

The Role of Water Resources Development in Paddy Cultivation of Mandalay, Pyin Oo Lwin and Kyaukse Districts, Mandalay Division

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Abstract

Paddy has cultivated in Central Myanmar by means of irrigation since the period of ancient Myanmar Kings. Agriculture sector of Myanmar has changed in various aspects since practicing of market oriented economy after 1988. Developments of water resources were reflecting in expansion and intensification of paddy lands as a distinguished spatial change. In addition, introduction of modern farm inputs and liberalization of paddy marketing are major contributors of recent agriculture sector development. Of these changes, this paper tried to analyze the role of water resource development in paddy cultivation from the case study of three districts located in northern part of Mandalay Division with following questions. (1) How does source of water used in paddy cultivation change during last 15 years and how do these changes differ among the townships located in the study area? (2) How do newly developed water sources effect on the paddy cultivation? (3) Do different water sources effect on the paddy yield? Data used in this study were derived from the Myanma Agriculture Service of Mandalay Division. Simple statistical analysis methods were conducted by using data derived at township level to be able to answers above questions. It is found that irrigated water derived from old dams and rain water and river water were mainly used for paddy cultivation until the early 1990s. However, water derived from new dams, river pumping stations, and tube wells was played an important role in the expansion and intensification of paddy lands during last decade. The ways of water resources development spatially differ based on the geographical background within the study area. Since irrigation could control the water requirement of paddy, the yield per acre is quite differ among different mode of water resources using in paddy cultivation.

Key words: Water resources development, paddy cultivation, Mandalay Division

Introduction

Agriculture sector is a backbone of Myanmar economy and occupied 40.2% of GDP, 12.4% of total export earning, and 61% of total labour force in 2005-06 (MOAI 2007). Agriculture policies were changed with the practicing of market oriented economy after 1988. New

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agriculture policies adopted in 1992-93 were based on three points: (1) to allow freedom of choice in agriculture production, (2) to expand agricultural land and to safeguard the right of farmers, and (3) to encourage the participation of private sector in the commercial production of seasonal and perennial crops, and distribution of farm machines and other farm inputs. Accordingly, five strategies were implemented for the development of agriculture sector. These strategies are (1) development of new agriculture land, (2) provision of sufficient irrigation water, (3) provision and support for agricultural mechanization, (4) application of modern agro-technologies and, (5) development and utilization of modern varieties (MOAI, 2003). The results of these efforts were revealing in the statistics of agriculture land expansion and intensifications. Although there was 21,533,000 acres of net sown area in 1992-93, it increased to 28,206,000 acres in 2004-05. In addition, intensification indices (Gross area sown/Net sown area \times 100) increased from 126.3% in 1992-03 to 152.71% in 2004-05 (CSO, 2006).

Research question

This paper tried to analyze the role of water resource development in paddy cultivation from the case study of three districts located in northern part of Mandalay Division with following questions. (1) How does source of water used in paddy cultivation change during last 15 years and how do these changes differ among the townships located in the study area? (2) How do newly developed water sources effect on the paddy cultivation? (3) Do different water sources effect on the paddy yield?

Data and Methods

Data related to area of paddy cultivation and paddy yields by type of water sources during 1992-93 and 2006-07 were derived from Myanma Agriculture Service of Mandalay Division. Location of dams and river pumping sites were derived from topographic maps printed from Forest Department and Water Resources Utilization Department. Simple descriptive statistical methods were used to analyze the relationships between paddy cultivation and water resource development.

Geographical Background of Study Area

Study area of Pyin Oo Lwin District (Madaya, Singu, Pyin Oo Lwin, Mogoke, Thabeikkyin, Tagaung Townships), Mandalay District (Mandalay City, Amarapura and Patheingyi Townships) and Kyaukse District (Kyaukse, Singaing, Myittha, Tada_u Townships) are located in northern part of Mandalay Division.

Eastern part of study area is occupied by a part of Shan Plateau with elevation range from 300 feet to 3000 feet. Western part of study area is bounded by Ayeyawady River and elongated flat plain with an elevation less than 150 feet lies between the river and eastern plateau. Doktawadi (Myintnge) River, Zawgyi River, Chaungmagyi Chaung (Creek) and Panlaung River take their sources in the eastern highland and flow into the Ayeyawady River. With the construction of dams and river pumping stations, these rivers are contributing to the development of agriculture in the area (Fig. 1A).

Average annual rainfall of Mandalay is 915 mm (1961-1990) and received in double-maximum form with peaks in May and October (FAO, 2005). Amount and type of water sources available for paddy cultivation varied with distribution of rainfall and its physical features such as topography and drainage pattern.

