (2018-2019)

Types	**Cultivated Aera (Hectares)**	**% of total**
Monsoon Paddy	56,391.34	35.79
Summer Paddy	36,297.86	23.04
Oilseed crops	4,570.21	2.9
Pulses	42,709.02	27.1
Maize	10,216.92	6.48
Chilli	2,522.87	1.60
Vegetables	4,853.09	3.08
Total	**157,561.31**	**100.00**

Source: Department of Agricultural Land Management and Statistics, Maubin Township

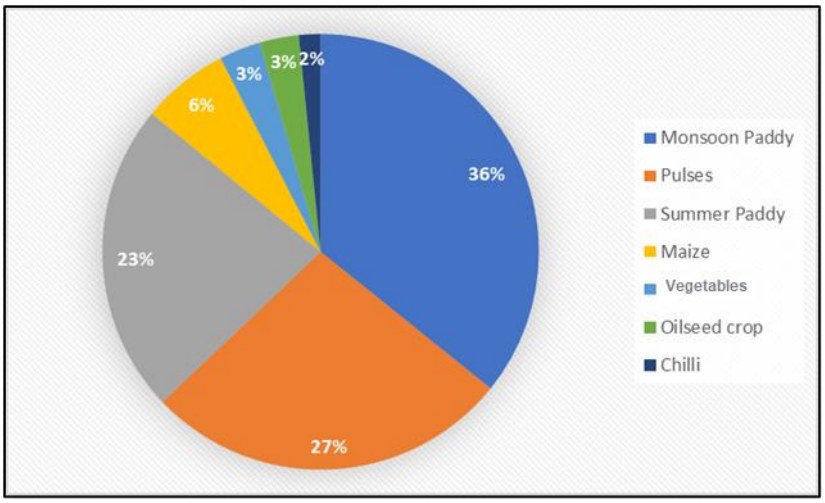


Figure (2) Types of Cultivated Crop in Maubin Township (2018-2019)
Source: Based on Table 1

Monsoon Paddy is the most important crop of the township occupying the largest sown area. Both monsoon paddy and summer paddy are grown in the study area. In 2018-2019, the total sown area of monsoon paddy was 56,391.34 hectares (139,343 acres) as shown in Table (1) and Figure (2). Monsoon paddy (*Moe Sabar)* is traditionally grown on "*le*" land with rainwater in the rainy season. Generally, it is mainly cultivated during May to August and harvested during November to December. During the monsoon period, the study area is sufficient for growing paddy without supplemental irrigation from river and streams.

Summer paddy (*Nway Sabar*) is the principal crop grown on "*le*" land especially with the available water supply in the study area. As the study area lies near the rivers and streams, the canals and sluice gates can provide growing summer paddy. The total sown area of summer paddy was 36,297.86 hectares (89,692.01 acres) in 2018-2019 Table (1) and Figure (2). Summer paddy (double crop) can be transplanted only after the monsoon when flood water recedes. Summer paddy is cultivated during November to January and harvested during March to May. The most common strains grown in the study area are Muyin and double crop paddy such as Manawthukha, Thihtetyin, Sinthukha and Yaynaelo, Yetkosel.

Temporal Changes of Summer Paddy Cultivation

As the study area is a part of the Ayeyarwady delta and it has a vast productive and fertile alluvial land, paddy is the most dominant cereal crop in the township.

Summer paddy was first introduced in 1993-94 and it is grown in the area close to the sources of water. Owing to improved farming techniques, and better paddy strain, yield per hectare increased in the study period. Comparatively the yield per unit area of summer paddy is much higher than that of monsoon paddy due to receiving longer sunshine hours which enhances photosynthesis of the plants. Although summer paddy cultivated area slightly increased in the study period, yield per unit area increased gradually shown in Figure (3). The large sown area of summer paddy is found near rivers and streams that can supply large amount of water to irrigate the farmlands.

