Economic and Technology Management Review, Vol. 10a(2015): 21 – 29

Water management in the paddy area in MADA

(Pengurusan saliran air di kawasan padi di MADA)

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Keywords: water management, drainage and irrigation, paddy production, MADA

Abstract

Water management is an important element in the paddy production. Water management can increase the productivity level, thereby increase the income of farmers. Water management system in MADA is divided into irrigation and drainage. The water storage under irrigation system covers three dams, namely Pedu, Ahning and Muda reservoir. This study examined the weaknesses of irrigation and drainage system in the MADA area. Among the problems are infrastructure density, very tiny road and the distance from the irrigation to the drains. Besides, water control in these areas is insufficient due to high and low paddy field areas. Therefore, several measures were identified to increase the efficiency of water management. Among them are implementation of reticulation system for irrigation and drainage, utilisation of booster and mobile pumps, construction of bunds and good farm practices. Apart from the modernised machines, good water management should be practised by paddy farmers to ensure the efficient use of water.

Introduction

Muda Agricultural Development Authority (MADA) is an organisation that assists in the development of the agriculture sector in Malaysia. Water management in MADA is important to increase paddy yield and farmer's income.

MADA plays a big role in the development of the rice sector through strengthening and enhancing paddy productivity level. From 1955 to the immediate post-independence years, a self-sufficient policy in rice has been adopted by the government. In accordance with the policy, Muda irrigation project was launched under the MP1 (1966 – 1970). The project was funded by a World Bank loan of USD45 million (MADA 2012). The Muda Irrigation Scheme covers an area of 126,155 ha. Meanwhile, the land under the paddy cultivation covers an approximate area of 96,558 ha.

Inventory of physical infrastructure in the MADA area includes irrigation system (dams and canals), drainage system, road network system, pumping and buildings for office and quarters (*Table 1*). The operating costs for drainage and irrigation systems include culvert cleaning, waste sludge and hydrology. On the other hand, the maintenance costs cover the cost of building services, maintenance of office buildings, workers' quarters, farm road, irrigation and drainage structures, and concrete canals.

The efficiency of water management in paddy production is very important to provide adequate water supplies in the paddy field. Therefore, the main purpose of this study was to examine the weaknesses of irrigation and drainage system in the

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Table 1. Inventory of physical infrastructure in MADA

Physical infrastructure	Items	Amount
Irrigation system	Dams and ponds	3
	Main canal	146 km
	Secondary canals	930 km
	Tertiary canals	740 km
Drainage system	Major drainage	240 km
	Secondary drains	883 km
	Tertiary drains	576.63 km
Road network system	Secondary farm road	802 km
	Tertiary farm road	844.36 km
Structures, pumping stations and others	Main control structure	378
	Secondary control structure	1,182
	Tertiary control structure	2,948
	Bridge street	33
	Path of farm machinery (various)	1,010
	Pump station (booster and recycled pumps)	143
	Hydrological stations	140
	Stone wall for beach protection	25 km
Building	Office complex	38
	Quarters (class H to class C)	353

Source: MADA (2012b)

MADA area. Besides, several measures have been identified to increase efficiency water management in the paddy area in MADA. This study used the depth-interview method with officer in irrigation and drainage department in MADA and the survey of the irrigation and dam. In addition, secondary data from MADA's library and report from water management department were also included.

Irrigation system

The water source for irrigation in the MADA area comprised dam discharge (32%), rain (52%), river flow (10%) and recycled water (6%). The water storage system covers three water storage dams as shown in *Table 2*.

The total storage capacity for the three dams is 1,509 million m^3. Since the Muda reservoir has a large catchment area (984 km^2) but a low storage capacity of 154 million m^3, water from the Muda reservoir is transferred to the Pedu reservoir, which has a higher storage capacity of 1,080 million m^3, via the 6.8 km long Saiong tunnel for storage and release.

