

ACTION RESEARCH AS AN EMPOWERMENT TOOL FOR SUPPORTING FWUA IN IMPLEMENTING EFFECTIVE IRRIGATION WATER MANAGEMENT

Case Study at FWUA Sirannuang in Bili-Bili Irrigation System

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Introduction

The Bili-Bili Dam, which completed construction in 1999, has the capacity to store 375 million m³ of water. Although the primary objectives of the dam are flood control and clean water supply for Makassar urban area and its surrounding environs, the dam also proves capable of providing irrigation for 25,472.16 ha of rice fields (Rampisela, 2011).

The Bili-Bili Irrigation System is supplied by the Bili-Bili Dam. Based on most recent identification efforts by Rampisela (2011), collection of water is accommodated by three intake weirs, namely the Bili-Bili Weir, serving 2,443.50 ha of rice fields; the Bissua Weir, serving 14,074.76 ha of rice fields; and the Kampili Weir, serving 8,973.90 ha of rice fields.

The Kampili Primary Canal distributes water into thirty secondary canals. Watergates located along the secondary canals in turn distribute water into tertiary canals. All farmers whose cultivation plots are served by the same tertiary canal fall under a WUA. All WUAs served by the same secondary canal fall under a FWUA. If the secondary canal happens to be too short in length, then its FWUA may be merged with other adjacent secondary canals forming a single FWUA comprised of multiple secondary canals. Kampili Irrigation Area, for example, is comprised of 11 FWUAs and 135 WUAs.

According to the project design of Bili-Bili Dam construction, the volume of water available for irrigation should suffice a two rice plantings and one alternative crop planting annually (alternative crop planting estimation at 40% of rice fields' size). However, currently, upon first dry season planting schedule (May-August), some fields remains unirrigated. Hopefully, improved water distribution management will ensure a more reliable supply to each cultivation plot. According to Governmental Regulation no...., WUA is responsible for proper distribution management of water at the local level.

One of the FWUAs located at the lowest downstream area from Kampili Primary Canal is the FWUA Sirannuang, which is comprised of two secondary canals, Majannang and Pammase. Majannang Secondary Canal serves 11 WUAs and Pammase serves 7 WUAs, bringing the total of to 18 WUAs in FWUA Sirannuang.

Materials and Methods

Time and location

Empowerment activities took place from 2008 through 2011 and followed by support activities in years 2011-2013. Empowerment activities were implemented in the Gowa District, Bajeng Subdistrict and West Bajeng Subdistrict, comprising eight villages.

Target group : FWUA Sirannuang (including 18 WUAs)

FWUA Sirannuang is selected as the target group, since its plots often experience irrigation water shortages during the first dry season planting schedule (May-August).

Participatory action

Basically, all activities by FWUA staff and WUA members and staff are conducted by means of field visits and meetings, at WUA as well as FWUA levels. Empowerment is accomplished by means of provision of technical and data support for combined staff in mentoring the WUAs to accomplish:

- 1) Taking inventory of plots and borders of each WUA's area of operation .
- 2) Identification of irrigation facilities in each WUA's area of operation
- 3) Monitoring of cropping pattern
- 4) Monitoring of irrigation water coverage within each area of operation
- 5) Taking inventory of problems related to water distribution, discussing and implementing actions toward rectifying identified problems.
- 6) Monitoring of rice production

Technical support provided comes in the form of GPS-assisted mapping.