Summer paddy is grown successfully only in areas where irrigation water is available. Therefore, summer paddy cultivation is mainly found on the farmlands near the rivers, streams and creeks that supply large amount of water to irrigate the farmlands. The village tracts with large sown area of summer paddy were Maletto, Thaungzar, and Theikgon, and Kyeechaung

village tracts respectively in 2007-2008. Irrigation water is available for these village tracts due to nearness to Toe River and Maletto stream.

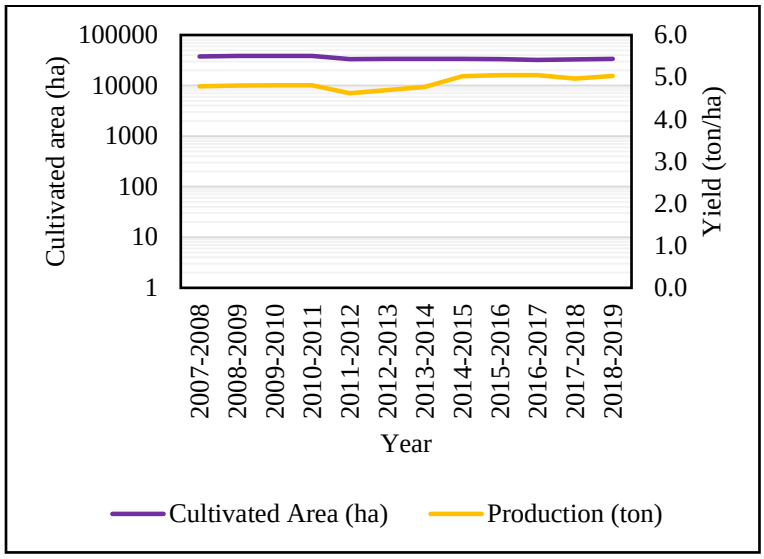


Figure (3) Summer paddy cultivated area and production in Maubin Township (from 2007-08 to 2018-19)

Source: Department of Agricultural Land Management and Statistics, Maubin Township

Summer paddy is by far the most dominant crop of '*le*' land which is after the monsoon paddy cultivation. Summer paddy consumes a large amount of water and thrives on flooded fields. Meadow clayey soils are less impervious and can store water for long time. Heavy incessant water occasionally causes supporting to the summer paddy-planted fields, resulting in more increase of the production. The summer paddy area occupied by fallow land has been increasing due to conversion into cultivated land, mainly for growing paddy.

The main summer paddy crops in Maubin Township are in high yield variety: special variety and local variety. The high yield varieties are Palethwe, Sinthuka, Theehtatyin, Manawthuka and Yetkosel. Sinthuka and Thehtatyin are mostly grown in the study area. Spatial distribution of summer paddy cultivation in Maubin Township varies depending on different soil types, availability of water, farmers' decision.

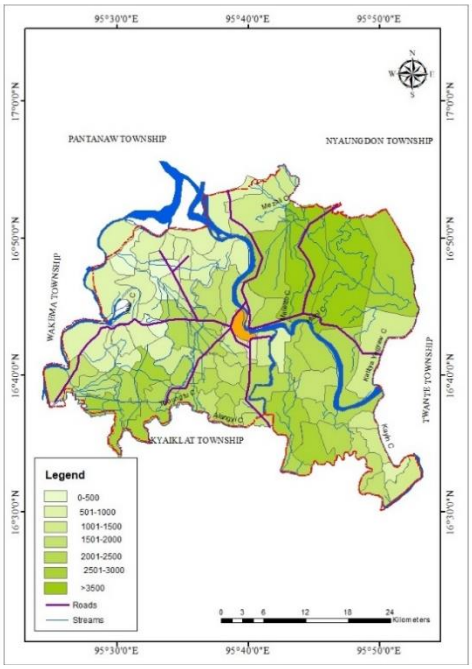
The average cultivated areas of summer paddy are 37,789.55 hectares (93,380 acres), and 36,297.06 hectares (89,692 acres) during the period from 2007-2008 to 2018-2019. The monsoon paddy occupies the largest sown acreage with 15,921.55 ha (39,343 acres) or 33.60%, summer paddy acreages with 36,297.07 ha (89,692 acres) or 21.63 %.