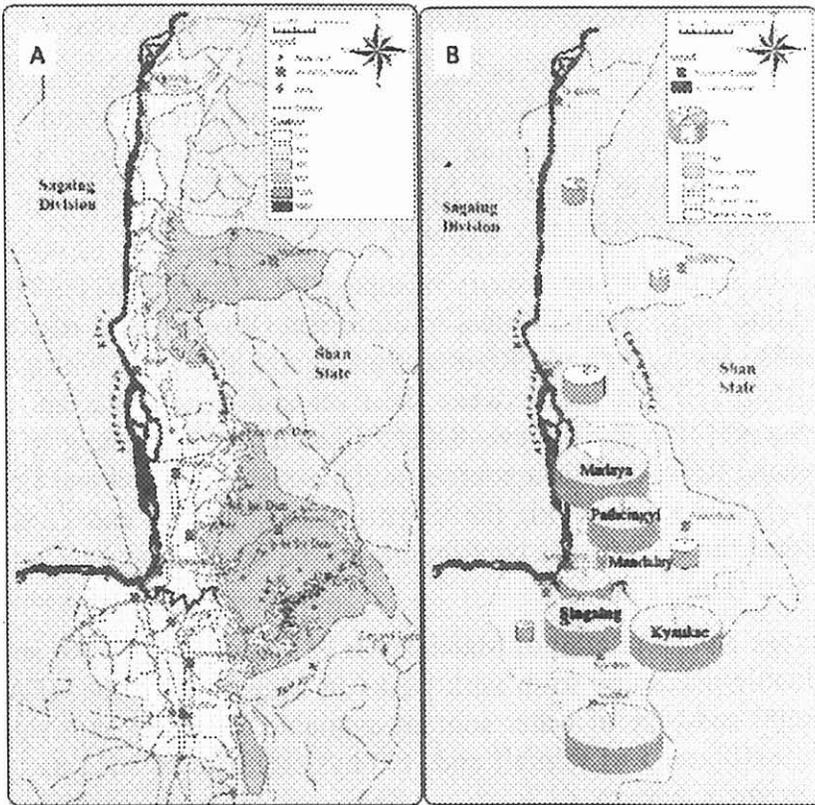


Figure (1A) Location and topography of study area

(Source: Department of Geography, Yangon University)

Figure (1B) Different sources of water in paddy cultivation

(Source: Based on data derived from Myanmar Agriculture Service of Mandalay Division)

Development of Water Sources

Summer cultivation program (land intensification) was introduced in Myanmar in 1992 (MOAI, 2003). Since then, the summer paddy cultivated area gradually increased with the construction and exploitation of new water sources such as dams, tube wells, river pumping stations, etc. Figure (2) shows the source of water used for paddy cultivation in study area in 1992-93 and 2006-07. In 1992-93, water derived from dams, natural rain and flooding river water (later it will refer as rain-feed) were used for paddy cultivation. The area of paddy cultivation increased from 324365 acres in 1992-93 to 476763 acres in 2006-07. However, the

percentage share of dam water decreased from 87% in 1992-93 to 85% in 2006-07. Construction of new dams, river pumping stations, temporary dams, and tube wells are newly emerged water sources for the development of paddy cultivation.

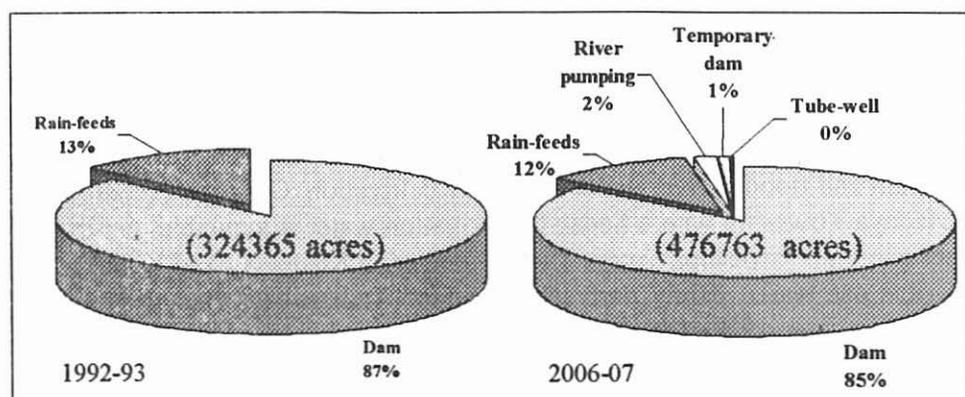


Figure (2) Different water source and their contribution for paddy cultivation area

Source: Data derived from Myanmar Agriculture Service of Mandalay Division.