A. Result of Inventory and identification

PROFILE OF FWUA SIRANNUANG								
No	WUA	Members	Size of Cultivation Area (ha)	WUA Board members (Persons)	Irrigation Facilities			
					Tertiary Unit	Length of Tertiary Canal (m)	Length of Earthen Tertiary Canal (m)	Number of Tertiary/Quaternary Boxes
1	Campaga	138	15	5	Mg1Ki,	DIRECT TAP FROM SECONDARY CANAL	DIRECT TAP FROM SECONDARY CANAL	0
2	Batang Kaluku	95	35	4	Mg2Ki		119,8	1
3	Sappaya	95	28,2	5	Mg3Ki	783,38	447,05	1
4	Lompo Batua	104	27,6	4	Mg3Ka,	386,7	98,8	3
			21,6		Mg5Ka	DIRECT TAP FROM SECONDARY CANAL	DIRECT TAP FROM SECONDARY CANAL	0
5	Kolasa	86	27,4	11	Mg4Ki	993	180	5
6	Tangkeballa	169	42,6	9	Mg4Ki			
7	Juluerota	215	61,3	5	Mg7Ki (downstream)	1135,17	88,4	2
8	Romangbone			5	Mg7Ki upstream			
		165	41,7	5	Mg6Ki (downstream)	814,73	0	1
9	Bontosunggu	187	56,8	6	Mg6Ki (upstream)	152,06	837,13	1
10	Bontoa			5	Mg7Tgh (upstream)			
11	Bajipamai	164	51,9	5	Mg7Ka			1
Secondary Canals of Majannang (3,000 m)		1.418	448	64		4265,04	1924,43	16
12	Tunikamaseang	107	16,1	5	Pm1Ka	122,1	207,3	2
			8,4		Pm2Ki	DIRECT TAP FROM SECONDARY CANAL	DIRECT TAP FROM SECONDARY CANAL	0
13	Borongunti	164	46,6	5	Pm3Ki	595,06	231,5	4
14	Tunirannuang	207	50,4	11	Pm4Ki	520	800	4
15	Sipakainga	63	7,1	4	Pm4Ka			0
16	Pammase	120	25,2	4	Pm5Ki		320,36	1
17	Binabbasa	153	56,5	11	Pm6Ki	960	247	5
18	Renggang	355	88,5	11	Pm6Ka	196	1735,5	7

B. Result of Monitoring of cropping Pattern and Production

Cropping Pattern in research area are dominated by the Rice-rice and Palawija pattern. Means most of farmers planting rice in wet season, 70% of area are planted with rice and the rest is palawiha or falllow during the first planting in dry season and in second planting in dry season are dominated by palawija (70%) and the rest is fallow due to the scarcity of water.

Table 2. Cropping Pattern

Cropping Pattern	Percentage (%)
Paddy- Paddy- Paddy	3
Paddy - Paddy -Palawija	62
Paddy -Palawija-Palawija	7
Paddy - Paddy –fallow	7
Paddy-Palawija- fallow	9
Paddy - fallow - fallow	11
Paddy - fallow -Palawija	1
Total	100

Rice production is also monitored during wet season and dry season and comparison of Upstream area (which is considered receive enough water during the year) and downstream area (which is considered received less water during dry season). Wet season rice production is much lower (3.91 ton/ha) compare to dry season rice (6.3 ton/ha) . However downstream area also showed comparatively higher production than upstream area.

Table 3. Paddy Production in FWUA Sirannuang

Season	Production		Average
	Upstream	Downstream	
Wet Season 2008/2009	3.32	4.5	3.91
Dry Season 2009	5.9	6.7	6.3
Dry Season 2010	6.4	6.4	6.4