Generally, summer paddy cultivated area of Maubin Township can be found in almost all village tracts. But most of the areas are found in northeastern part of the Maubin Township such as Maletto Village Tract occupied 3,185.28 hectares (7,871 acres), Aungbon and Htani village tracts amounted to 1,794.38 hectares (4,434 acres) and 1,786.28 hectares (4,414 acres) respectively. Kywedone, Innma and Yelegyi village tracts have no summer paddy cultivation in 2018-2019 seen in Table (2) and Figure (4) and (5).

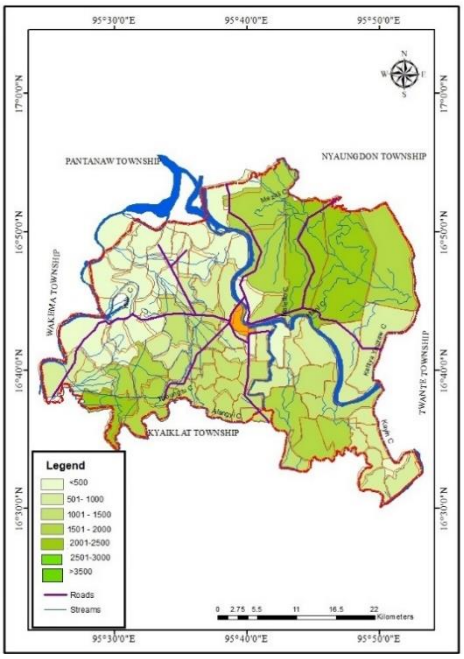
Table 2. Summer Paddy Cultivated Areas in 2007-2008 and 2018-2019

Sr.	2007-2008		2018-2019	
	Summer Paddy Cultivated Area (Acres)	Number of Village Tracts	Summer Paddy Cultivated Area (Acres)	Number of Village Tracts
1	< 500	37	< 500	26
2	501-1000	26	501-1000	19
3	1001-1500	7	1001-1500	19
4	1501-2000	1	1501-2000	3
5	2001-2500	1	2001-2500	3
6	2501-3000	1	2501-3000	6
7	> 3500	3	>3500	0
	Total	**76**	**Total**	**76**

Source: Department of Agriculture, Irrigation and Livestock in Maubin Township



Figrure (4) Summer Paddy Cultivation in Maubin Township in 2007-2008
Source: Based on Table 2



Figrure (5) Summer Paddy Cultivation in Maubin Township in 2018-2019
Source: Based on Table 2

Physical Factors Influencing on the Summer Paddy Cultivation

Basic geographic factors support summer paddy cultivation in Maubin Township. On the other hand, farming methods, inputs and irrigation have a significant influence on summer paddy cultivation.

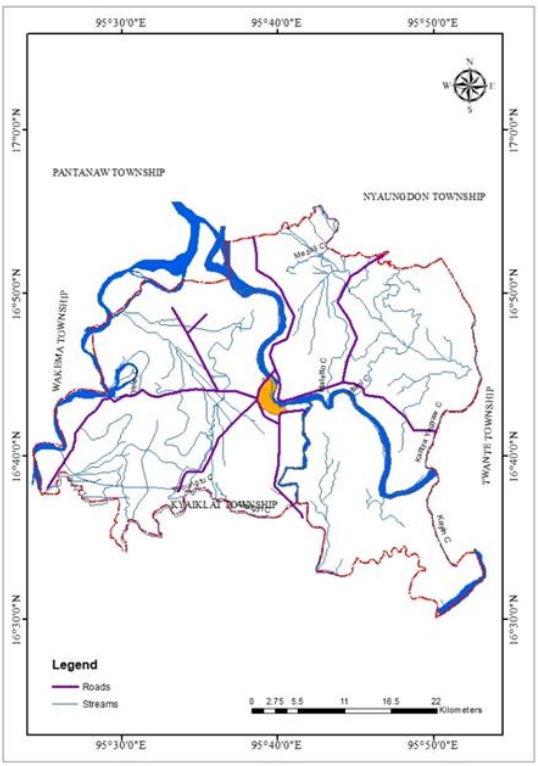
Physical factors such as relief, drainage, climate and soils directly or indirectly have an influence on summer paddy cultivation of any area. Maubin Township is located in southwestern part of Ayeyarwady Region. Temperature and rainfall of the area are very suitable for summer paddy cultivation.