In 2011, the release of water from Pedu and Ahning reservoir accounted to 1,322.15 x 106 m^3 (1,071,881 ac-ft) *(Table 3)*. Of this amount, a total of 1,110.21 x 106 m^3 (900.058 ac-ft) was channelled for paddy cultivation activities twice a year in the programme while 211.94 x 106 m^3 (171.823 ac-ft) was used for domestic and industrial needs. The speed of water discharge by Pedu reservoir is 1,000 ft^3/s (minimum) or 3,000 ft^3/s (average) per day, and the amount could reach up to 5,000 ft^3/s a day. A one second discharge of water could meet the needs of 1,000 plots of paddy fields. Compared to Pedu lake, the Muda lake does not discharge water directly into the rice fields. Instead, it supplies water to the Pedu reservoir through Saiong tunnel. Pedu lake is a reservoir for the Pedu dam with acreage of 25 mi^2. Pedu lake reservoir is 65 miles in width, whereas, the level of the lake reservoir spillway elevation is 320 ft.

Table 2. Reservoir capacity in MADA

Reservoir	Reservoir area (km^2)	Catchment area (km^2)	Maximum reservoir storage		Water supply capacity	
			x 10^6 m^3	x 10^3 ac-ft.	m^3/s	Q
Muda	16	984	154	125	45	1600
Pedu	52	171	1080	875	142	5000
Ahning	12	122	275	223	12	400
Total	80	1277	1509	1223	199	7000

Source: MADA (2012b)

Table 3. Total water discharge (acre feet) at the dam MADA (2012)

Dam	Pedu	Ahning	Muda	Total
January	13,851	16,500	0	30,351
February	17,306	15,785	0	33,091
March	0	1,579	0	1,579
April	15,603	1,661	0	17,264
May	70,620	1,091	0	71,711
June	184,169	9,405	0	193,574
July	63,769	1,686	0	65,455
August	69,599	1,603	0	71,202
September	10,843	0	0	10,843
October	30,893	0	0	30,893
November	39,632	314	0	39,946
December	61,430	0	0	61,430
Total	577,715	49,624	0	627,339

Source: MADA (2012d)

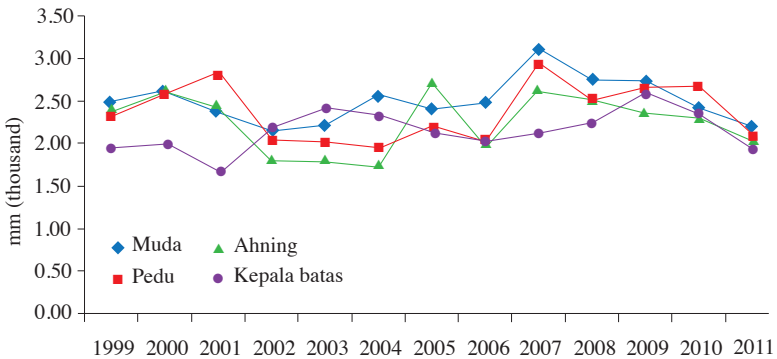
Based on *Table 4*, the release of water for paddy fields is periodically in accordance with the paddy planting season (1 season = 3 months of discharge). The last day of water release for season 1/2012 was on 18 September 2012, while the water release for season 2/2012 starts on 3 October 2012. Maintenance expenses for these paddy fields could reach RM0.5 million per year and the life expectancy of the dam is 100 years. Among the issues and challenges faced by the engineers of Pedu reservoir is the lack of technology designs and advancements. This creates another problem such as the non-existence of a communication system in the structure of the dam and no immediate access to repair any damage below the dam. MADA has to rely on private workshops with high fees and exports specialised consultants from abroad for maintenance purpose of the machineries used.