C. Result of Monitoring of irrigation water coverage

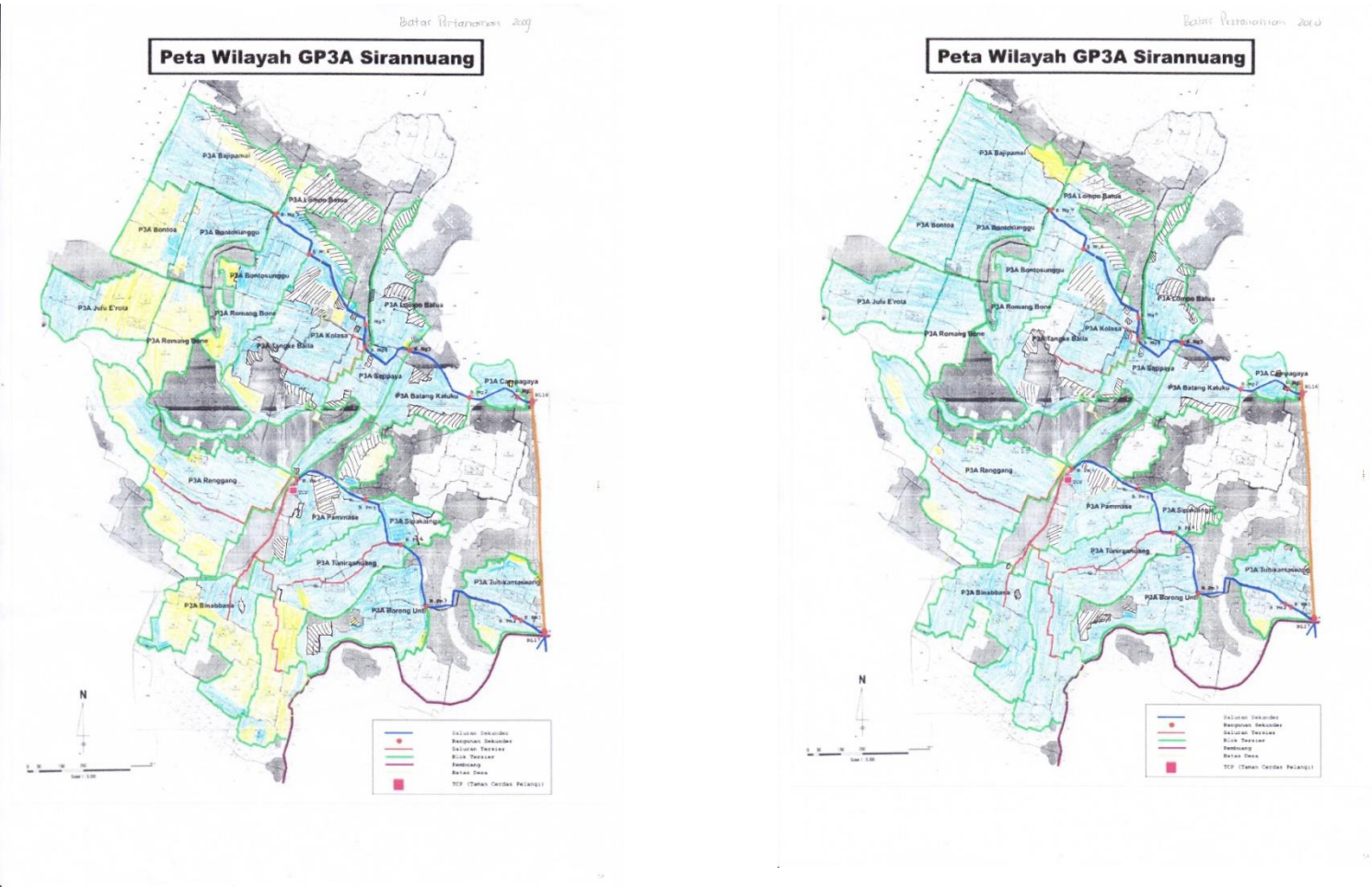


Figure 1. Irrigated area (blue color) and un-irrigated area (yellow color) in dry season 2009 and 2011

Conclusion:

1. Action research produced data in simple form and easily measured by and understandable for farmers
2. Further analysis and interpretation of data by researcher will help farmers understand their own condition and issues
3. Farmers will take necessary action to solve the problems (for example water distribution problems) in the field.

CROPPING PATTERN IN WORKING AREA OF FWUA SIRANNUANG BILI-BILI IRRIGATION SYSTEM

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Bili-Bili Irrigation System provides irrigation for 24,600ha of rice fields, stretching across the downstream areas of Bili-Bili Dam, straddling regions of Makassar City, Gowa District, and Takalar District. Some of these rice fields could trace their existence back to the 1930s, where they relied on irrigation provided by Kampili Canal. The completion of Bili-Bili Dam's construction at the end of 1999, a capacious dam capable of storing 375,000,000 m³ of water, 80% of which are allocated for irrigation.

The creation of this technical irrigation system necessitates better water management, and the government responded by forming or revitalizing Water Users' Associations and adapting them to hydrological terrains and water distribution. Bili-Bili Irrigation System alone boasts over three hundred WUAs. The WUAs' hierarchy is dictated by their hydrological terrain, based on the principle of one WUA per one tertiary-level branch of the irrigation canals, encompassing all farmers utilizing water from the same tertiary canal. Several WUAs taking in water from the same secondary canal make one Federation of Water Users' Association (FWUA)

FWUA Sirannuang is one of the 28 FWUAs existing within the Bili-Bili Irrigation System, part of the Kampili Irrigation Area, which is supplied by water from Kampili Primary Canal. FWUA Sirannuang is selected as research location, since it encompasses two furthest downstream secondary canals of Kampili Primary Canal. FWUA Sirannuang's work area is roughly 800ha in size.