Relief and Drainage

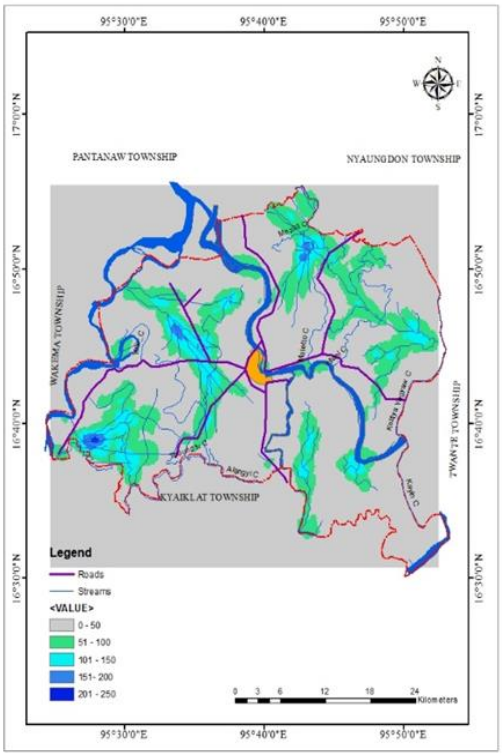
In general, the study area is lower at the southern portion and only small areas in the north western tip of the study area have an elevation of more than 5 meters above sea level. Western part of the Toe River is higher than that of the eastern part. Many streams, cannals, lakes and ponds are found in the north eastern part of the Toe River, because almost the whole area are swampy area. Rivers and streams are the most important water resources for agricultural activities. The major rivers that flow along the township are the Ayeyarwady, Toe and Kyaiklat rivers. The distinctive drainage systems of Maubin Township include Maletto, Htani, Panhlaing Yegyaw, Pantaput, Thaungtu, Shweboyo, Tamangale, Kanu, Alan, Khamon, Kyweguyo and U Yin Streams. All the rivers and streams are tributaries and distributaries of the Ayeyarwady River that flows along the northwest and western boundaries of the township generally from north to south. It flows across Maubin Township for about 40.23 kilometers (24.99 miles). It serves as the boundary line between Maubin and Pantanaw townships in the northwest and between Maubin and Wakema townships in the west shown in Figure (6).

Near Chaungyi, about 16.10 kilometers (10 miles) north of Maubin, the third of the delta distributaries of Ayeyarwady, Toe River is given off and flows across Maubin Township for about 56.33 kilometers (35 miles). It is the second most important river of Maubin Township.

In Figure (7), the streams network density is favorable for summer paddy cultivation in Maubin Township. A highly stream network density reflects a highly accessible water resource for cultivation. Some areas gradually change into the fishery ponds. These areas are in very low level plain.



Figure(6) Drainage in Maubin Township
Source: Digital Elevation Model



Figure(7) Streams network density in
Source: Digital Elevation Model

Climate

Climate is one of the most significant factors for the agriculture development of an area as well as in determining the choice of crops to be cultivated. As Maubin Township is situated in the southeast part of Ayeyarwady Region, it falls in the Monsoon Belt of Myanmar. It experiences slightly moderate temperature and high annual rainfall (Figure 8).