Control of the water discharge also depends on the rainfall rate, where the dam will be closed during heavy rain (*Figure 1*). During the dry season or when there is less rain, the dam will increase the water discharge for planting seeds purposes. Muda's dam in average receives the highest rainfall from 1992 to 2011 amounting to 2,483 mm followed by Pedu (2,396.8 mm), Ahning (2,132.2 mm) and Kepala Batas (2,066.5 mm). Climate change results in high intensity of rainfall (100 – 200 mm or more) in 1 – 3 days period on river catchment area which flows to Muda area. The impact of flood in Muda area

Table 4. Planting schedule and water supply in MADA (2012)

Phase	Planted area (ha)	Season I/2012			Season II/2012		
		Start date for seeding	Deadline for seeding	Date to stop water supply	Start date for seeding	Deadline for seeding	Date to stop water supply
I	32,166	15.4.2012	19.5.2012	11.8.2012	12.9.2012	10.10.2012	15.1.2013
II	36,553	29.4.2012	2.6.2012	25.8.2012	26.9.2012	24.10.2012	29.1.2013
III	27,839	13.5.2012	16.6.2012	8.9.2012	10.10.2012	7.11.2012	12.2.2013

Source: MADA (2012d)



Source: MADA (2012d)

Figure 1. Rainfall in MADA (1999 – 2011)

included infrastructure and paddy damage, reduction of farmer's income and liability to government.

Natural disasters-floods

The MADA area flooding is a common phenomenon and over the years, happens every year. This has been particularly damaging rice crops and property to the detriment of farmers' lives. Compassionate incentives by MADA were channelled to farmers every time there is a flood to alleviate the burden of the farmers.

Throughout 2010, a total of three floods occurred in the MADA area during the month of June, September and November (*Table 5*). Factor due to the occurrence of floods is heavy, extensive and prolonged rainfall. To help alleviate burden of the farmers, the federal government has approved the compassionate incentives of RM60.566 million on 3 December 2010. Total incentives include replanting (RM43.702 million), production of paddy seeds (RM7.210 million) and infrastructure improvements (RM9.654 million).

Drainage system

The implementation of drainage water recycle in the Muda area has been undertaken by MADA in 1983 as an innovative project to introduce the fourth water source for irrigation. Since 1984, the recycling pump capacity is 1998 ft^3/s, for which it is built in 78 recycling stations. All the recycling pumps contribute 17% of the water released from the reservoirs. The annual average pumping volume (2000 – 2009) of 178 million m^3 (144,180 ac-ft) is equivalent to 1.15 times the full reservoir storage of Muda's dam. The volume of recycled water from drainage in *Figure 2* shows fluctuating pattern between 1992 and 2008. In 1997, recycled water reaches its highest volume at 279 $x10^6$ cubic meters. However, it

Table 5. Paddy acreage flooded and damaged (ha), incentives (RM) in MADA (2012)

Period	June (season 1/2010)	September (season 1/2010)	November (season 1/2010)	November (season 2/2010)	Total
Submerged area (ha)	2,474	462	34,488		37,488
Damage area (ha)	1,075	364	129	25,359	26,927
Estimated value for loss revenue (RM)	5,719,657	1,936,293	685,141	130,936,616	139,277,707
No. of farmers involved	905	391	120	15,201	16,617
Types of incentives	Replanting	Living cost	Living cost	Living cost	
Total cash money (RM)	941,683	655,051	231,784	22,024,765	23,853,283
Rate of incentives (RM/ha)	876	1,800	1,800	876	5,352

Source: MOA (2010)

Source: MADA (2012b)

Figure 2. The volume of recycling water from drainage in MADA (1992 – 2008)

falls sharply in 1999 and shows the lowest level of recycled water consumption of 26 x10^6 cubic meters in 2000.

Weakness in the irrigation and drainage system

Among the problems faced by the irrigation and drainage system in MADA are infrastructure density and very tiny road with an average of 18 m/ha (*Table 6*) compared to other granary areas and other countries such as Taiwan (50 m/ha) and Japan (100 m/ha). The distance from the irrigation site to the drains is about 1 – 2 km and it could take up to 30 days to fill all the rice growing areas. Besides, water control in these areas is insufficient due to high and low paddy field areas.

Management of water in the paddy field

To facilitate the farmers to obtain an adequate water supply for paddy production twice a year, MADA has implemented a system called the reticulation system, pumps (booster and recycling), mobile pump, constructing bunds and good farm practices.