Effective irrigation water management relies heavily on plant water need data. One of the primary factors is the types of plants, as well as the planting schedule. Direct field research on Bili-Bili Irrigation Area's cropping pattern is thus necessitated.

Objectives of Research: To study cropping pattern in Bili-Bili Irrigation Area

Benefits of Research: this basic data may be utilized as basis for calculating water needs, resulting in a more accurate and effective water management.

Methodologies

The research was conducted during *wet season, first planting and second planting in dry season from November 2010 to October 2012*. The research studied 513 farmers of 18 WUAs of FWUA Sirannuang. The research focused on commodities cultivated in the years 2007-2008. This was conducted to find out farming conditions, including cropping pattern, before beginning research. This research is an action research, emphasizing on measurement of results after the end of the research; as well as participation of farmers and FWUA caretakers in its execution.

Results

Research indicates that planting season in FWUA Sirannuang is composed of three plantings; they are rainy season planting (rendeng), lasting from November until March, and two dry season plantings (gadu). The first dry season planting is from March until July and the second lasts from August until October.

During the rainy season, 100% of the fields are planted; during the first dry season planting only 86.7% are planted, and during the second dry season planting only 72.7% are planted (Figure 1)

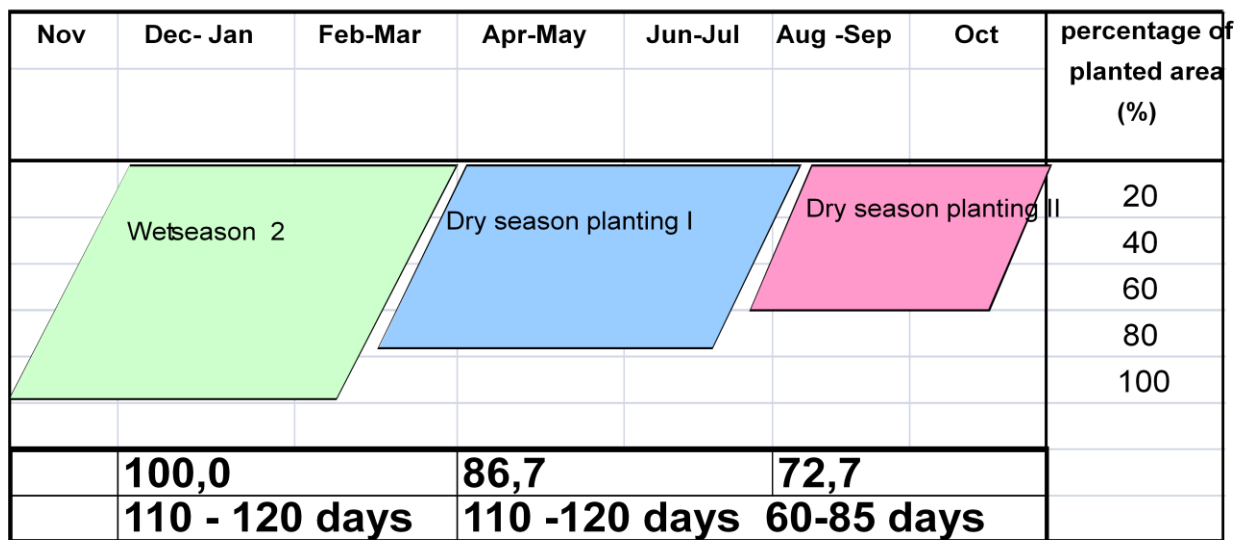


Figure 1. Planting Seasons and Percentages of Plants within FWUA Sirannuang

Table 1 indicates seven types of cropping pattern within the area of research. The most dominant cropping pattern is the rice-rice-alternative plants (61.99%). In some areas water is so scarce, 11.89% of the fields implement the rice-fallow-fallow pattern, where rice is planted only once, during the rainy season.