The role of large dams in the paddy cultivation was shown in Fig. (3). There are 7 major dams supplying agriculture water in the study area. Sedawgyi Dam was constructed as one of the canals and tanks construction projects completed during 1974 and 1987 (Hla Tun Aung, 2003) and became a major contributor for the development of paddy cultivation. Zawgyi and Kinda Dams opened in 1997 and 1991, respectively, were also major contributors of water for paddy cultivation. Thit tet kon Dam was opened in 2001 (Department of Geography, 2002). Pyukan and Chaung manet Dams were completed only after 2003-04. In addition, Yenyar Oo Dam has been contributing paddy cultivation of Thabeikkyin Township since 2006-07. Their contribution areas, however, are relatively small. Contributions of private dams are found in Pyin Oo Lwin, Mogoke and Tagaung Townships. All townships except Mandalay City and Amarapura Township used rain-feed water for paddy cultivation.

There are two types of river pumping stations based on their energy sources: diesel and electric power. River pumping stations were mainly

constructed along the Ayeyarwady River and tributaries of Myintnge (Doktawadi), Zawgyi and Panlaung Rivers. There are 17 river pumping stations (10 diesel and 7 electric power) contributing 8,106 acres (4,458 acres of monsoon paddy and 3,648 acres of summer paddy) of paddy cultivation in the study area in 2006-07. All river pumping water are used for paddy cultivation in Amarapu, Patheingyi, Singaing and Tada-u Townships. Artesian wells are mainly used in Singu and Thabeikkyin Townships.

Different source of water and their amount using in each township was shown in Fig. 1B. Townships located in Pyin Oo Lwin District mainly used rain and flooded river water for paddy cultivation. Only the exception is Madaya Township where Sedawgyi irrigation water is available. On the other hand, all townships except Tada-u located in Mandalay and Kyaukse Districts use water mainly derived from dam. Tada-u used rain water as one major water source for paddy cultivation.

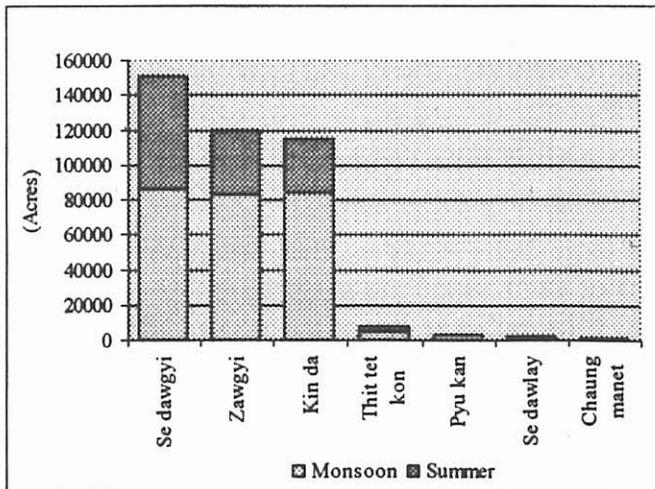


Figure (3) Role of large dams in paddy cultivation of study area (2006-07)

Source: Myanma Agriculture Service of Mandalay Division.

Development of Paddy Cultivation Areas

With the construction of new water sources paddy cultivation was developed in two ways: paddy land expansion and intensification. Table

(1) shows these developments. There was 199,002 acres of paddy land in 1992-93 in study area. But it increased by 127,803 acres (1.64 times) in 2006-07. In addition, land intensification increased from 141% (total paddy area/monsoon paddy area \times 100) in 1992-03 to 149% in 2006-07.

Table (1) Change of paddy growing areas in study area

	1992-93			2006-07		
	Monsoon	Summer	Total	Monsoon	Summer	Total
Mandalay Dist.	42573	21115	63688	45465	35517	80982
Pyin Oo Lwin Dist.	35725	29322	65047	91795	49103	140898
Kyaukse Dist.	120704	31993	152697	189545	74906	264451
Total	199002	82430	281432	326805	159526	486331

Source: Myanmar Agriculture Service of Mandalay Division.