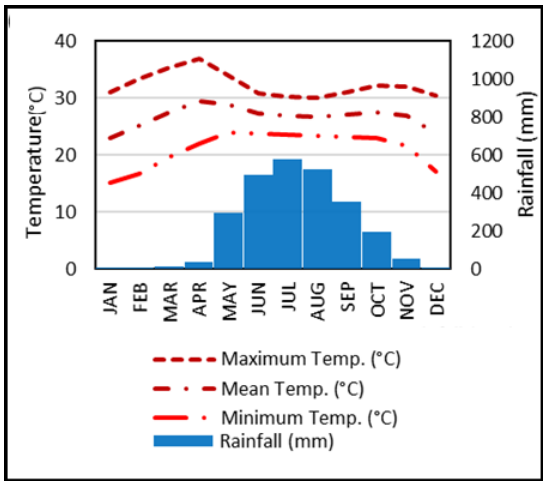


Figure (8) Climograph of Maubin Township (2007-2019)
Source: Meteorology and Hydrology Department of Yangon

Soils

Soil is one of the major controlling factors in the crop cultivation of the study area. Soil types found in the Maubin Township are Meadow Alluvial Soil, Brown Meadow Soil, Light Brown Meadow Soil, Meadow Gley Soil, Brown Meadow Slightly Gley Soil and Meadow Gley Swampy Soil. The soil of the study area is the delta region soil which is covered by meadow alluvial soil and meadow gley soil so that it is favorable to develop the summer paddy cultivation in this area. (Figure 9).

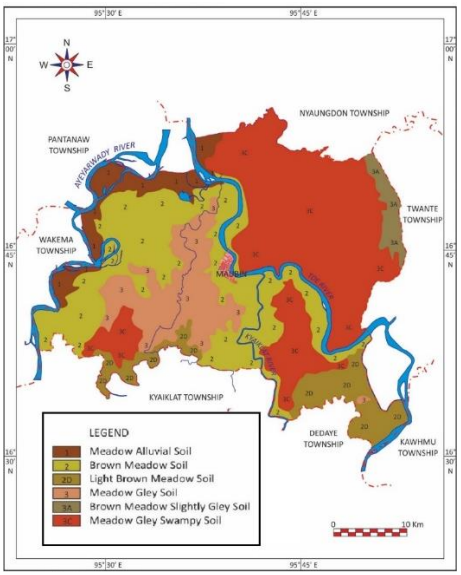


Figure (9) Soil Types of Maubin Township
Source: Land use Department, Yangon

Availability of Water Sources for Summer Paddy Cultivation

An adequate water supply is important for paddy cultivation. There are two types of irrigation water sources such as surface water sources and groundwater sources. Surface water sources are rivers, small canals, and streams. The groundwater sources are used less. The use

of water resource for summer paddy cultivation has been carried on by the irrigation works. Irrigation pumps are used to pump water from the river, stream, and small canals. Most of the summer paddy cultivated areas depend on the availability water in the study area.

Irrigation Water and Using Surface Water-Pumps

In the past, summer paddy was grown by traditional method for local self-sufficiency and for sale in the domestic markets. The practice of market-oriented economic policy, the increased availability of irrigation water and the extension of summer paddy area have changed the agricultural intensity and the cropping pattern of Maubin Township. Therefore, this paper studied the changes of summer paddy cultivation in Maubin Township from a geographical point of view. The farming practices and summer paddy cultivations are depending on the availability of water.

Most of the areas have an easy access to the water for summer paddy cultivation. The higher the availability of irrigation water, the lower the cost of irrigation and the more the summer paddy cultivations. Many streams are intertwined with high tide areas growing the most summer paddy cultivation.

Maubin Township is a very good place for summer paddy cultivation. Water is important in summer paddy cultivation. Farmers who grow a few acres of summer paddy use portable water pump machines. Farmers who grow many acres of summer paddy have high power pump machines that produce tens of thousands of gallons of water per hour. The ownership of various water pumps can be seen in Table (3) below in the village tracts of Maubin Township.

In the past, summer paddy was grown only in areas near streams and creeks. The required water was irrigated. Due to the less of technology in the use of water pumps, it took a long time to irrigate. Due to the high cost of diesel and the high irrigation cost per acre, summer paddy cultivation has not developed well. More recently, farmers have been expanding their summer paddy acreage. In the past, after the monsoon paddy was harvested, only black gram was grown. Summer paddy is increasingly being grown when water is easily available with the help of technology in areas far from streams. Therefore, the acreage of pulses has decreased, but the acreage of summer paddy has increased in the study area.