Table 1. Cropping Patterns Practiced in FWUA Sirannuang

1.	Rice	-	Rice	-	Rice	2.53 %
2.	Rice	-	Rice	-	Palawija	61.99 %
3.	Rice	-	Rice	-	Fallow	5.65 %
4.	Rice	-	Palawija	-	Palawija	6.82%
5.	Rice	-	Palawija	-	Fallow	9.75%
6.	Rice	-	Fallow	-	Palawija	1.36 %
7.	Rice	-	Fallow	-	Fallow	11.89%

If these cropping patterns are analyzed further, it is revealed that during the rendeng season all farmers plant rice, while during the first gadu planting, 70% of farmers plant rice, 16.67% alternative crops, and 11.89% idle their fields. During the second gadu planting, only a tiny minority plants rice (2.53%). Most cultivate alternative crops (70.18%) and 27.29% idled their fields. (Tabel 2). The most common alternative crop that we see are mung beans and corn, as well as cucumber.

Tabel 2. Cropping Pattern and percentage of planting area in Wet Season and Dry Season.

Kind of crops	Percentage of PlantingArea in planting seasons		
	Wet season planting	Dry season planting I	Dry season planting II
rice	100,00	70,18	2,53
palawija	0,00	16,57	70,18
not planting	0,00	11,89	27,29
Percentage of planting area	100,00	86,74	72,71
	100,00	98,64	100,00

Conclusions

1. Farmers still heavily favor cultivation of rice, both in the rainy and the dry season

2. Farmers plant alternative crops only in the case of water scarcity
3. During the first gadu planting, only 70% of the lands had access to irrigation water.



Figure 2. Rice field in FWUA Sirannuang Working Area during Wet season



Figure 3. Mung beans in FWUA Sirannuang Working Area during Dry season



Figure 4. Corn plant in FWUA Sirannuang Working Area during Dry season



Figure 4. Following plot in FWUA Sirannuang Working Area during Dry season

ANALYSIS OF WATER AVAILABILITY IN THE SECONDARY CANALS IN SUPPORTING EFFECTIVE IRRIGATION WATER MANAGEMENT OF BILI-BILI IRRIGATION AREA

“Action Research” Study on the Causes of Water Supply Scarcity in the Work Area of Federation of Water Users’ Associations (FWUA) Sirannuang

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Abstract

In order to fulfill the needs for irrigation water in the work area of FWUA Sirannuang, analysis needs to be conducted regarding the availability of irrigation water. This specific issue intends to analyze the primary causes of water scarcity of in WUA Renggang during First Planting of the Dry Season of 2012. WUA Renggang was one of the furthest downstream rice plant location from the Bili-Bili Dam. According to water Discharge planning and design, the availability of irrigation water during First Planting of the Dry Season should be adequate.

Water availability analysis on Pammase Secondary Canal (the canal carrying water to WUA Renggang) reveals that on the upstream area of the secondary canal (Pm1 to Pm4), water supply volume is three times as the volume needed. This indicates that water scarcity during the first planting of the dry season is not caused by inadequate water supply by the primary nor the secondary canals, but by uncontrolled water acquisition at the watergates heading toward tertiary canals, especially the Pm4 watergate. The problem is exacerbated by damage on the canal embankments, between the Pm4 and Pm5 watergates.

The causes of this water scarcity problem should have been addressed at the local level, if the board members of FWUA Sirannuang, the FWUA to which the Pammase Secondary Canal belongs to were capable of conducting proper coordination among water masters, WUA board members, and farmers; assisted by related heads of villages.

keywords : irrigation water availability, WUA.

1. Introduction

Paradigm change in irrigation management causes farmers, through WUAs, to assume greater responsibilities in building, operating, and maintaining tertiary-level canals (Regulation of Ministry of Public Works No. 30/2007). For this purpose, the government has also made it mandatory for farmers to be part of a WUA. These top-down mandated organizations are awkwardly positioned, for they are expected to be independently managed as well as for being responsible over tertiary canals. On the other hand, laws and regulations emphasize the importance of government's roles in supporting the effectiveness and efficiency of the organizations. The fact that the organizations are highly numerous impedes the government's capacity in reaching down to WUA level.

Organizational skills, as well as funding and technical skills of the WUA board members are limited. Therefore, support from researchers and academicians would be invaluable in terms of providing easily applicable water management data and technical skills. Currently in more developed countries, a class of research designated as "*Action Research*" is gaining traction. *Action research* is a type of research that extends down to the troubleshooting spectrum, making it immediately actionable and therefore directly beneficial to the public involved.