Reticulation system

Reticulation for irrigation includes the *pelubang* (excavator) regulator, primary

Table 6. Comparison of density between MADA and other granaries

Granary area		Density
MADA	Muda II (38%)	30 m/ha (average 18 m/ha)
	Non Muda II (62%)	11 m/ha
KADA		24 m/ha
IADA KSM		31 m/ha
IADA Kemasin Semerak		33 m/ha
IADA Seb. Perak		36 m/ha
IADA P. Pinang		39 m/ha
IADA BLS		43 m/ha
IADA KETARA		48 m/ha

Source: MADA (2012c)

canals, secondary canals/farm roads and tertiary canals or farm roads. Whereas the reticulation for drainage includes tidal control barrage, primary drains, secondary drains and tertiary drains or farm roads.

The operation and the maintenance of Pedu, Muda and Ahning dams are under the supervision of Division of Management and Water Resources. Through reticulation system, the water is released from Pedu to Ahning reservoirs and flows through Sungai Pedu/Sungai Padang Terap (*Table 7*). There are several streams along the Sungai Padang Sanai/Sungai Padang Terap. Among the largest streams are the ones at the Sungai Padang Sanai and Sungai Naka.

Figure 3 shows the flow of water in the reticulation system for the entire irrigation system in the Muda area. Water from Pedu takes, on average, 19 hours to get to alator pit where the water is then channelled to two different directions: the North Channel and the Middle Channel. If there is an excess stream, the water will be collected in the head pond in alator upstream pit. Water flowing into the main channel is maintained at desired level by 17 alators in certain places. The amount of water flowing downstream canal is controlled by this alator. For example, the water from the North pit will be drained directly to the alator in Arauvia, Jitra and Lana Bulu. Between alator pit (North) and alator Jitra, the water will be distributed to secondary reticulation system, which takes off from Jitra and channelled to control point A (Telaga Batu) until the control point C (Kubang Sepat).

Booster and recycling pumps

Secondly, the pump usage in the MADA area consists of two types of pumps, namely booster and recycling pumps (*Table 8*). Booster pumps refer to the irrigation system from one canal to another one for higher planting area. Meanwhile, recycling pumps refer to the irrigation system which channels the water from the canal to the drain.

Booster pumps in the MADA area total up to 76 units as compared to 176 units of recycling pumps. Flow rate for each pump is 10 ft^3/s (Q) and each has an operating period of 4 months (times 24 hours/day). Total capacity of water needed is based on the lower benchmark, where higher benchmark indicates higher water capacity needed.

Mobile pumps

Based on *Table 9*, the total number of mobile pumps at the MADA area is 784 units, in which province II records the highest users of mobile pumps by farmers (271 pumps). Mobile pumps are given free of charge to farmers together with diesel allocation for each season.

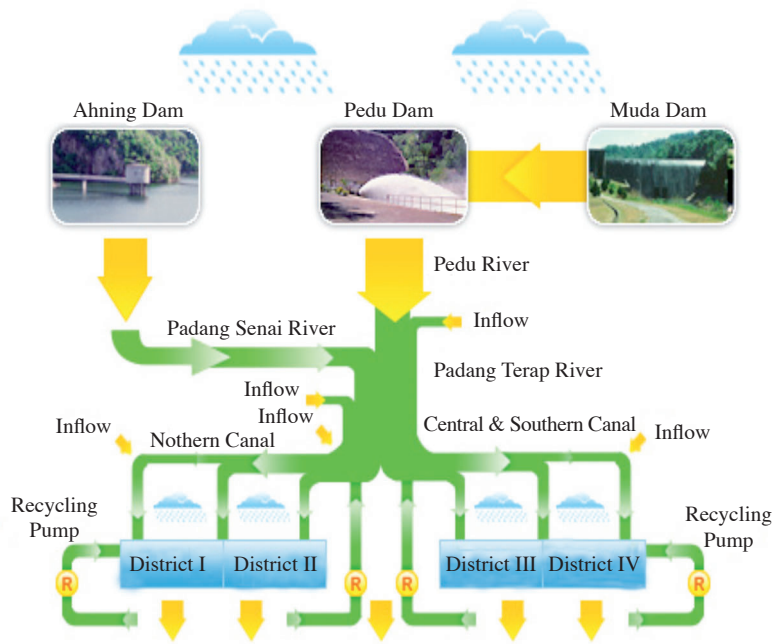
Constructing bunds

Management of water in the paddy field is done by constructing bunds that are well compacted and sealed from cracks, rat