A summer paddy cultivation usually consumes between 1,100 and 1200 liters of water to produce 1kg of paddy rice (Rabbinge, 1993). Therefore, water requirement is high in the cultivation. Amount of irrigation water mainly depends on the type of soil. It is necessary to irrigate at least 4 times on sandy soils and 3 times on loamy soils. Some farmers are pumping water from private tube wells in their own cultivatable fields. Although the commanded area is not known, one tube well has the capacity to irrigate 3 to 5 acres. Usually tube wells are used four inches P.V.C pipes shown in Plate (1).

Water pump with diesel engine

Kayu Dalatcher pump
(ခရူဒလက်ချာရေပန့်)

Double *Kayu Dalatcher* Pump

Irrigated Summer Paddy Field

Plate (1) Irrigation in Summer Paddy Cultivation, Sountheik Village Tract, Maubin Township
Source: Field observation

Irrigation is carried out by pumping water from the rivers, streams and canals using the machines. Water is then sent to cultivated fields through the distributaries. According to the table, among the 76 village tracts in Maubin Township, there are 12 village tracts that own most of the water pumps. Most of summer paddy cultivators live in these village tracts. There are 13 village tracts owning 61 to 80 water pumps, 23 village tracts with 41 to 60 water pumps. There are 27 village tracts with 21 to 40 water pumps and there is one village tract where the amount of water pumps is between 0-20 seen in Figure (10).

Table 3. Using Surface Water-Pumps in Maubin Township

Sr.	Pumping Machines	Number of Village Tracts
1	0-20	1
2	21-40	27
3	41-60	23
4	61-80	13
5	81-102	12
	Total	**76**

Source: Department of Agriculture Mechanization,
Maubin Township

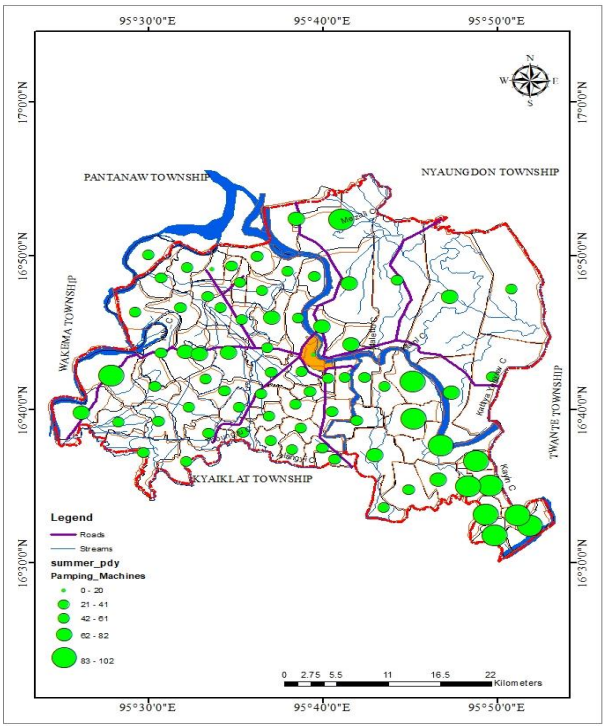


Figure (10) Distribution of Surface Water-Pumps in Maubin Township (2018-2019)

Source: Based on Table 3

Correlation between Surface Water-Pumps and Summer Paddy Cultivated Area

The relation between summer paddy cultivation and using the water pumps is also examined by using the line graphs and regression methods. In this Figure (11), lines graph shows summer paddy cultivated area (hectares) of ten village tracts and water pumps are related. During the ten-year period of 2007-2008 to 2018- 2019, the summer paddy cultivation prevailed among the studied years. The equation y= 0.0433, x=30.026, the determinant R^2==0.5058 and the correlation coefficient r=+0.736, and the regression line clearly shows that there is a high degree of positive correlation between using water pumps and summer paddy cultivation.