For this purpose, researches select WUA Renggang, the archetypically water-deprived WUA, especially during the dry season planting cycles (planting cycles I and II). In order to yield effective countermeasures, the causes of this lack of water being supplied to WUA Renggang's plots need to be isolated.

WUA Renggang's plots are supplied by the Pm6 tertiary canal, which inducts water from Pammase secondary canal, which is one of the intake gates at BL 17 point (distribution

box located furthest downstream of Kampili primary canal. This primary canal inducts water from Kampili dam, which is one of the three distribution dams of Bili-Bili Irrigation System.

Rice fields of WUA Renggang measure to 88.5ha, some of them were not sufficiently irrigated during the first dry season planting of 2102 (May-August). The cause of this insufficient supply was thought to be inadequate water supply at the downstream end of the primary canal, or water loss/mismanagement at local levels of tertiary canal grid of the upstream parts of Pammase canal. In addition, there was a possibility of difficulties in managing irrigation water at tertiary levels. The objectives of this research is to analyze the primary causes of irrigation water scarcity at WUA Renggang during the first dry season planting of 2012.

2. Methodology

The research was conducted from May to August of 2012, and encompassed the following activities.

- a. Research activity location was set at Pammase secondary canal, which supplied irrigation water to the fields of Kalebajeng Village and Tanabangka Village, Subdistrict of Bajeng, District of Gowa.
- b. Discharge measurement was conducted on a weekly basis at seven points at upstream area of each of the tertiary plot watergates.
- c. Discharge measurement and field observations were conducted using participatory method, involving board members of FWUA Sirannuang, the umbrella organization to eighteen WUAs, one of which is WUA Renggang.
- d. Rainfall rate measurement, employing automatic measuring devices, yielded rainfall data every ten minutes.
- e. Estimating irrigation needs of the plants during May 15 – August 15, 2012.

3. Results and Reviews

Results of measurement and mapping of location of Kampili Distribution Dam on the downstream part of Jeneberang River, overlaid with locations and coordinates of watergates along the Kampili Primary Canal are presented in Figure 1. This figure also shows the location of Pammase Secondary Canal, found at the downstream part of Kampili Primary Canal.