Table 7. Rivers that supply water to paddy plantation in MADA

River	Water level (m)	Danger level (m)	Flow (Q)
Sg. Padang Sanai	29.61	36.00	30
Sg. Padang Terap	12.86	17.07	890
Sg. Bata	5.79	9.14	30
Sg. Arau	4.96	7.00	30

Source: MADA (2012d)



Source: MADA (2012b)

Figure 3. Schematic of irrigation water sources and distribution in MADA

holes and others. Farmers will build stout bunds and manage the spillways. This will minimise water loss through seepage. The depth of water stored in a paddy plot is controlled properly by adjusting the spillway height. The recommended spillway height is 5 cm and should be maintained at such level during rainy seasons to ensure sufficient storage capacity of the paddy plots. However, when irrigating the field during rainless days, the depth of water applied must be shallow (1 cm or less) to provide free board for the storage of rainwater.

Farm practices

Apart from the modernised machines, good water management should be practised by farmers in the paddy field to ensure the efficient use of water. Planting schedule is set to help farmers irrigate their fields in accordance with the scheduled water release by MADA. The announcement of date for water release is done in mosques, *surau*, *Pertubuhan Peladang Kawasan* (PPK) and MADA offices. Any delay to the schedule set by MADA will cause dry paddy land due to the lack of water or the soil will become wet because of the stagnant water. This will eventually reduce the level of yield

Table 8. Number of pumps in MADA (2013)

Types	No. of stations	No. of pumps	Total capacity (Q)
Booster pump	41	76	898
Recycling pump	88	176	2,200
Total	129	252	3,098

Source: MADA (2012d)

Table 9. Mobile pump in MADA (2013)

Province	Pump 4" dia.	Pump 6" dia.	Total
Province I	106	41	147
Province II	207	64	271
Province III	117	50	167
Province IV	157	42	199
MADA	587	197	784

Source: MADA (2012d)

produced. In addition, tolerance among the farmers in the area of cultivation is also important. A problem that often occurs is when the passage of water from the dam does not get to the other farmers' fields, especially in the lowland area because of farmers in the highland area do not open the waterways to the next plots. Communication among farmers is very important to prevent such issues from continuing in the future.

Conclusion

Water management is one of the important elements in paddy production. Water management could increase the productivity level, thereby increase the income of farmers. Based on the above discussion, there are four methods that can be used by MADA to improve management of water including reticulation system, booster and recycling pumps, mobile pumps and constructing bunds. In addition, farmers themselves also play an important role in ensuring the efficiency of water management under the supervision of MADA. Among the actions could be taken by farmers are to ensure the planting schedule is in parallel with the water release scheduled by MADA, cooperate and tolerate with other farmers and frequently communicate with MADA's officers.

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Abstrak

Pengurusan air merupakan elemen penting dalam pengeluaran padi. Pengurusan air boleh meningkatkan tahap produktiviti, seterusnya meningkatkan pendapatan petani. Sistem pengurusan air MADA terbahagi kepada pengairan dan saliran. Penyimpanan air di bawah sistem pengairan meliputi tiga empangan air iaitu takungan Pedu, Ahning dan Muda. Kajian ini melihat kepada kelemahan sistem pengairan dan saliran di kawasan MADA. Antara masalah yang dihadapi ialah kepadatan infrastruktur dan jalan raya yang sangat kecil serta jarak dari pengairan dan longkang. Selain itu, kawalan air tidak mencukupi disebabkan oleh kawasan sawah padi yang tinggi dan rendah. Oleh itu beberapa langkah telah dikenal pasti bagi meningkatkan kecekapan pengurusan air. Antaranya ialah pelaksanaan sistem retikulasi untuk pengairan dan saliran, penggunaan pam 'booster' dan pam mudah alih, membina benteng dan amalan ladang yang baik. Selain mesin moden, pengurusan air yang baik perlu diamalkan oleh petani di sawah untuk memastikan kecekapan penggunaan air.