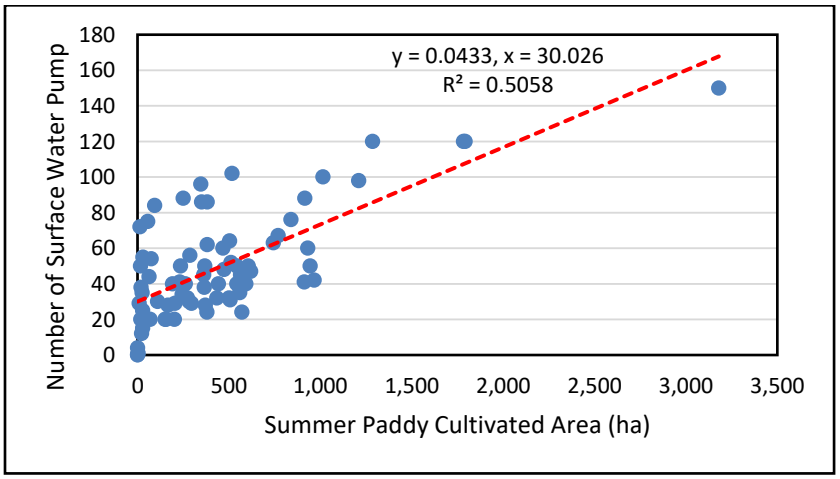


Figure (11) Correlation between using the surface water-pumps and summer paddy cultivated area

Source: Department of Agriculture Mechanization, Maubin Township

Water deficiency condition in summer paddy cultivation

In the region, water is an important input to the agricultural production systems. In most townships of the region, water irrigation has a long history which is closely linked to the history of rice cultivation.

Nearly half of the northeastern part of the township is covered with inundated areas. Most of the lakes and ponds are found in this part. The most prominent lake, Maletto is located at the northeastern part of the township. A large number of rivers, streams, and small creeks, the inundated areas as well as flat lowlands favor the good opportunity for the development of various crop cultivations in Maubin Township.

The numerous streams and canals are supporting summer paddy cultivations. As long as summer paddy cultivated areas are being increased, irrigation water will be more necessary for cultivated areas. In recent years, some farmers have faced the water deficiency during season of the summer paddy. The water level of streams becomes low in summer period. It is not sufficient for summer paddy cultivations seen in Plate (2).

Low water level of the stream

Lack of water in the stream

Dry soil in the field

Insufficient water for Paddy

Plate (2) Water deficiency conditions in Wadaw and Taloaklat-Ashe village tracts
Source: Field observation

The water irrigation is necessary for cultivation of Hybrid rice varieties. The preparation of soil is also needed to irrigate the water. Irrigation is applied one week later after broadcasting seeds. If sufficient water cannot be supplied to the summer paddy plants, it will reduce the quality of paddy and then productivity.

CONCLUSION

Topographically, Maubin Township lies on low land and existing drainage conditions support irrigation water for summer paddy cultivation. The temperature and rainfall are favorable for paddy cultivation. Most areas are covered with meadow soils which are favorable for paddy cultivation. But water pumps are necessary for irrigation of summer paddy cultivated areas.

There is the relationship between irrigation and soil salinization. So systematic management and efficient use of irrigated water should be promoted to maintain soils quality. Authorities concerned should renovate irrigation canals, hire agriculture machineries, irrigation machines and other tractors at a reasonable price, and loan support to farmers when they are in need. Moreover, market and price which are major items affecting incomes from paddy cultivations.

The summer paddy cultivated lands are found as a gradual increase of its area under irrigation to intensify the summer paddy production. The irrigated area has increased substantially from 2007-2008 to 2018-2019. Depending on the level of field, the availability of water can vary across the whole township. Among the different irrigation systems, the traditional flood irrigation system is the main irrigation technique, used predominantly in summer paddy cultivation. Owing to the irrigation water, farmers are able to practice double/ triple cropping in these areas.

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