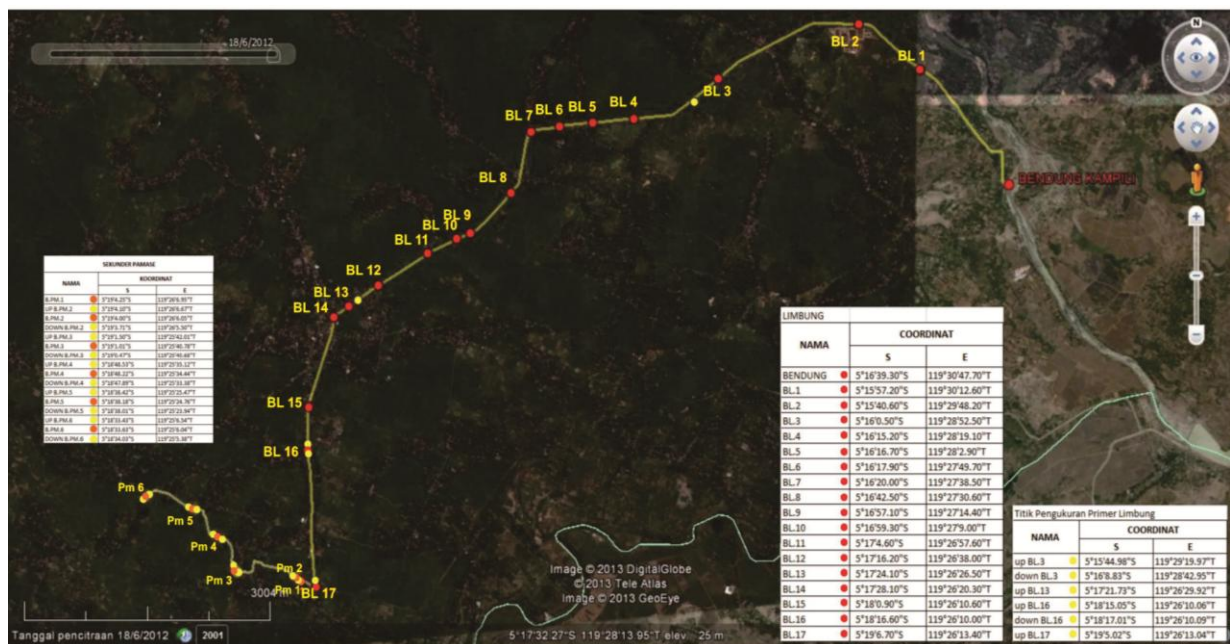


Figure 1. Water intake and distribution points along the Kampili and Pammase Primary Canals

Kampili primary canal was host to seventeen water intake points. However, not all of them were secondary induction gates. Some of these intakes plug directly to tertiary canals (as opposed to going to secondary canals first) that irrigate fields located along the length of the primary canal. Secondary induction gates can be found at BL3, BL6, BL14, BL15, BL16 and

BL17. Most of them utilized gravity flow mechanism, but others utilized pumps to induct water.



Figure 2. Gate of Pammase secondary channel at BL17 point on Kampili Primary Channel

At the furthest downstream area, namely points BL16 and BL17, each point having their own secondary canals: Majannang and Pammase secondary canals. Both secondary canals fall under FWUA Sirannuang's work area.

This research conducts water Discharge measurements along Pammase secondary canal, at twelve points, namely at points before and after watergates supplying tertiary canals: points Pm1, Pm2, Pm3, Pm4, Pm5, Pm6ki, Pm6 ka. This makes Pm6ka the induction point located furthest downstream. Pm6ka distributes water to to WUA Renggang.

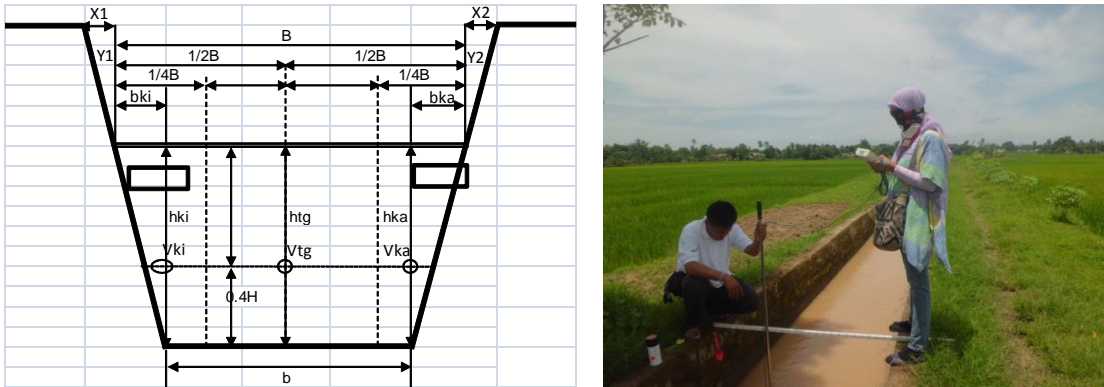


Figure 3. Discharge measurement and Cross Section of Pammase Secondary channel

Result of water Discharge measurement at the upstream part of secondary canal watergates revealed that irrigation water supply at the secondary canal intake gates measure at 1,234 mm per planting season.

Table 1. Result of Water Availability at Pammase Secondary Canal during Dry Season Planting of 2012

Timeframe	Water Inflow Pammase Canal (mm)	Irrigation Water Discharge (mm)						
		Pm 1	Pm 2 up	Pm 3 up	Pm 4 up	Pm 5 up	Pm 6 ki	Pm 6 ka
May (16-31)	269.8	300.3	222.1	234.8	192.7	114.5	108.3	73.7
June (1-30)	410.0	457.8	406.6	397.4	376.7	202.6	181.4	184.9
July (1-31)	390.4	419.3	385.7	392.6	366.5	162.5	112.7	105.8
August (1-27)	163.7	212.4	192.8	205.1	168.5	53.7	0.0	0.0
Total	1,234.0	1,389.8	1,207.2	1,229.8	1,104.4	533.3	402.4	364.4

Down to watergate Pm4, water supply was found to be stable. Starting from watergate Pm5, however, severe reduction in water supply was detected. This limited the water supply to Pm6ki (WUA Binabbasa) and Pm6ka (P3A Renggang). Map of FWUA Sirannuang's work area are presented in Figure 2.