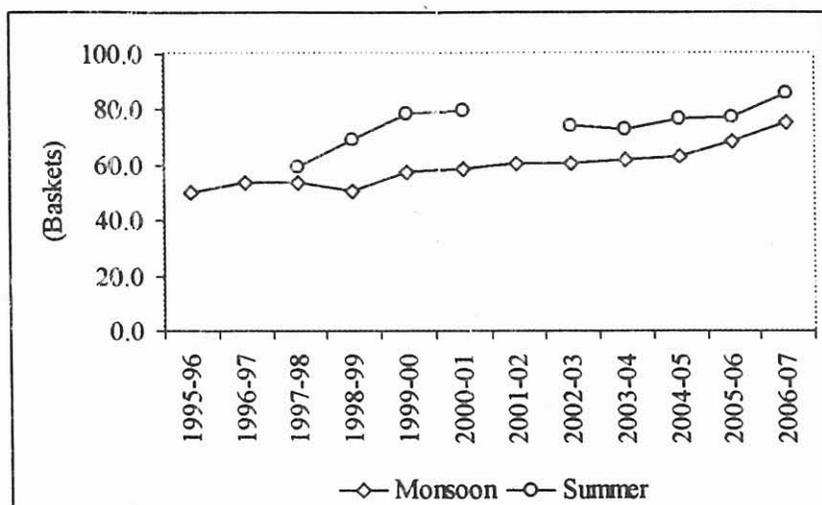


Figure (4) Increasing paddy yield in study area

Source: Myanmar Agriculture Service of Mandalay Division.

In addition to above agriculture land expansion and intensifications, yield per care of paddy increased due to adding of more farm inputs such as using high yield varieties, pesticides, fertilizers and improvement of farming methods. Figure (4) shows the increasing yield of paddy in study area. Although average monsoon paddy yield was 50.03 baskets per acres in 1995-06 it increased to 75.6 baskets in 2006-07. Summer paddy yield also increased from 59 baskets in 1997-98 to 86.1

baskets in 2006-07. It is no doubt, that agriculture land intensification and expansion greatly boosted the total production of paddy in the area.

Different Yield with Different Source of Water

There are many water source developed during last 15 years and they have different contributions to the paddy production. To understand these variations, calculations were conducted in two steps. First step is aerial generalization. It was calculated by averaging amounts of yield per acre recorded by same type of water sources (e.g. dam) in the same year of different townships. Then, average amount of yield for different type of water source was derived for one year. After calculating for 12 years between 1995-06 and 2006-07, average and standard deviation values were calculated again to get the representative value of yield for each type of water source.

Table (2) Different yield per acre with different water source

	Monsoon (basket)			Summer (basket)		
	Yield/Acre	STDEV	N	Yield/Acre	STDEV	N
Dam	74	7.63	12	84	8.76	9
River pumping	66	10.27	12	82	4.49	6
Tube- well	64	8.28	12	71	8.41	9
Temporary-dam	55	6.21	10	65	5.51	5
Rain & Flooded river water	47	6.94	12	73	8.22	9

Note: It is calculated base on two steps. First, averaging yield per acre of all townships using same water source. Then, average and standard deviation are calculated for years mentioned as N.

Source: Based on data derived from Myanma Agriculture Service of Mandalay Division.

The results are shown in table (2). In case of monsoon paddy water derived from dam produced highest yield per acre of paddy and follow by river pumping, tube well, temporary dam and rain and flooded river water sequentially. Dam water and river pumping produced highest and second highest yield per acre of paddy in case of summer paddy. However, differ

from monsoon paddy rain-feed and flooded river water produced higher yield per acre than tube-well and temporary dams.

Conclusions

In earlier section of this paper we posted three major questions to be answered with this study. The first question is "How does source of water used in paddy cultivation change during last 15 years and how do these changes differ among the townships located in the study area?" It is clear that the types of water source have changed during last 15 years and many new dams, river pumping stations, and tube-well were introduced in the study area (Fig. 2 and 3). Their spatial contributions, however, differ based on the geographical features (Fig. 1A). Townships located in Pyin Oo Lwin Districts mainly used rain and flooded river water for paddy cultivation. Only the exception is Madaya Township where Sedawgyi irrigation water is available. On the other hand, all townships except Tada-u located in Mandalay and Kyaukse Districts use irrigation water mainly derived from dams. Tada-u used rain water as one major water source for paddy cultivation.

The second question is related to the effect of newly constructed water sources on paddy cultivation. From table (1) it could conclude that paddy cultivation is changed in two dimensions (expansion and intensification) with the development of new water sources. As an expansion dimension, the area of paddy cultivation increased nearly 1.64 times during 1992-93 and 2006-07. In intensification dimension, it increased from 141% (total paddy area/monsoon paddy area \times 100) in 1992-03 to 149% in 2006-07.

The third question is related to the relationship between water sources and paddy yield. From table (2), it becomes clear that, there are variations among the type of water sources and even between the monsoon and summer paddies. There should be based on the nature of water and nature of newly developed land and difference in farm input. The exact reason, however, is beyond the scope of this paper and need further detail field observations.

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