This data shows either a severe water loss in WUA's fields or a leak on the secondary canal, between watergates Pm4 and Pm5. This insufficiency exacerbated at the PM6

GP3A SIRANNUANG



Figure 2. Map of FWUA Sirannuang's Work Area.

watergate, which forks into two branches, Pm6ki and Pm6ka. On these two tertiary plots, water availability vital for plant growth is supplemented by the 100mm rainfall, most of which were cast during the initial week of planting, hopefully augmenting soil's water reserves. Even so, the limitations on local distribution capacity forced some farmers to supplement their water requirement from underground sources.

According to Oue et al. (2013), level of Evapotranspiration of rice plants during the first dry season planting schedule at Pm6ka tertiary block (WUA Renggang) was measured at the daily average of 4mm, or amounting to a total of 400mm during the course of riceplant growth period (100-110 days).

Table 2. Evapotranspiration rate and water discharge at Pm6 points on Pammase Secondary Channel

Time frame	ET (mm)	Rainfall rate (mm)	Storage (mm)	Pm 5	Pm 6 ki	Pm 6 ka
May (16-31)	39.91	3.6	42.37	114.5	108.3	73.7
June (1-30)	120.25	70.8	157.16	202.6	181.4	184.9
July (1-31)	122.29	25	160.46	162.5	112.7	105.8
August (1-27)	111.40	0.6	49.66	53.7	0.0	0.0
Total	393.85	100		533.3	402.4	364.4

Data on plant water requirement indicate that water supply scarcity occurred at tertiary blocks Pm5, Pm6ki, and Pm6ka. At Pm5, starting on week 11, water supply quantity had dropped below the evapotranspiration (ET) level. However, soils' water reserves made up for the insufficiency, up to more than 90%. In the case of Pm6ki and Pm6ka, starting from week 7, water supply had dropped below the ET level, even though soil moisture carried on sustaining the plants up to week 10. For the last four weeks, however, Pm6ki and Pm6ka were totally deprived of irrigation water supply. Adding to the problem was the low rainfall rate (0.6mm), forcing farmers to pump water from underground sources to sustain the plants which by now has neared harvest.

Based on these findings, the research team then followed up by conducting field observation. The findings are as the following:

- a. WUA Tunirannuang (taking in water from Pm4) had been going without board members for the last two years. Consequently, water consumption at this point went uncontrolled. Each farmer were able to open the tertiary watergate by themselves, resulting in overconsumption.
- b. Water master in charge of opening and closing the tertiary watergate was incapable of controlling Pm4 watergate.
- c. Leaks were found at the base of the canal, between Pm4 and Pm5, resulting in water entering drainage canals instead.
- d. Illegal taps were found along the secondary canal, inducting water directly from secondary canal into fields.
- e. Some farmers owning fields of some heights would often build illegal dams to increase water surface, resulting in wastage.

All field findings were handed to the board members of FWUA and WUAs involved, and would be followed up by a FWUA-level meeting, in which will be discussed the solutions to current problems, and hopefully solved by the next first dry season planting schedule (May-August 2013).

4. Conclusions

- a. Water shortages that occurred during the first dry season planting schedule at the downstream areas of Kampili Irrigation Area were not caused by water supply problems at the primary and secondary canals.
- b. Water shortages were primarily caused by losses incurred at the Pm4 Tertiary Block, as a result of WUA board members being in inactive state.
- c. The water shortages problems should be addressed at local level, where the board members of FWUA Sirannuang are expected to execute better coordination among water masters, board members of WUAs Tunirannuang, Binabbasa and Renggang with the support of heads of villages of Kalebajeng and Binabbasa.
- d. Improve water management. Tertiary blocks Pm5, Pm6ki, and Pm6ka need to be prioritized, due to limited water supply potential.
- e. "Action research" in agriculture need to be developed so that follow-up actions may be immediately applicable.
- f. Action research also feature additional benefits in terms of improving farmers' knowledge and awareness.

5. References

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